# POISONOUS MUSHROOMS OF BHUTAN

## A FIELD GUIDE

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# Preface

Mushrooms are one of the most important natural and agricultural products of Bhutan, not only because they provide export revenue to the state coffers, but also because they increase individual income, work opportunities, and provide essential nutrition for good health. The supply of the wild mushrooms, Matsutake and Ophiocordyceps sp., is limited compared to the export demand. On the other hand, Bhutanese people love mushrooms and hunt for wild mushrooms in the forest. Unfortunately, however, many accidents occur every year due to eating poisonous mushrooms. This was why the JICA Partnership Program (JPP) in cooperation with the National Mushroom Centre (NMC) decided to produce a book to provide knowledge to the public.

In Bhutan, the study of wild mushrooms is still in its infancy and there are many unknown mushrooms. The species covered here are just a few of the wild mushrooms that are considered poisonous and there are many more that are not covered in this book. For convenience in the field, this book is written to help you distinguish between species based on macroscopic characteristics. It is unlikely that any of the species in this book will be used for food. However, some could be confused with edible ones. Accurate identification of mushrooms requires observation of microscopic features and sometimes investigation at the DNA level. Never eat unknown mushrooms.

The JPP "Improving Conditions for Mushroom Farmers in Western Bhutan" project worked with the NMC for three years starting in July 2016. The project was formulated by the University of the Ryukyus, in Japan and led by the Project Manager, Dr. Yoshie Terashima.

Mr. Eiji Nagasawa, an expert on wild mushrooms in Japan, agreed with the publishing of the book and joined the program as one of the authors. Dr. Kazuo Watanabe, a Japanese expert on mushroom cultivation, stayed at

the NMC and shared his knowledge of wild mushrooms with the staff. This book was completed thanks to the many people at NMC and JPP.

We hope that this book will help the citizens of Bhutan to identify poisonous mushrooms and eliminate unfortunate accidents.

JPP Project Manager
Dr. Yoshie Terashima

# FOREWORD

Foraging for wild edible mushrooms is part of human history worldwide, from highly priced Yartsa Guenbub, truffles and Matsutake to some of the common ones like Chanterelles, Oyster mushrooms, wood ear and so on. Despite their taste, flavour and abundance, wild edible mushrooms are usually sought after during growing seasons because they are very difficult to produce commercially. Traditionally, wild edible mushrooms are relished for their taste and flavour. In recent times, the awareness of health benefits and association to nature, the organic aspect, has driven demand in the urban areas. As a result, collectors of wild edible mushrooms from urban areas are a common sight for enhancing their household income. Unlike the collectors (farmers) in the rural areas where knowledge on the identity of wild edible mushrooms is passed- on from generation to generation, the urban collectors are not well informed on their identity. This is because the urban collectors of wild edible mushrooms are not part of the ecosystem where information and knowledge are still well-preserved like in the rural communities.

As a result, reports on mushroom poisoning cases during the collecting season are a common occurrence due to lack of knowledge on the identity of edible and non-edible mushrooms. Some cases of poisoning from consumption of non-edible wild mushrooms could be confused with common food poisoning, which are not life threatening. However, poisoning from consumption of some other non-edible wild mushrooms, due to misidentification, could lead to death. This is a big concern for the Ministry of Agriculture and Forests. The effort of this first publication is to inform the general public, particularly the collectors, potential collectors and consumers on some of these highly hazardous groups of mushrooms that need to be avoided. It is also the goal of this publication to share information on the poisonous non-edible wild mushrooms with wider clientele such as professionals in the education sector including students, health workers, developmental partners, NGOs, academia, and so on so that awareness is created widely.

The toxicity of poisons in different species of wild non-edible mushrooms vary greatly, and hence toxic effect or symptom(s) of poisoning could

be felt immediately or days later. Through this publication, we would like to urge anybody who might have consumed mushrooms and feel unwell afterwards to contact the nearest health facility or the National Mushroom Center (NMC) at the given contact information.

Thank You.

Kinlay Tshering (Director – DoA)
Ministry of Agriculture and Forests

# Acknowledgements

The first book on wild mushrooms of Bhutan was published about a decade ago. This book is the first book on poisonous mushrooms of Bhutan. Although there are so many mushrooms in Bhutan, it is a challenge in their documentation due to inadequate facilities for proper identification of the species. To identify mushrooms properly, DNA sequencing is required since identification based on morphology is not always sufficient. This means working with experts around the world and having the facilities to use this method is crucial in the identification of any species.

The presence of a JICA project at National Mushroom Centre gave us the opportunity to invite mushroom experts from Japan and they in turn made confirmation of the species possible. Therefore, our heartiest appreciations go to the Project Manager Dr. Yoshie Terashima for bringing the project to Bhutan and fielding many mushroom experts from Japan. Special thanks also goes to Dr. Kazuo Watanabe, Project Coordinator, for his enthusiasm, expertise and dedicated work encouraging us to go ahead with the book. Not forgetting to mention Dr. Shuhei Kaneko for contributing few of his photos for the book.

The compilation of the book was undertaken with the help of diverse sources such as books, internet web pages and mycologists. Our heartiest appreciation goes to all the authors listed in the references. Very special thanks to mycologists from Japan and other parts of the world who had contributed directly or indirectly to this book.

Many thanks to Dr. Naomi Diplock, Australian volunteer who helped us in designing the cover of the book and heartfelt thanks to all the staff of National Mushroom Centre who are listed in the end page of the book for all the bits and pieces of supports rendered from the planning to write the book till it is published.

Last but not the least we would like to acknowledge the continued support received from the management at National Mushroom Centre, Department of Agriculture and the Ministry of Agriculture and Forestry, Royal Government of Bhutan.

# Contents

# Introduction

Mushroom poisoning refers to harmful effects caused by ingestion of toxic substances present in a mushroom. The symptoms can vary from slight gastrointestinal discomfort to severe pain and even death. Mushroom poisoning is usually the result of consuming wild toxic mushrooms mistaken as edible species. The most common reasons for the misidentification includes lack of knowledge in identification and close resemblance of the toxic mushroom species with the edible ones. To prevent mushroom poisoning, the mushroom collectors need to familiarize themselves with the mushroom they intend to collect, as well as with any similar looking toxic species.

Poisonous mushrooms contain a variety of toxins and they have very different toxicity. The symptoms of mushroom poisoning may vary from gastric upset, hallucinations, delirium, etc, to organ failure resulting in death. The time taken between ingestion and onset of symptoms considerably varies between toxins, some taking days to show symptoms of poisoning. Symptoms of poisoning from more perilous mushrooms do not always occur immediately after comnsumption. They can appear after many days and even weeks, after serious damages were caused to the organs like the kidney or the liver, thus making treatment difficult.

It is estimated that of the approximate 100,000 known species found worldwide, about 100 of them are considered poisonous to humans. Some mushrooms, although considered edible, can be poisonous when eaten raw since some toxins are thermolable and get destroyed upon cooking. Others might concentrate toxins from the substrate on which it grows and the presence of toxins in the substrate (sometimes from spraying of chemicals in the field) can make an edible mushroom poisonous.

Many folk traditions are related to defining of poisonous mushrooms. These are not reliable since there is no general rule of the thumb for identifying poisonous mushroom. Nor are there shortcuts in the process of identification. The toxins responsible in the mushroom are produced naturally by the fungi themselves and each individual specimen of toxic species should be considered equally poisonous. Only proper identification of a mushroom can prevent mushroom poisoning.

Examples of erroneous folklore myths around the world include:

- Poisonous mushrooms are brightly coloured.
- Insects or animals will avoid toxic mushrooms.
- Poisonous mushrooms blacken silver.
- All mushrooms are safe if cooked, parboiled, dried or picked.
- Poisonous mushrooms have pointed caps.
- Boletes are in general safe to eat.
- Using *Zanthoxylum piperitum* while cooking the mushroom can make a toxic mushroom edible (Bhutan).
- It is believed that giving a name to a toxic mushroom can transform it into an edible one (Bhutan).

In Bhutan too, mushroom poisoning has been occurring almost every year and some cases have proved fatal. To prevent mushroom poisoning National Mushroom Centre has been conducting awareness through training and in the media. Some of the reasons for the misidentification of mushrooms are migration (rural urban migration and migration between regions) and loss of traditional knowledge. People new to a place can misidentify a poisonous mushroom found in the new location and these have been reported in other parts of the world too.

Some mushroom poisoning symptoms can be confused with other common sickness like food poisoning or other illnesses with similar symptoms. It is important to know the history or background of the sickness in order to provide treatment. During the mushroom season, mushroom poisoning should be considered a possibility when people get sick.

The publication of this book is aimed at contributing to alleviation and prevention of mushroom poisoning.

# Basic knowledge on identification of wild mushrooms

The term mushroom is used to refer to the reproductive structure or fruit body of a fungus and the mushrooms that are grown on its own in nature are termed as wild mushrooms. Actually, the fungus itself called the mycelium is composed of a series of filaments that are not generally visible to the human eye. The mushroom which we see on the ground, sprouting out of tree barks or decaying woods are the fruit bodies of the mycelium network lying underneath. Mushrooms grow on surfaces (soil, wood, manure, etc.) when environmental conditions (such as light, acidity of soil, humidity) are appropriate.

Most wild mushrooms that people collect for culinary purposes belong to the *Basidiomycota* group, however, many mushrooms of the *Ascomycota* group that are appealing because of their shape or colour are also considered edible. Wild mushrooms should be identified properly before being collected for culinary purposes. Below are the basic features of wild mushroom that are essential to study for accurate identification of wild mushroom and to know its edibility.

### *1. Substrate*

It is the medium or the material on which mushrooms grow. Identifying the substrate helps to identify the wild mushroom because most of the mushrooms grow in a particular substrate. It can be **terrestrial** (on the soil), **coprophilous** (on manure), **lignicolous** (on wood), fungicolous (on other fungi). For example; *Amanita* group. *Cortinarius* group, etc. will never grow on wood and *Pholiota* group (except *Pholiota terrestris)* seldom grow on the soil.

### *2. Growth Habit*

This is the manner in which a wild mushroom grows. Growth habit is one of the important features of identifying the wild mushroom species. The habit can be **solitary** when it grows alone/ individually, *(Sparassis, groups*), **scattered** when several grow in the same area (*Amanita, Russula* and *Cortinarius groups*), **gregarious** when they grow together, but not intertwined (*Hypholoma, Coprinus, Cantharellus*), **caespitose** where they grow together

as in the form of clusters and have a common base (*Ramaria* group and *Lyophyllum* aggregatum).

### *3. Morphology*

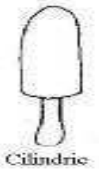
Wild mushrooms have different shapes, size and colour. The most common ones are umbrella type, bracket, ear, star, coral, shelf crust, or trumpet which belong to the *Basidiomycota* group. Those that belong to the *Ascomycota* group have a cup, finger, hive and other shapes. Their appearance or consistency is variable, as they may be gelatinous, cartilaginous, spongy, fleshy and milky or even cork-like. There may also be variation in size. The most common fruit bodies are the fleshy ones, mostly formed by a cap or upper part called **pileus**. The fertile layer or hymenophore may be either smooth or entirely consist of lamellae (gills), venations, wrinkles, teeth, pores, etc. In addition, they have a stem or stalk that is called **stipe**. In some species the stem can be missing (in which case they are sessile) or be very small. The inner part of the pileus and the stem is called the **context**. The **spores** are specialized cells that are part of the reproductive stage.

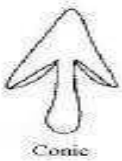
#### *3.1. Pileus/Cap*

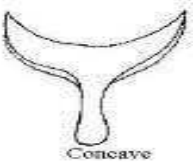
It is the upper part or top of a fruit body. It is important to note the size, shape, colour and surface texture of the mushroom cap to identify wild mushrooms. Different wild mushroom species have their own shape, size and colour with particular surface texture.

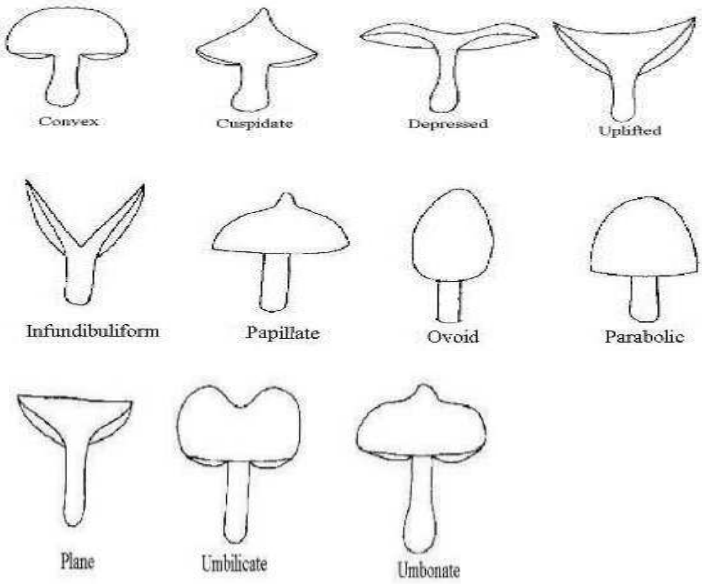
#### 3.1. a. Shape

Take note of the form of the cap in both young and mature fruit bodies. It is advisable to take into account the shape of both young and mature fruit body for some mushrooms, the shape varies when they are young and mature. Among these shapes, there are campanulate, cylindrical, conic, concave, convex, cuspidate, depressed, uplifted, infundibuliform, ovoid, parabolic, plane, umbilicate, umbonate, etc. as shown figures below.

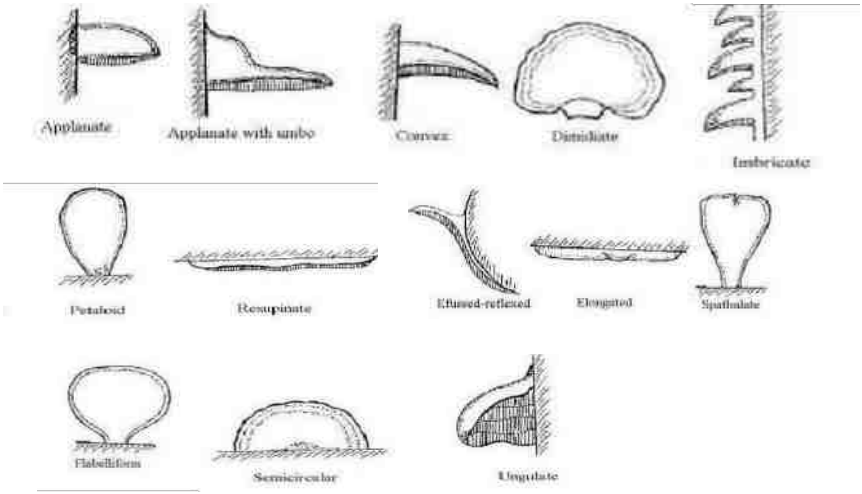






There are other shapes of cap when the specimen is generally adhered to wood and lacks a well- shaped stem. They can be applanate, applanate with umbo, convex, dimidiate, imbricate, petaloid, resupinate, effused-reflexed, elongated, spathulate, flabelliform, semi-circular, ungulate, etc., as shown in figures below.

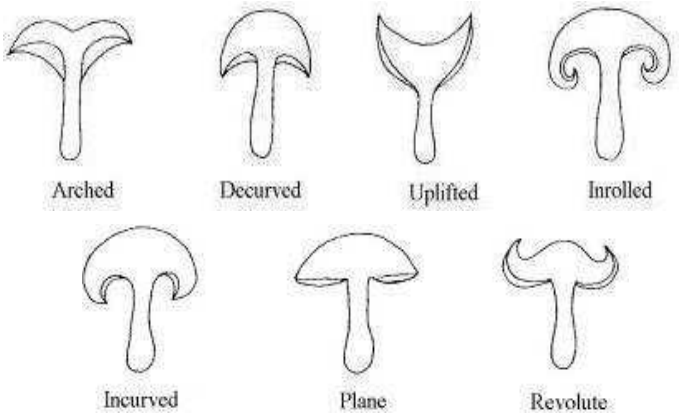


### 3.1. b. Colour

The colour of the cap is noted taking into account both young and mature specimens, given that some of them may change with age. It is very important to note the colour of the disc or central area of the cap, or any other observation of colours in another area of the cap, if it is different. It is also important to study if there is a change in colour when the mushroom is manipulated.

### 3.1. c. Margin

The margin of the cap of a mushroom may vary according to the degree of expansion it has reached. It is advisable to cut the fruit body length wise to carefully study the type of margin, which may be; arched, decurved, uplifted, incurved, , involute, straight, and revolute, etc.




The texture of the margin of the cap is another characteristic that must be noted. The margin may be as followings:

*Appendiculate*: with attachments or parts. When a portion of the partial veil that hangs from the edge of the pileus when it expands is also called appendiculate margin.

*Crenate*: the margin is ornamented with very fine undulating shaped as rounded teeth.

*Split*: with the margin cut or divided in sections.

*Entire*: with a totally smooth margin.

*Eroded*: with the margin uneven, nibbled or gnawed.

*Striate*: with grooves lifted over the margin.

*Lacerate*: with the margin torn or with deep fissures.

*Undulating*: with waves on the margin.

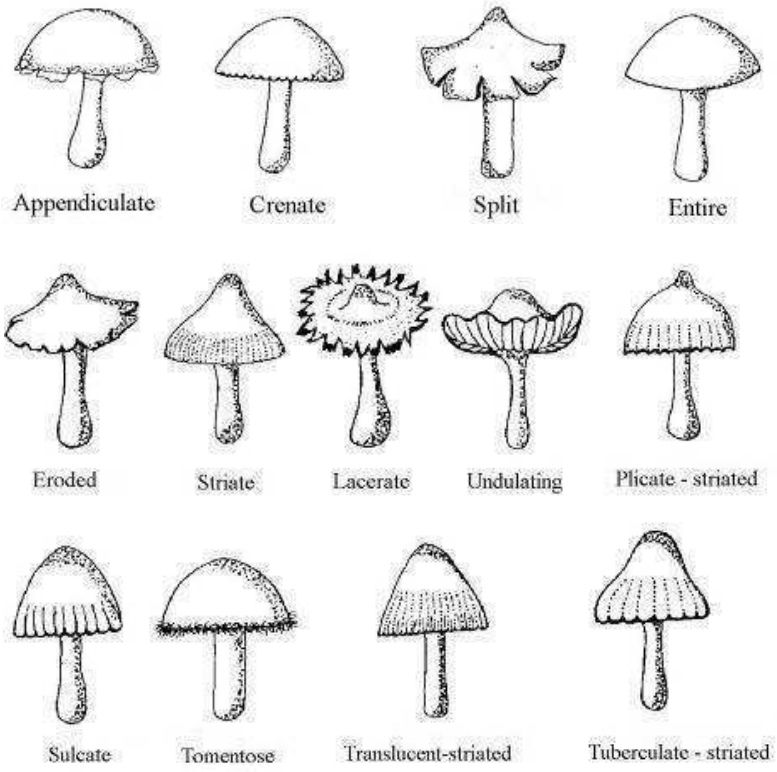
*Plicate-striated*: with very evident pleats and grooves.

*Sulcate*: when the margin lines form slits or furrows.

*Tomentose/hairy*: with filaments or hairs that can be simple or branched, usually close together and intertwined.

*Translucent-striated*: the lamellae are visible through translucent lines through the pileus.

*Virgate-streaked*: with bulges over the grooves.



### 3.1. d. Surface

Texture and ornamentation of the surface often vary with age, environmental conditions, etc. Therefore, it is very important to study the surface of the cap in every fruit body, which may be as the following:

#### 3.1. d. 1. Dry surface:

*Fibrillose*: with fine threads intertwined.

*Fibrillose appressed*: with threads arranged sort of radially.

*Squamose*: filaments are arranged in groups or fascicules.

*Squamose fibrillose recurve*: fascicules of recurved scales.

*Squarrose*: straight scales close to the centre of the pileus.

*Pulverulent or pruinose*: texture like flour.

*Tomentose*: woolly surface with soft hairs.

*Velutinous*: compact surface with short, fine and soft hairs.

*Glabrous*: smooth, without threads.

*Rivulose*: with deep channels or depressions called alveolus.

*Lacunose*: with deep holes surrounded by crests.

*Areolate*: the cuticle of the pileus seems to be cracked.

*Rugulose*: with very fine wrinkles arranged in a regular way.

*Rugose*: with deep wrinkles arranged irregularly.

*Granulose*: the surface seems to be covered by salt granules.

*Pubescent*: compact surface with short hairs.

*Villose*: surface with long and fragile hairs.

*Hirsute*: surface with stiff and shaggy hairs.

*Hispid*: with stiff straight hairs.

*Strigose*: coarse with pointed hairs.

### 3.1. e. Context

It is the inner fleshy tissue that is part of the cap or the fruit body overall. Take note of the following:

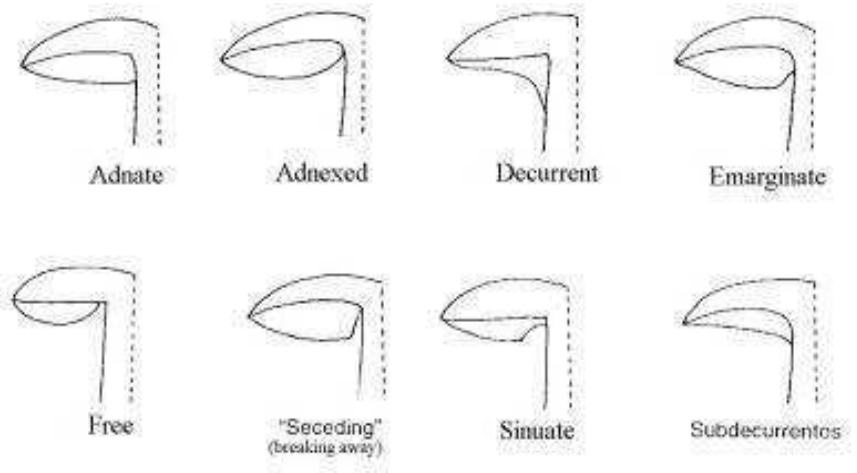
- Colour and changes in colour when manipulated.
- Thickness, smell and taste .

### *3.2. Hymenophore or Fertile Surface*

It refers to the surface of the hymenium or the fertile surface of the mushroom, which may be smooth, porous, lamellate, dentate, verrucose, reticulate, with venations, etc. When the said surface is constituted by pores and tubes, the changes in colour that may occur should be studied. If the hymenophore is made of teeth, colour and changes in colour must be noted, in addition to the length of the teeth. If the hymenophore is constituted by lamellae, then the type of attachment to the stipe, colour and spacing of the gills should be studied to identify the different species. Example; *Amanita* species will always have white and free attachment of the gills.

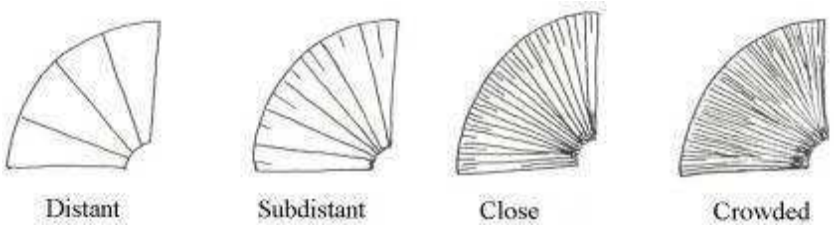
#### 3.2. a. Type of attachment

The attachment of the hymenophore (gills) with the stipe varies according to the age of the specimen and the different genera of the mushrooms; therefore, variations within a collection must be noted. The type of junction may be: adnate, adnexed, decurrent, emarginate, free, seceding, uncinate, sub-decurrent, etc.



### 3.2. b. Spacing

This refers to the space between one lamella and another, which may be: distant, sub-distant, close, crowded, etc. This is one of the features of identification in the Russula group; example *Russula nigricans* has very distant gills whereas *Russula densifolia* has crowded gills.




### *3.3. Stipe/Stem/Stalk*

It is the base that holds the cap of a fruit body. For the proper identification of the wild mushroom species, the following features of the stipe are important.

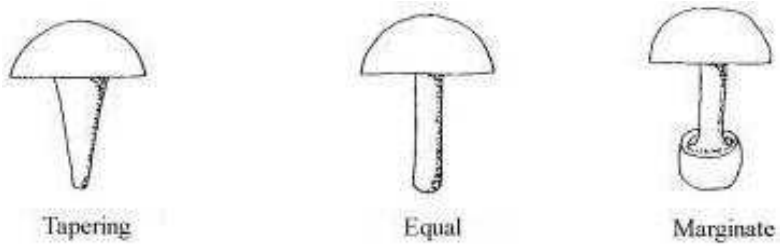
### 3.3. a. Colour and Size

*Length* (it is measured in mm or cm from the base to the apex).

*Width* (generally measured in the apex, it is advisable to cut the specimen lengthwise).

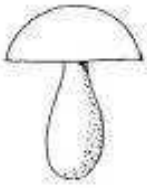
### 3.3. b. Shape

The stipe may be; tapering, equal or uniform, marginate, abruptly bulbous, bulbous, clavate, radicating, sub-clavate, ventricose, etc.

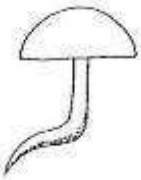


Abruptly bulbous

Bulbous



Clavate



Radicating

Sub - clavate

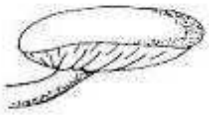
Ventricose

### 3.1. c. Position of attachment to the cap/ pileus

It must be noted if the stem is; central, lateral or eccentric.

Central

Lateral



Eccentric

### 3.3. d. Context (interior)

The inner tissue of the stem can be:

*Solid*: stuffed and uniform interior

*Semi-stuffed*: non homogeneous, with a central channel or with holes.

*Hollow*: empty inside

### 3.3. e. Presence of Ring (Annulus)

The ring remnants of a partial veil left on the stipe.

*Position*: May be apical, basal or central.

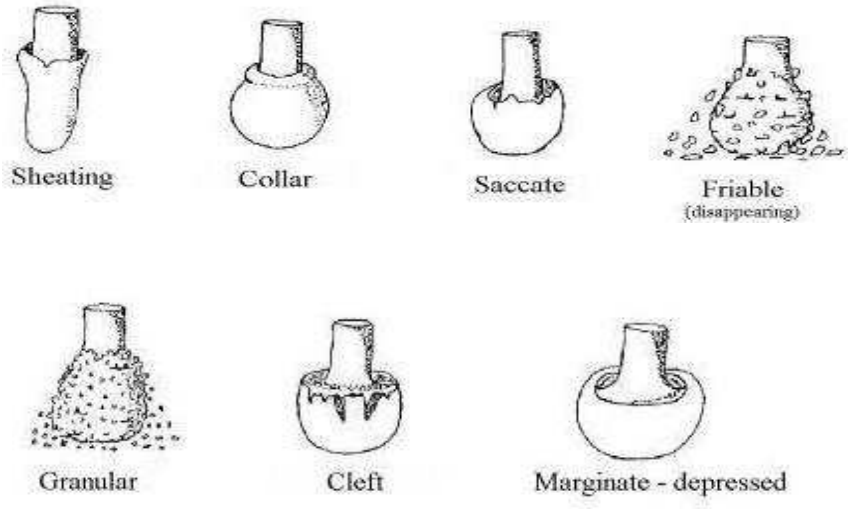
*Type*: May be adhered or movable, persistent or ephemeral.

*Structure*: it can be made of one or two layers, membranous or fibrillose.

*Colour*: Make note of colour of the ring or the cortina, and/or changes in colour when it is manipulated.

### 3.3. f. Volva

The volva represents remnants of the universal veil that covers the mushroom in the early development stages. Volva can be found in shapes such as: Sheating, Collar, Saccate, Friable (or disappearing), Granular, Cleft and Marginate-depressed.



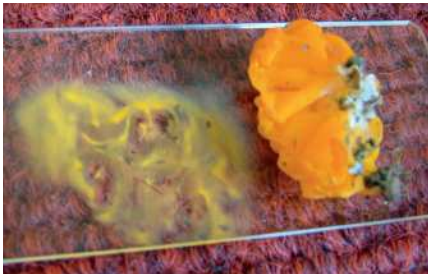
### *4. Spore colour or Spore print*

The spore print is the aggregate or mass of spores that fall off the fertile surface of a fungus. Most of the spore colour is noticeable on the gills or pores in the mature fruit body if the colour of the spores is not same as the colour of the gills. Example; In *Cortinarius* species, the gills of mature fruit bodies will be brownish due to the deposit of the spores. Spore print is also done placing the whole cap (if there are enough specimens) or a part of it (in the case of only one or two specimens available) with the fertile surface (lamellae, pores, teeth, venations etc.) facing down on a white paper sheet or on black piece of cloth if it is white spore mushroom. Leave for a few hours until the spores fall off or overnight for some fungi. The colour of the spore deposited is one of the most important features of identification such as white spore for all Amanita species, pink spore print for *Entoloma* species, brown spores print for all *Cortinarius* species etc. Few spore prints of different mushroom species are shown below.

Spore Print of *Neolentinus lepideus*

Spore Print of *Amanita* sp.

Spore Print of *Agaricus bisporus*



Spore Print of *Dacrymyces chrysospermus*.

# Species Descriptions and Photographs

Ascomycetes–False Morels

**_Gyromitra infula_ (Schaeff.) Quél.**

= *Helvella infula* Schaeff.

(Saddle-shaped False Morel, Hooded False Morel)

PC: Yeshi Lhendup (left top) & Dawa Penjor (right top and bottom)
Local name: No local name known

### *Medical Symptoms and Onset*

This species contains the toxic compound gyromitrin which was first found in *Gyromitra esculenta,* a member of the same genus. When a person eats a mushroom containing gyromitrin, gyromitrin rapidly changes in the body into a highly toxic substance called monomethyl-hydrazine, which can cause significant damage to the kidney and liver, sometimes resulting in death. The onset of poisoning occurs (4-24) hours after the mushroom has been consumed. The main symptoms are as follows: at first nausea, vomiting, often watery or even bloody diarrhoea, muscle cramps, and severe abdominal pain, then symptoms of liver and kidney damage develop (jaundice, oliguria, etc.)

### *Fruiting*

Solitary or gregarious, on or in close association with rotten wood, often in pine forests. Summer.

### *Main Macromorphological Characters*

Pileus medium-sized to relatively large (up to 10 cm wide and high), saddle-shaped to irregularly lobed, with incurved margin which is at first free, then joined with stipe here and there; surface (where hymenium developing) smooth to slightly wrinkled and convoluted, reddish brown to dark brown; under surface light brown to white.

Stipe cylindrical to expanding downwards, compressed at times or with irregular furrows, up to 6×2 cm, hollow or chambered; surface off-white to brownish, felty towards the base.

Spore print creamy white.

### *Comments*

The appearance with a saddle-shaped cap reminds us of a member of genus Helvella, this species is not a member of Helvella, but that of Gyromitra, having two oil-drops in each spore (one in Helvella). The true morels (Morchella spp.) which contains many excellent, edible species are different from the false morels including G. infula in having the cap covered with a well-developed reticulum over the entire surface.

***Helvella crispa* (Scop.) Fr.**

(Fluted white Helvella, Wavy Lochel, Saddle Back)


PC: Shuhei Kaneko (left) & Sabitra Pradhan (right)
Local name: No local name known

### *Medical Symptoms and Onset*

*H. crispa* is often reported as edible after cooking but is known to contain the toxic compound gyromitrin though the amount is small. Hence, it seems to be dangerous to use this species as food. For symptoms of poisoning see page of *Gyromitra infula*.

### *Fruiting*

Solitary to scattered, or clustered in small groups, on soil or on rotting woody debris, in conifer and hardwood forests, summer to fall.

### *Main Macromorphological Characters*

Pileus medium-sized (up to 6 cm wide and 4 cm high), saddle-shaped but often indistinctly so; margin rolled inward at first but not fused with the stipe, then expanding, often revolute and wavy-undulating when old; surface (where hymenium develops) pale cream-coloured to pale ochre, smooth to more or less irregular; under surface whitish, downy.

Stipe up to 10×2 cm, equal or tapering upwards, white to cream-coloured, surface very uneven, strongly fluted or ribbed throughout, with holes between the ribs.

Spore print creamy white.

### *Comments*

The combination of pale-coloured fruiting bodies (nearly whitish throughout or only the cap is tinted pale ochre when old), the irregularly saddle-shaped cap, and deeply fluted stipe are distinctive. There are several similar species which can be confused with *H. crispa,* all having a saddle-shaped cap. If fruiting bodies have a dark-coloured cap (brown, smoke grey, or blackish) or the stipe is not ribbed, you may have other species, such as *H. lacunosa, H. atra, H. elastica,* etc.

***Amanita citrina* Pers.**

= *Amanita mappa (Batsch) Bertill* (False Death Cap, Citron Amanita)

PC: Sabitra Pradhan (left) & Kazuo Watanabe (right)
Local name: No local name known

### *Medical Symptoms and Onset*

This species may cause disorders of the central nervous system with symptoms, such as headache, chills, loss of balance, dizziness, drop of blood pressure, hallucination, etc., because it is known to contain indole alkaloids, such as bufotenine as toxic compounds. Onset occurs within 2 hours after ingestion.

### *Fruiting*

Solitary to gregarious on the ground in mixed pine and hardwood forests, often in association with oaks. Summer to fall.

### *Main Macromorphological Characters*

**Pileus** 2.5-8 cm across, convex when young and then broadly convex or nearly flat in age, surface sticky when young and fresh, colour pale greenish yellow, fading quickly to nearly white, sometimes staining purplish to brownish with brownish or purplish patches or warts when young (but these sometimes disappear at maturity), margin not lined when young but sometimes it becomes slightly lined at maturity.

**Gills** free, close to crowded with frequent lamellulae. The colour is creamy or sometimes yellowish in age.

**Stipe** 4-9 cm tall and 0.5-1 cm thick, more or less equal but with an abruptly bulbous base. The surface is bald or finely hairy, whitish, sometimes discolouring purple to brownish. It has white or pale-yellow ring. The base has a whitish volva that adheres tightly and features a rim or gutter on the upper edge.

**Spore Print** white.

### *Comments*

*Amanita citrina* is characterized by the pale-yellow cap with scattered pale yellowish volva fragments on the surface, the stipe with a yellow-tinted membranous ring and the sub-globose, marginated bulb at the base. This species is said to be not fatal but yellow-capped *Amanita* species lacking conspicuous striations at the margin of the cap like this species should be paid special attention, because some deadly poisonous members of *Amanita,* such as *A. phalloides* and *A. subjunquillea* are very similar to this species, having a similarly coloured cap and lacking distinctive striations at the margin. Those dangerous species, however, differ in having a white, not yellow-coloured ring and a membranous saccate volva.

***Amanita flavipes* S. Imai**

PC: Sabitra Pradhan (top) & Shuhei Kaneko (bottom)
Local Name: No local name known

### *Medical Symptoms and Onset*

Toxins unknown but this mushroom causes gastrointestinal and neuropathic poisonings, such as nausea with vomiting or diarrhoea, or both, abdominal pain, muscular spasms, delirium, etc. Onset time is usually within 2 hours after ingestion.

### *Fruiting*

Solitary to gregarious on the ground in mixed coniferous and hardwood forests.

### *Main Macromorphological Characters*

**Pileus** 4-7 cm across, oval to convex when young, then expanding to plane to somewhat depressed at centre as it matures, margin non- or short-striate when matured, surface yellowish brown (near Buckthorn Brown) to brownish orange, sometimes with greyish tints, often paler or yellower towards margin, decorated with scattered, yellow small powdery to floccose masses of volva fragments which may be washed away after rain. Flesh thin and white.

**Gills** free, rather close, whitish to pale yellow.

**Stipe** 7-11 cm tall, gradually tapering upward from an enlarged, subclavate to sub-globose base, with a yellow membranous ring at the upper stipe, hollow inside, surface pale yellow to yellow, base with powdery to granular volva remnants in a few incomplete rings.

**Spore print** white.

### *Comments*

This elegant *Amanita mushroom,* originally described from Japan and then known from China, India, Pakistan, and Korea, is characterized by the yellowish brown to orangish yellow cap

with yellow, powdery to floccose volva fragments, the pale yellow, fine floccose stipe with an expanded base where volva remnants present as powdery to granular fragments, and the yellow, membranous, persistent ring at the upper stipe.

*Amanita flavipes* seems to be comparatively common in Bhutan and as the photos presented here indicate, *A. flavipes* in Bhutan shows a relatively wide variation in colours of the cap, the stipe, and the volval remnants. This may suggest that the Bhutanese populations constitute a species complex.

## ***Amanita pantherina* (DC.) Krombh. (s. lato)**

(Panther Cap)

PC: Sabitra Pradhan (right) & Eduardo Alvarado (right)
Local name: No local name known

### *Medical Symptoms and Onset*

Ibotenic acid, muscimol, muscarins, amatoxins, allylglycine, etc. are contained as toxins. These act on the gastrointestinal and nervous systems and induce a variety of disorders in patients, such as abdominal pain, vomiting, diarrhoea, hypersalivation, sweating, miosis, tachycardia, mydriasis, increased heart rate, dizziness, confusion, ataxia, illusion, agitation,

depression, paralysis, etc. In severe cases coma and dyspnea occur and are rarely fatal. Onset within about 30 minutes after ingestion.

### *Fruiting*

Solitary to gregarious, on the ground under coniferous and broadleaved trees, in forests, parks, or gardens. Summer to fall.

### *Morphological characters*

**Pileus** 3-18 cm across, convex when young, becoming broadly convex or flat in maturity with brown to tan or yellowish-brown colour. The surface is sticky when fresh with numerous cottony whitish warts and the margin is sometimes somewhat lined at maturity.

**Gills** free, crowded with frequent lamellulae, white.

**Stipe** 4-20 cm tall and 2.5 cm thick, equal to somewhat tapering to apex with a swollen, marginate basal bulb, surface somewhat scaly or fairly bald, whitish and with a skirt-like whitish ring near the middle. Basal bulb with or without concentric scaly bands of volval material below a collor-like rim.

**Spore print** white.

### *Comments*

The brownish cap shortly lined at the margin (at least when expanded), the whitish fragile volval leaving fragmented patches or warts over cap surface and an abrupt collar-like band on top of the stipe bulb, and the superior to nearly median, persistent, membranous ring are key field characters of *A. pantherina*. As is often the case in *Amanita,* there is considerable variation in this species on its cap colour, in size and in mode of volval remnants. Recent morphological and molecular phylogenetic studies have revealed that some of these variants really represent an autonomous species (*A. ibotengutake, A. parvipantherina, A. pseudopantherina, A. subglobosa,* etc.). It is often difficult to distinguish them from each other only based on macromorphological characters. Hence, in a practical viewpoint, *A. pantherina* is treated here as a species complex consisting of morphologically similar related species, all supposed to be poisonous.

## ***Amanita cf. orientogemmata* Zhu L. Yang & Yoshim. Doi**

PC: Sabitra Pradhan (left) & Shuhei Kaneko (right)
Local name: No local name known

### *Medical Symptoms and Onset*

Sweating and clouding of consciousness occur as mild muscarinic poisoning does, and the symptoms recover in about an hour. In addition, gastrointestinal symptoms such as vomiting and diarrhoea appear, but they recover in 2 to 3 days. Onset time is usually within 2 hours after ingestion

### *Fruiting*

Solitary to scattered, in mixed hardwood and coniferous forests or hardwood forests. Summer and fall.

### *Main Macromorphological Characters*

**Pileus** 5-10 cm across, ovate to hemispheric at first then expanding to convex to plano-convex, at times slightly depressed over the centre when old, dull umbonate or not, margin becoming rather conspicuously tuberculate-striate with age, surface viscid when wet, light yellow to yellow ochre, paler around the margin, glabrous, typically scattered with white, floccose, small patches or warts (volval remnants); volval remnants easily washed away by rain or remaining attached to debris through which the pileus has been pushed. Flesh thin, white, odour indistinctive.

**Gills** free to remote, white to pale cream, close, with truncate short ones of 2-3 lengths.

**Stipe** 6-11 cm tall and up to 1 cm wide, somewhat tapering to apex from the broadly ovate to sub-globose base, stuffed then hollow, primarily annulate but the ring fragile and appearing ex-annulate at times, surface white, smooth or fibrillose-squamulose downwards. Ring white, floccose-membranous, narrow, friable, at times adhering to the pileus margin or falling off, if present variable in the position on the stipe, superior (above the middle), almost median, or at time even inferior (below the middle); volva white, thin and soft, adnate to the basal bulb with an obscurely edged margin, at times forming a slight collar-like margin or appressed scaly zones at the apex of the bulb.

**Spore print** white.

### *Comments*

*A. subjunquillea* and *A. palloides,* which contain α-amanitin as a major toxin and are more dangerous and fatal than this species, are similar in the macromorphology and can be easily confused with *A. orientigemmata* in the field. However, those species lack distinct striations at the pileus margin at least when mature. In addition, they have a rather persistent membranous ring and a saccate volva at the base.

In Bhutan, *A. ochracea* (= *A. hemibaha* var. *ochracea*) is an edible species and is much larger species with a distinctly umbonate, more brown-coloured pileus up to 20 cm in diameter, an ample, yellowish membranous ring, a yellowish-brown scaly stipe, and a large, white saccate volva at the base.

***Amanita cf. princeps* Corner & Bas**

(Head Man Slender Caesar)

PC: Sabitra Pradhan

Local name: No local name known

### *Medical Symptoms and Onset*

Muscle cramps occurred 4 hours after eating and death was brought after another 4 hours.

### *Fruiting*

Terrestrial, solitary or at times in groups of a few, growing with cir pine (*Pinus roxburghii*) in subtropical forest, in summer.

***Main Macromorphological Characters***

**Pileus** 8-13 cm across, initially ovate then expanding, margin long grooved-striate (up to 4 cm long), surface smooth without volval remnants, creamy to yellowish brown, tinted more brownish at the centre, paler towards the margin.

**Gills** free, close, white-creamy.

**Stipe** 8-15 cm tall, nearly cylindrical, with a white, ample, thick-membranous ring at the upper portion and a large, saccate volva at the base, hollow inside, surface white, fibrillose. Volva widely sheathing the base, thick-membranous, surface felty, greyish brown, partially tinted greyish orange, irregularly cracking into scaly patches (when grown in dry weather?) showing whitish flesh.

**Spore print** white.

***Comments***

This is the only species of *Amanita* which has been known to cause quick death after ingestion in Bhutan (see page 30) but its toxins are not yet known. Several deadly species of *Amanita* such as *A. phalloides, A. subjunquillea, A. verna* and so on are known in the world, which contain α-amanitin as a major toxic component. Intoxication brought by those (see page 32 for *A. verna*) causes gastrointestinal disorders first more than 6 hours after eating, and then liver and kidney dysfunction, leading to death, but it usually takes several days to die.

ITS sequencing and its macromorphology suggest that this deadly species in Bhutan is closely related to *A. princeps,* though the poisoning by that species has not been known previously. The use of the name to the Bhutanese fungus, however, requires further study, because *A. princeps* seems to be different in its subtropical to tropical distribution and the habitat in evergreen broad-leaved forests with Fagaceae and Dipterocarpaceae. The edible paddy straw mushroom (*Volvariella volvacea*) may be confused with this species in lowland tropical or subtropical area because it looks alike in the younger stage of the growth. However, *V. volvacea,* a saprobic species which grows on horse dung, compost heaps or in meadows, lacks the ring on the stipe and striations at the cap margin. Further, the gills become pinkish as the cap expands.

## ***Amanita rubrovolvata* S. Imai**

(Red Volva Amanita)


PC: Eiji Nagasawa (left) & Sabitra Pradhan (right)
Local name: No local name known.

### *Medical Symptoms and Onset*

Disorders of gastrointestinal and nervous systems occur after ingestion, but toxic components are unknown. Possible symptoms: vomiting, diarrhoea, sweating, miosis, tachycardia, mydriasis, dizziness, confusion, ataxia, illusion, agitation, depression, paralysis, etc. Onset within 30 minutes to 2 hours.

### *Fruiting*

Solitary to scattered or gregarious, on the ground in broadleaved or mixed forests, often under or near fagaceous (*Quercus, Lithocarpus, Castanopsis*) trees. Summer to fall.

### *Morphological Characters*

**Pileus** 2–6.5 cm across, convex to flattened, sometimes with a slight umbo, dark red to reddish-orange, paler to yellowish around the margin, surface densely covered with red to orange to yellow powdery to floccose remnants of the volva, margin conspicuously sulcate-striate. Flesh thin, white to cream.

**Gills** 3–6 mm wide, free, close, white to pale yellow, with truncate lamellulae which are typically half the length of the gills.

**Stipe** 5–10 cm tall and 0.5–1 cm thick, roughly cylindrical above, enlarged towards a bulbous base, annulate with a membranous ring at the upper portion, stuffed then hollow, surface cream above the ring and cream to yellowish below it. Ring persistent, white above and pale yellow below, fringed orangish to reddish at the edge with volval remnants. Basal bulb broadly ovate to sub-globose, 1–2 cm wide, at the upper part covered with orangish yellow to yellow or reddish, woolly to powdery fragments of the volva; the tissue of the upper bulb often torn into a few rings concentrically and there fringed with orangish to yellowish volval fragments.

**Spore print** white to cream.

### *Comments*

This comparatively small, elegant Amanita species seems to be rather common in Bhutan, growing in forests with *Quercus, Lithocarpus,* or *Castanopsis.* It can be easily recognized in the field by the bright red to reddish orange cap becoming yellow towards the radially grooved margin, yellow to reddish orange, floccose-pulverulent volval fragments on the cap and at the sub-globose base, and the superior white to yellowish membranous ring.

Macroscopically, *A. rubrovolvata* is very similar to *A. frostiana* known from North America and *A. subfrostiana* known from China, particularly in the colour and from of the fruiting bodies and the nature of volval remnants. *A. rubrovolvata* can be clearly separable from them microscopically, having smaller spores (7-8.5 x 6-7 µm). However, it may be difficult to separate this species from those based only on macroscopical characters, although *A. rubrovolvata* has a small and slender stature in comparison with those North American and China species.

***Amanita verna* (Bull.) Lam. (s. lato)**

(Destroying Angel, White Death Pileus)

PC: Eduardo Alvarado

Local name: No local name known

### *Medical Symptoms and Onset*

Initial symptoms are violent and prolonged vomiting, persistent diarrhoea (often watery diarrhoea), and intense abdominal pain, cramps in the feet and legs, etc. Later symptoms are liver and kidney dysfunction (Liver

hypertrophy, jaundice, etc.). Onset time is usually 6-24 hours after ingestion for the initial symptoms and 4-7 days after ingestion for later ones.

***Fruiting***

Solitary to scattered, in hardwood and coniferous forests or hardwood forests. Summer and fall.

***Main Macromorphological Characters***

Pileus 5–10 cm across, pure white, initially egg-shaped then expanding to bell-shaped to sometimes almost flat with an umbo, surface smooth or when young scattered with a few white patches of volval remnants which are easily washed off by rain and rarely seen on mature pileus. Flesh thin and soft, odour mild to somewhat nauseous.

Gills free, crowded with short ones, white, with concolourous fimbriate edges.

Stipe 8-15 cm tall, 0.6-2 cm wide, subequal or enlarged towards an ovate to subglobose bulb, stuffed then hollow, pure white, surface striate and often minutely torn near the superior ring, somewhat fibrillose scaly below, ring membranous, ample, pendent, white, volva membranous, cup-like with free lobed margin, white.

Spore print white.

***Comments***

This species and its look-alikes such as *Amanita bisorigera, Amanita extialis, Amanita overwinklerana, Amanita subjunquillea* var. *alba, Amanita virosa,* etc., all containing α-amanitin as the major toxin, are extremely lethal and have the following combination of characters in common: the fruiting body coloured white to whitish overall, the cap not striated at the margin, and the stipe with a membranous ring at the upper portion and a cup-like volva at the base. It is difficult to distinguish these species from each other in the field. Hence, from the viewpoint of practical use, it seems better that these white highly toxic *Amanita* species are treated as one species as a whole.

***Amanita virgineoides* Bas**

PC: Kazuo Watanabe
Local name: No local name known

### *Medical Symptoms and Onset*

Poisoning with this mushroom is said to induce disorders of the gastrointestinal and nervous systems but the causal toxin is unknown. Onset within 30 minutes to 2 hours. Refer to *A. rubrovolvata,* page 30.

### *Fruiting*

Solitary to scattered or gregarious, on the ground in broadleaved or mixed forests, often under or near fagaceous (*Quercus, Lithocarpus, Castanopsis*) trees. Summer to fall.

### *Main Macromorphological Characters*

**Pileus** 9-20 cm across, convex to applanate, sometimes concave when old, white, surface viscid when wet, covered with white, minute, conical to pyramidal volva remnants which are easily detachable, margin often appendiculate with veil fragments. Flesh thick, white and unchanging in colour when cut, odour somewhat chlorine-like when fresh, disagreeable when dried.

**Gills** free to sub-free, more or less crowded, white to cream coloured, short ones attenuate, with fimbriate edges.

**Stipe** 10-20 cm tall, 1.5-3 cm wide, sub-cylindrical or slightly attenuated upwards, with an enlarged broadly ovate or at times sub-globose base 3-5 cm wide, solid, surface white powdery-granulose to minutely floccose squamulose, with concentric rings of minute pyramidal warts (broken volval fragments) at the upper basal bulb. Ring apical, white, its upper surface radially striate and lower surface covered with verrucose to conical warts, often broken and fallen off during expansion of the pileus.

**Spore print** white.

### *Comments*

This large *Amanita* is very distinctive in its overall chalk white colour, easily detachable volva remnants which are present as minute, granular to pyramidal warts on the cap and stipe surfaces and the apical, large, membranous ring which is very fragile and easily detached from the stipe. There are several white *Amanita* species with pyramidal warts on the cap and stipe surfaces as in A. virgineoides, such as A. sphaerobulbosa (deadly poisonous), *A. castanopsidis* (deadly poisonous), *A. yennii* (suspected poisonous), *A. virginea* (suspected poisonous), *A. hongoi* (suspected poisonous) etc., but *A. virgineoides* would be comparatively easily separated from those similar species even in the field, if you pay attention to the nature of the ring and volva.

## ***Amanita volvata* Pec k (s. lato)**

(Volvate Amanita)

PC: Eiji Nagasawa (left) & Sabitra Pradhan (right)
Local name: No local name known

### *Medical Symptoms and Onset*

Although toxic components are unknown in this species, the ingestion causes disorders of the gastrointestinal and nervous systems, such as vomiting, diarrhoea, numbness in limbs, facial paralysis, and speech disorders. Moreover, in severe cases, symptoms leading to death, such as

dyspnea, heart weakness, and liver and kidney dysfunction occur. Onset shortly after eating or several hours later.

### *Fruiting*

Solitary or scattered, in broadleaved and mixed forests with fagaceous trees. Summer to fall.

### *Main Macromorphological Characters*

**Pileus** 5-8 cm broad, sub-globose at first, expanding to convex to plane, surface dry or sub-viscid when wet, white, shiny, often tinted pale brown to reddish brown over the centre (particularly when old), scattered with randomly distributed whitish, powdery to floccose squamules or at time large patches of volva remnants which are discoloured brownish to reddish when bruised or when old, margin shortly striate when old. **Flesh** white, weakly turning reddish then brownish when cut, odour and taste

**Gills** free to sub-free, close, broad, white to creamy, later discolouring pale reddish brown, edges somewhat powdery.

**Stipe** up to 10 cm tall, and 1 cm wide, cylindrical to tapering slightly to the apex, stuffed then hollow, lacking a ring, but at times with an indistinct floccose-powdery zone at the upper portion, surface densely powdery to minutely floccose scaly, whitish, becoming reddish to brownish on handling or with age, base enveloped in a large, thick-fleshed, white to pale reddish brown, sub-globose, cup-like volva.

**Spore print** white.

### *Comments*

This medium-sized white *Amanita* is treated here in a broad sense, including *A. clarisquamosa* and *A. avellaneasquamosa*. It is characterized by the cap decorated with soft, cottony patch-like scales which are initially whitish but gradually discolour pale brown to pale reddish brown on bruising or with age, the flesh which may weakly change to pale reddish to brownish when damaged, the lack of a ring, and by the thick cup-like volva which stains brownish to reddish brown on damage or with age. The combination of these features easily separates this species from other white amanitas.

## ***Ampulloclitocybe* cf. *clavipes* (Pers.) Redhead, Lutzoni, Moncalvo & Vilgalys**

= *Clitocybe cf. clavipes* (Pers.) P. Kumm.

(Club-footed Clitocybe, Fat-footed Clitocybe)

PC: Sabitra Pradhan

Local name: No local name known

### *Medical Symptoms and Onset*

This species contains toxins that are dangerous when consumed with alcohol. If it is consumed with alcohol or alcohol is consumed after eating this mushroom; the symptoms such as flushing of the face, throbbing of the head and neck and puffy hands would onset after around five to ten minutes. Although the symptoms are similar to that of *Coprinopsis atramentaria,* the aldehyde dehydrogenase inhibitor in this species is not known. Symptoms are similar to those of a hangover (burning face, headache, tachycardia, etc.). In severe cases, dyspnea and unconsciousness occur. This poisoning

is induced only when alcohol is consumed, during or after eating this mushroom. It is necessary to stop drinking for a week after ingestion. Onset usually within 30 minutes to 2 hours.

### *Fruiting*

Growing solitary to more frequently gregarious, or in small clusters, on the ground in coniferous (*Pinus* and *Larix*) and mixed conifer and hardwood forests. Summer to fall.

### *Main Macromorphological Characters*

**Pileus** 2–10 cm across, flat with a slightly incurved margin, eventually becoming centrally depressed or at times shallow funnel-shaped, margin strongly in-rolled at first, usually with a slight obtuse umbo, surface glabrescent, nearly smooth, moist to dry, not viscid when wet, medium brown to pale greyish brown, sometimes with olive tones, darker over the centre and lighter towards the margin.

**Gills** decurrent, close or nearly distant with frequent lamellulae, white to cream, or yellowish buff when old.-

**Stipe** 2.5–5 cm tall and 1–3 cm thick, usually bulbous or club-shaped at the base, sometimes more or less equal, especially at maturity, stuffed and spongy at the base, surface smooth, fibrillose streaked, coloured like the cap or paler, covered with white mycelium at the base.

**Flesh** soft, white, odour very strong fruity fragrant, taste not distinctive.

**Spore Print** white.

### *Comments*

Among the clitocyboid mushrooms, *Ampulloclitocybe clavipes* is distinguished by its greyish brown pileus, white spore print and the frequently bulbous stipe coloured like the pileus. The bulbous stipe is what gives the species its name (*clavipes*), but it is not always bulbous as shown in the photos. Although edible, if consumed with alcohol it gives disulfiram-like reactions (Disulfiram works by inhibiting the enzyme acetaldehyde dehydrogenase causing many of the effects of a hangover to be felt immediately following alcohol consumption).

***Armillaria mellea* (Vahl) P. Kumm.**

(Honey Mushroom)

PC: Eiji Nagasawa (top) & Sabitra Pradhan (bottom)
Local name: No local name known

### *Medical Symptoms and Onset*

Gastrointestinal disorders, such as nausea, diarrhoea, flatulence, etc. Onset within dozens of minutes to 24 hours after ingestion.

### *Fruiting*

In small or large clusters on stumps, logs, and living trees (often at the base) of either coniferous or hardwood species, or scattered to gregarious on the ground around stumps, fallen trunks, etc. Spring to fall.

### *Main Macromorphological Characters*

**Pileus** 3.5–12 cm across, convex when young and expanding to broadly convex to nearly flat, or depressed at the centre, umbonate, surface moist or slightly tacky when wet, bald or with tiny green blackish to dark brown scales concentrated near the centre, colour golden yellow to olive yellow or light brown when young and fresh but soon fading to pale brownish to pallescent from the centre to margin, translucent-striate when moist or wet at least in expanded pilei.

**Gills** attached to the stipe or slightly decurrent, close with lamellulae, whitish to yellowish, spotted brown where damaged or when old.

**Stipe** 7–20 cm tall and 0.5–1 cm wide, cylindrical, at times with somewhat enlarged base, cartilaginous and brittle, annulate with a rather persistent, membranous ring near the apex, surface whitish to faintly pinkish near apex, becoming dark greyish to blackish brown downwards with age, fine squamulose below the ring, fibrillose to nearly bald towards the base. Ring whitish and striate at the upper side, yellowish to brownish squamulose at the underside, double-edged and edges fringed with fine dark yellowish or dark brown hairy scales. **Flesh** white, thin, odour mild, taste bitter to astringent.

**Spore Print** white.

### *Comments*

*A. mellea* is generally known as edible when well cooked, but some people experience gastrointestinal disorders; hence caution would be advised when it is collected for human consumption. In a broad sense *A. mellea* is variable in its colour, shape and habitat.

Now, *A. mellea* s.l. is separated into several independent species, such as *A. mellea s.str., A. fuscipes, A. gallica, A. clavescens, A. cepistipes, A. ostoyae, A. gemina,* etc. based on mating test, DNA sequence data in addition to morphological data. The Bhutanese *Armillaria* represented in the photo here seems to be close to *A. mellea* s. str. having a cylindric stipe with a persistent, membranous ring, and yellowish cap with fine fibrillose scales over the centre. *A. tabescens* is similar but it lacks a ring from the first.

Basidiomycetes–Gilled Mushrooms with Pale-Coloured Spores

***Chlorophyllum molybdites* (G. Mey.) Massee**

(False Parasol, Green-spored Parasol)

PC: Sabitra Pradhan

Local name: No local name known

### *Medical Symptoms and Onset*

Chills, headache, and severe gastrointestinal disorders such as vomiting, diarrhoea, and sometimes bloody stools. Onset within 20 minutes to 2 hours after ingestion.

### *Fruiting*

Solitary to scattered or in groups, typically forming fairy rings, in grassy places, such as meadows, lawns, pastures, gardens, or waste land. Summer to early fall, especially after rains.

### *Main Macromorphological Characters*

Pileus 10–22 cm across, convex to spherical when young then becoming broadly convex to nearly flat in age, umbonate, surface dry, smooth and uniformly pinkish buff to pinkish brown or tan-coloured in the button

stage, as the pileus expands, soon fragmenting into scales and exposing white fibrillose ground except for the centre that remains smooth, scales concentrated near the centre often concentrically, scattered towards the margin, easily detached and nearly absent in old specimens, margin with small, white, fibrillose scales.

**Gills** free from the stipe or slightly attached to it, crowded with frequent lamellulae, white when young, later becoming greyish green to brownish green as the spores mature.

**Stipe** 8–20 cm tall and 1.5–3 cm thick, nearly equal with a somewhat enlarged base, typically annulate at the upper or middle portion, surface dry and bald or very finely fibrillose, firm, white, discolouring pinkish brown from handling and ageing. Ring persistent and often movable, shaggy fibrillose, double, white above, brown or greenish below.

**Flesh** soft, white, unchanging or turning reddish slowly when injured, odour and taste indistinctive.

**Spore Print** dull greyish green.

***Comments***

This relatively large, parasol-like mushroom is charactered by its soft, white cap decorated with brown scales around the centre, the white then pinkish brown stipe with a double shaggy ring, the white then greyish green gills, and the greyish green spore print. The scales on the cap come from remnants of a crust-like layer covering the cap surface initially and are easily detachable. When young the ring is attached to the stipe but becomes free from it and movable with age.

There are some lookalikes around this species, such as *C. rachodes* (poisonous?), *Macrolepiota procera* (edible), *Leucoagaricus americanus* (poisonous?) and so on, all of which have in common a parasol-like fruiting body and a brown to brownish scaly cap. However, if we pay attention the colour of the gills and spore print, these species can be easily distinguished from *C. molybdites* in having gills not becoming greyish green with age (retaining the white colour until late) and bearing a white spore print.

***Clitocybe cf. phyllophila* (Pers.) P. Kumm.**

(Frosty Funnel)

PC: Sabitra Pradhan

Local name: No local name known

### *Medical Symptoms and Onset*

Symptoms of poisoning by this and several similarly white capped *Clitocybe* species are those associated with muscarine poisoning, for example excessive salivation, lacrimation, and sweating. Depending on the

amount consumed, victims may also suffer abdominal pains, vomiting and diarrhoea, together with blurred vision and difficulty in breathing. Onset is within 30 minutes to 2 hours after ingestion.

### *Fruiting*

Gregarious, often in troops, on soil in leaf litter of broadleaved and coniferous forests. Fall.

### *Main Macromorphological Characters*

Pileus 10 cm in across, convex then plane-depressed, surface dry, weakly hygrophanous, smooth, covered with a rather persistent powdery whitish coating, pale buff to whitish, margin not translucent-striate when wet, often lobed-undulate when old, shortly ridged-striate.

Gills broadly adnate to short decurrent, crowded to close, white to cream, flushed slightly pinkish with age.

Stipe 5-8 cm tall and 0.5-1.5 cm thick, equal, stuffed then hollow, white to cream, white tomentose at the base.

Flesh thin but firm, odour faint, pleasant to slightly earthy-farinaceous, taste mild.

Spore print pinkish cream.

### *Comments*

Among *Clitocybe* species with a white to whitish, little hygrophanous cap, *C. phyllophila* is characteristic in its relatively larger size and pinkish cream spore print. *Clitocybe* mushrooms, particularly those with a white cap are often known to contain a variable dose of muscarine as toxin, hence should be avoided as food.

*Trogia venenata* (Zhu L.Yang, Y. C. Li & L. P. Tang), a deadly poisonous species known from Yunnan, China is somewhat similar in having a whitish, cup-shaped cap, but it grows on rotten wood and is smaller in size.

## ***Entoloma rhodopolium* (Fr.) P. Kumm. (s. lato)**

(Wood Pinkgill)

PC: Eiji Nagasawa

Local name: No local name known

### *Medical Symptoms and Onset*

Severe gastrointestinal upset, vomiting and diarrhoea for 1 to 2 days. In severe cases, symptoms of muscarine poisoning (sweat, tears, salivation, convulsions, diminished pupils, bradycardia, visual impairment, decreased blood pressure, etc.) may occur, but the worst case leading to death is said to be rare. Onset within 20 minutes to 2 hours after ingestion.

### *Fruiting*

Solitary to scattered, or at times in small clusters, on the ground in forests, parks, or gardens, mainly under deciduous hardwoods. Summer to fall.

***Main Macromorphological Characters***

**Pileus** 3-12 cm across, bell-shaped to convex when young, becoming broadly convex to nearly flat with maturity, often umbonate, surface dry to moist, sub-viscid when wet, smooth, tan to pale yellowish brown or pale greyish brown, hygrophanous, fading and drying out to greyish or almost whitish on losing moisture or when old, margin translucent-striate when wet at least at maturity. Flesh thin, whitish, odour mealy or nitrous, taste mealy or mild.

**Gills** adnate to sinuate, close or sub-distant, white when young, becoming pink with age, edges eroded.

**Stipe** 4-10 cm tall and 0.6-1.2 cm thick, more or less equal or somewhat enlarged at the base, stuffed then hollow, corticate, stiff, fragile, surface dry to moist, bald or pruinose at the apex, white to dingy whitish, fibrillose-streaked, dull to satiny.

**Spore print** pink.

***Comments***

*Entoloma* includes both edible and poisonous species. Of these, *E. rhodopolium* is the most well-known poisonous one along with *E. sinuatum*. *E. rhodopolium* has been known as variable in the appearance, colour and nature of the pileus, taste and smell, etc. Recent molecular phylogenetic studies have revealed that the formerly known *E. rhodopolium* is a complex of closely related species. It is so hard to distinguish each of these in the field that *E. rhodopolium* is treated here in a broad sense as a medium-sized to relatively large species, which has a yellowish brown to dull brown, or greyish brown, hygrophanous cap with translucent-striate margin when wet, relatively fragile flesh, a mild to farinaceous or alkaline smell, and a white to faintly greyish cylindric stipe. The edible *Lyophyllum shimeji* and *L. decastes*, both having a similarly coloured cap, may be confused with *E. rhodopolium*, but those are clearly different in having white gills and bearing white spore prints. In addition, they often grow in large tufts.

***Hygrocybe conica* (Schaeff.) P. Kumm.**

(Witch's Hat, Conical Slimy Pileus)

PC: Sabitra Pradhan

Local Name: No local name known

### *Medical Symptoms and Onset*

Disorders of the gastrointestinal system (nausea, vomiting, and diarrhoea, etc.) or the nervous system (light-headedness and numbness, etc.) may appear within 20 minutes to several hours after ingestion, although the corresponding toxins are unknown.

### *Fruiting*

Solitary to gregarious, or in small groups, on the ground in forests, grassy open places, parklands, or burnt areas. Summer to fall.

### *Main Macromorphological Characters*

**Pileus** 1-7 cm across, acutely to bluntly conical when young, expanding to broadly conical, never fully expanded, margin often lobed or incised, surface sticky when very fresh or when moist, sometimes with a thin glutinous covering after heavy rains, soon dry and shining, smooth to finely radially fibrillose, colour variable, usually scarlet to orange yellow, or at times primrose yellow to chrome yellow, all parts becoming black with age or when handled.

Flesh thin, brittle, coloured like the surface or whitish, blackening, odour indistinctive, taste mild.

**Gills** adnexed to nearly free, close or nearly distant with frequent lamellulae, ventricose, whitish to pale yellow, waxy, blackening on bruising or on ageing.

**Stipe** 3-8 cm tall and 0.5-1 cm thick, nearly equal or somewhat tapering towards the apex, hollow at maturity, brittle, yellow to orangish yellow or orange, white at the base, fibrous-fleshy, fragile, splitting, surface dry to moist, sub-viscid when moist, longitudinally fibrillose-striated, twisted at times, bruising black when injured or with age.

**Spore print** white.

### *Comments*

Members of *Hygrocybe* and its related genera (*Hygrophorus* s.l) are commonly called "waxy caps or slimy caps," forming a fruiting body with a texture similar to that made of wax. Although variable in form, size, colour, habit, habitat and so on, they have in common comparatively thick gills that are waxy in appearance and a white to whitish spore print. Of the waxy caps *H. conica* is well characterized by its slimy, relatively small, conical cap coloured brilliant red to orange or yellow and the fruiting body blackening almost anywhere where injured or entirely when old or dried.

***Hygrophoropsis aurantiaca* (Wulfen) Maire**

(False Chanterelle)

PC: Sabitra Pradhan

Local name: No local name known

### *Medical Symptoms and Onset*

Although toxicity of *H. aurantiaca* is being questioned, the consumption of this mushroom may cause serious digestive problems, such as nausea and vomiting, abdominal pain, diarrhoea. Onset usually within 30 minutes to 2 hours after ingestion.

### *Fruiting*

Solitary to scattered, or in small groups, in humus and on decaying wood of conifers, in coniferous or mixed forests; sometimes on woodchips used in gardening and landscaping. Summer to fall.

### *Main Macromorphological Characters*

**Pileus** up to 8 cm across, initially convex, becoming nearly plane, often with a depressed centre, finally funnel-shaped when old, margin remaining in-rolled until late, often lobed and wavy-undulate when old, orange to brownish yellow or brownish orange, at times darker brown to almost blackish over the centre, surface dry, soft and felted or velvety. Flesh thin but pliant, white to yellowish or orangish, odour and taste mild.

**Gills** decurrent, close to crowded, thin and narrow, repeatedly forked, generally with a more intense shade of orange than the cap.

**Stipe** 3-5 cm high and 0.5-1 cm thick, central or eccentric, equal or somewhat enlarged at the base, spongy within, sometimes hollow, surface glabrous or faintly velvety, more or less concolourous with the pileus, or darker brownish towards the base.

**Spore print** white to cream.

### *Comments*

The typically bright orange, dichotomously forking gills, soft texture of the cap, and white spore print are the significant clues to identify this species macroscopically. The colour of cap may vary with tones of yellowish orange to orange to deep reddish orange, or brownish yellow to brownish orange, often darker or browner over the centre, at times reddish brown to dark brown, or rarely whitish to cream or nearly concolourous gills and stipe. The variant with a reddish- brown cap may be treated as an independent species, *H. rufa* (= *H. aurantiaca* var. *rufa*), that with a dark brown cap as *H. bicolor,* and the one with a whitish cap as *H. pallida* (= var. *lacteus*) or *H. macrospora* (= var. *macrospora*). Against the false chanterelle (*H. aurantiaca*) the true chanterelle (*Cantharellus cibarius*) forms a bright egg-yellow fruiting body which has gill-like folds (false gills) with blunt edges and crossing veins between folds.

***Lactarius scrobiculatus* (Scop.) Fr.**

(Bearded Milk Cap, Spotted Milk Cap)


PC: Sabitra Pradhan

Local name: Om Shamong

### *Medical Symptoms and Onset*

Disorders of gastrointestinal system, causing nausea, vomiting, diarrhoea, abdominal pain, etc. Onset within 30 minutes to 2 hours.

### *Fruiting*

Solitary to scattered or gregarious, on the ground in coniferous forests (*Abies, Picea, Pinus,* etc.) in subalpine regions. Summer to fall during the rainy season.

### *Main Macromorphological Characters*

Pileus 4 -12 cm across, convex to flattened, depressed or even umbilicate at the centre, margin in-rolled when young and typically bearded with hairs, surface dry to moist, glossy and slimy when wet, smooth or finely squamulose concentrically in age, straw yellow to pale ochre yellow, sometimes reddish yellow, usually faintly to conspicuously zonate, Flesh thick and hard, very acrid in taste and strongly acidic-fruity in odour, white and producing concolourous copious latex (milk) when broken, milk also very acrid, soon discolouring pale yellow when exposed to the air and staining the flesh the same colour.

Gills adnate to slightly decurrent, crowded to close, often forked near the stipe, whitish to cream, with yellowish to pale brownish stains where damaged, bleeding white to cream then soon turning yellow milk (latex) on injuring.

Stipe 1- 3.5 cm tall and 1-3.5 cm thick, cylindric or somewhat tapering downwards, hollow in age, surface dry, glabrous, whitish to pale yellow and with distinct, brighter yellowish to ochraceous pits.

Spore print white.

### *Comments*

This is a robust, coniferous forest member of *Lactarius*. Its main field characters include a viscid (when wet), yellow to yellowish ochre, depressed cap with an inrolled, bearded margin, the dry whitish stipe with distinct, yellow to ochraceous pits, the acrid white sap which quickly turns yellow when exposed to the air, and the coniferous forest habitat.

***Lactifluus piperatus* (L.) Roussel**

(= *Lactarius piperatus* (L.) Pers.) (Peppery Milk Cap)

PC: Sabitra Pradhan

Local name: Om Shamong

### *Medical Symptoms and Onset*

Disorder of gastrointestinal system, causing nausea, vomiting, diarrhoea, abdominal pain, etc. Onset within 30 minutes to 2 hours.

### *Fruiting*

Solitary to widely scattered or gregarious, on the ground under hardwoods, especially with fagaceous trees or in mixed forests.

***Main Macromorphological Characters***

**Pileus** 6-15 cm across, convex to broadly convex, expanding to plane or at times funnel shaped, depressed or even umbilicate at the centre with age, margin thin and acute, in-rolled at first, surface dry, white to creamy white, at times with yellowish to pale ochraceous stains where tightly bruised or when old, glabrous, not glossy, smooth or somewhat rugulose over the centre, becoming tessellately rimose in dry conditions.

**Flesh** hard and sturdy, white, very acrid, odour indistinctive, producing copious white latex (milk) when broken, latex very acrid, unchanging in the colour when exposed to the air or at times changing to bluish green as it dries after some hours.

**Gills** adnate or running slightly down the stipe, particularly crowded and narrow, frequently forked, white like the stipe but becoming creamy with age, at times with pale ochraceous stains where damaged.

**Stipe** 3-7 cm tall and 2-3 cm thick, cylindrical, sometimes tapering towards the base, solid or becoming hollow when old, surface white and smooth.

**Spore print** white.

***Comments***

In the field, members of *Lactarius* (s.l., including recently segregated genus *Lactifluus*) are characterized macroscopically by the combination of a clitocyboid, brittle fruiting body and a milky or juicy fluid that leaches from the flesh when broken. In appearance and brittle nature of the fruiting body, they are similar to members of the genus *Russula,* but the latter does not exude sap when injured in fresh fruiting bodies. Therefore *L. piperatus* can be easily distinguished from some similar, white members of *Russula* such as *R. delica, R. brevipes, R. cascadensis,* etc. in this character, even in the field.

Among the *Lactarius* there are several look-alikes such as *L. glaucescens, L. subpiperatus, L. deceptivus, L. velleus,* and *L. subvelleus,* etc., which are macroscopically different in nature of sap, gills' spacing, surface condition of the cap and stipe. All of these have an extremely hot taste, hence regardless of species they should be avoided to eat to prevent poisoning.

### *Lepiota* cf. magnispora Murrill

(= *L. ventriosospora* Reid) (Yellow Foot Dapperling)

PC: Sabitra Pradhan
Local name: No local name known

#### *Medical Symptoms and Onset*

The presence of the lethal toxin amanitins is doubted. If so, there is a possibility that serious symptoms leading to death may appear within 6 to 24 hours after.

#### *Fruiting*

Solitary to scattered or in small groups, on the ground among forest litter or on decayed wood in the forests. Summer to fall.

***Main Macromorphological Characters***

**Pileus** 4-7 cm across, elliptic oblong to convex at first, becoming broadly convex to nearly flat in age, dull umbonate, rusty brown to tawny brown, or pinkish ochraceous, surface dry, felt-like and smooth at first, soon becoming rimose-areolate then breaking up into small floccose scales on pale yellowish ground with age except for the disc remaining smooth, margin sometimes with veil remnants hanging over the edge.

**Flesh** thin and soft, white to pale yellowish, odour and taste indistinctive.

**Gills** free from the stipe, close with short gills, white to cream becoming slightly brownish with age, at first covered by a thin, white, floccose partial veil.

**Stipe** 4-9 cm tall, 0.5-1 cm thick, more or less equal, hollow, cartilaginous and fragile, with an easily collapsing, floccose ring near the apex, appressed silky-fibrillose above the ring, floccose-tomentose to floccose-scaly below it, pale yellow, tinted like the cap in the floccose scales.

**Spore print:** white.

***Comments***

The Yellow Foot/Yellow Leg Dapperling *Lepiota magnispora* is probably best recognized in the field by the ragged veil fragments that hang from the rim of the scaly cap. Among members of *Lepiota* (Parasol mushrooms) *L. magnispora* is characterzed by the shaggy appearance of the cap margin and stipe, the brown fragmental scales of veil remnants on the cap and stipe, the cottony-fibrous, easily collapsing ring, and the free, white gills. *L. magnispora* closely resembles *L. clypeolaria* macroscopically and has often been confused with it. In the field, *L. magnispora* may be distinguished from *L. clypeolaria* by the frequent presence of brown scales on the stipe that are densely arranged towards the base and scattered upward as the stipe elongates, but more clearly under the microscope in the spores that are differently shaped, in equilateral-fusiform, and somewhat longer.

Both *L. magnispora* and *L. clypeolaria* are suspected to be poisonous, because in *Lepiota* there is present of some similar, potentially lethal species with amatoxins, such as *L. brunneoincarnata, L. helveola, L. subincarnata* and so on, although the two species are clearly different from those in their shaggy appearance among others.

***Mycena pura* (Pers.) P. Kumm.**

*(Lilac Mycena)*

PC: Sabitra Pradhan

Local name: No local name known

### *Medical Symptoms and Onset*

Expression of complex symptoms due to muscarine poisoning, such as headache, chest and abdominal pain, recurrent vomiting, flushing on the face, profuse sweating, diarrhoea and confusion. In sever case, death occurs through bradycardia, bronchospasm and shock. Onset within dozens of minutes to 1 to 4 hours after ingestion.

### *Fruiting*

Solitary to gregarious or in small groups, on humus and leaf-litter in coniferous and hardwood forests. Summer to fall.

***Main Macromorphological Characters***

**Pileus** 2-6 cm across, convex to flattened or depressed with age, surface glabrous, smooth, moist, hygrophanous, translucent-striate almost to the centre when moist, at times furrowed-striate and tuberculate-striate, colour variable, pale to dark violaceous, blue lilac, violaceous grey, etc., at times yellow to entirely white. **Flesh** thin except for the centre, more or less con-colorous with the surface when moist, becoming pallid as it gets dry, odour and taste like radish.

**Gills** adnate, adnexed to uncinate, close or nearly distant, broad, often ventricose in old caps, developing cross-veins between gills with age, colour variable, tinged purplish, lilac or bluish, often with a slight greyish shade, at times white to whitish.

**Stipe** 4-10 cm tall and 2-6 mm thick, equal, hollow, smooth or with tiny hairs, colour whitish or flushed with the cap colour.

**Spore print** white.

***Comments***

Within the genus *M. pura* is fairly easy to recognize in the field by its overall purplish to lilac tones and distinct radish-like odour, combined with the relatively larger size for the genus. The colour is variable, but there usually remains a trace of lilac somewhere on the fruiting body, especially the stipe. *M. rosea,* formerly known as a colour variant of this species, forms somewhat larger, pinkish to rose fruiting bodies with a stipe somewhat enlarging towards the base. *M. perianthina* and *M. diosma,* forming similarly coloured fruiting bodies on leaf-litter (usually hardwoods) and having a strong smell of radish, are also similar to this species, but they are easily separable in having dark reddish to purple, punctate gill-edges in the former and a darker, violet-brown, often noticeably zonate cap in the latter. Apart from *Mycena,* it may be confused with *Laccaria ametystina,* an edible species with a similarly coloured fruiting body, but the latter is different in forming a tough, fibrous-fleshy fruiting body with gills retaining purplish tones until late and more clearly in having spiny spores.

**_Russula_ cf. _densifolia_ Secr. ex Gillet**
(Crowded Russula, Reddening Russula)


PC: Dorji (top) & Sabitra Pradhan (bottom)
Local name: No local name known

### *Medical Symptoms and Onset*

Gastrointestinal disorders such as nausea, vomiting, abdominal pain, diarrhoea, etc. In severe cases may even cause death. Onset within 30 minutes to 2 hours.

### *Fruiting*

Solitary to scattered, gregarious, or in groups, on the ground in both hardwood and coniferous forests. Summer to fall.

***Main Macromorphological Characters***

**Pileus** 4-15 cm across, broadly convex when young, becoming flat or centrally depressed, thick and rigid, surface sticky when wet, soon dry and polished, smooth, glabrous, pellicle peelable about halfway to the centre, initially dull white when young and fresh, soon changing to smoky brown or blackish when old, margin non-striate.

**Gills** adnate to slightly decurrent, narrow, close or crowded, usually alternating long and short ones, brittle, white to cream, when bruised slowly turning reddish, then blackish, more or less acrid in taste.

**Stipe** 1.5-9 cm tall and 1-3.5 cm thick, equal, hard and rigid, hollow at times when old, surface smooth, white when fresh but soon darkening like the cap with age.

**Flesh** firm and rigid, white, slowly changing to reddish then black when cut or damaged, taste mild to slowly and slightly acrid, odour indistinctive.

**Spore print** white.

***Comments***

In addition to the brittle nature of the fruiting body which is common throughout the genus *Russula,* the white then dingy brown cap, the crowded and narrow gills, the mild to somewhat acrid taste, and the flesh turning red then black when injured or broken are key characters for identifying this species in the field. There are several look-alikes around *R. densifolia,* such as *R. nigricans, R. subnigricans, R. dissimulans, R. adusta, R. acrifolia, R. albonigra.* It may be possible to separate them macroscopically, based on the difference of characters about the colour changes of the flesh when cut, the spacing between the gills, and the taste, etc. However, those features are not always stable; hence microscopic observations are fundamentally needed for reliable identification. *Russulas* which are similarly coloured and with reddening and/or blacking flesh like this species should not be eaten, because those are considered to be poisonous and at times lethal (*R. subnigricans*)

***Russula nigricans* Fr.**
(Blackening Russula)


PC: Jit Bdr. Chawan
Local name: No local name known

### *Medical Symptoms and Onset*

Gastrointestinal disorders such as nausea, vomiting, abdominal pain and diarrhoea, and in severe cases, sever pain and paralysis of the body, at times leading to death. Onset within 30 minutes to 2 hours.

### *Fruiting*

Solitary to scattered, gregarious or in groups of few, on the ground in both and hardwood and coniferous forests. Summer to fall.

### *Main Macromorphological Characters*

**Pileus** 5-20 cm across, convex when young, later becoming broadly convex to flat with a central depression or shallowly infundibuliform, surface dry, smooth, glabrous, sub-viscid and slippery when wet, initially dull white, discolouring to smoky umber to blackish when old, margin usually not lined but rarely ribbed when very old.

**Gills** narrowly attached, distant, inserted with short ones, thick and brittle, convex below when old, white to cream, soon discolouring reddish orange, then greyish to blackish when bruised, mild then slowly acrid.

**Stipe** 3-8 cm tall and 1-4 cm thick, stout, equal, surface smooth or slightly irregular, whitish at first but darkening like the cap with age, when bruised soon turning reddish, then blackish.

**Flesh** firm and brittle, white, soon changing to reddish then black when cut or damaged, **taste** mild to slowly acrid, **odour** indistinctive.

**Spore print** white.

### *Comments*

In addition to the brittle nature of the fruiting body, which is common throughout the genus *Russula*, the initially white then greyish to blackish brown cap, the thick, widely spaced gills, and the quickly reddening then blacking flesh when injured or broken are distinctive in *R. nigricans.* The lethal *R. subnigricans* also with fairly well-spaced gills can be confused with *R. nigricans*. However, in the former, when injured, the whitish flesh slowly staining reddish then dull reddish brown but never black as in the latter. *R. dissimulans* is also similar in most of field characters but is said to be different in having gills not so widely spaced as in *R. nigricans,* and microscopically somewhat larger spores.

***Tricholoma saponaceum* (Fr.) P. Kumm.**
(Soap Scented Toadstool, Soap Tricholoma)

PC: Eiji Nagasawa
Local name: No local name known

### *Medical Symptoms and Onset*

Gastrointestinal disorders, such as nausea, vomiting, abdominal pain and diarrhoea. Onset within 30 minutes to 2 hours. Saponaseolides are suspected to be its toxic ingredients.

### *Fruiting*

Solitary to gregarious, on the ground in coniferous and mixed forests. Summer to fall.

### *Main Macromorphological Characters*

**Pileus** 4-10 cm across, convex with an incurved margin when young, becoming broadly convex to flattened when old, often dull umbonate, surface dry or moist but not viscid, smooth or at times with fine sub-pruinose squamules over the centre, often cracked irregularly when grown in dry weather, variable in colour, pale grey or pale brown, usually more or less tinted olive or greenish, darker at the centre, paler at the margin. Flesh white, at times staining slowly yellowish or pinkish when bruised, thick, firm, odor and taste disagreeable and rather soapy or farinaceous.

**Gills** sinuate to emerginate, sub-distant, rather broad, white or sometimes with a faint greenish or yellowish tinge.

**Stipe** 5-10 cm tall and 1-2 cm thick, more or less equal to sub-ventricose, base at times rooting, solid, surface appressed fibrillose, smooth or finely squamulose, white or coloured more or less like the pileus, often stained pinkish to pinkish orange at the base when old, squamules darker and sometimes nearly blackish.

**Spore print** white.

### *Comments*

*T. saponaceum* is treated here in a broad sense as a highly variable species in its macromorphological characters. Although the colour of the cap, the scales of the pileus and stipe, and the colour change of the fruiting body when bruised vary considerably among the population, the unpleasant odour like soapy water and the tendency to bruise reddish, especially at the base of the stipe are important clues to recognize this species in the field.

The Bhutanese fungus represented in the photo seems to be the var. *squamosum,* having dark fine- fibrillose scales over the centre of an olivaceous-grey cap and on a whitish stem (particularly towards the base).

***Tricholoma ustale* (Fr.) P. Kumm.**

(Burnt Knight)

PC: Sabitra Pradhan

Local name: No local name known

### *Medical Symptoms and Onset*

This species contains ustalic acid as a toxic component and causes gastrointestinal disorders, such as nausea, vomiting, abdominal pain and diarrhoea. Onset within 30 minutes to 2 hours.

***Fruiting***

Solitary to scattered, gregarious, or in groups, on the ground in hardwood and mixed forests, often in association with fagaceous trees.

***Main Macromorphological Characters***

**Pileus** 3-10 cm across, bell-shaped to conical with an incurved margin when young, convex to plane or shallowly infundibuliform when old, often dull umbonate, surface glabrous, sticky when fresh, soon becoming dry and glossy, often weakly radially fibrillose when dry, orangish brown to reddish brown or darker at the centre, paler at the margin.

**Gills** sinuate, rather broad, close, white to beige, often stained rusty brown when old, especially on the edges.

**Stipe** 4-7 cm tall and 1-2 cm thick, more or less equal, solid or narrowly fistulose, surface bald or with fine silky fibrils, whitish when young, becoming brownish to reddish brown towards the base with age, without a ring zone.

**Flesh** white, faintly browning or unchanging in colour when sliced, odour and taste farinaceous.

**Spore print** white.

***Comments***

*Tricholoma,* to which this species belong, is a large genus of agaric mushrooms primarily distributed in the Northern Hemisphere. The members are ectomycorrhizal and form a relatively small to large, fleshy fruiting body in association with trees, especially of Pinaceae, Fagaceae, Betulaceae, and Salicaceae. In this genus, there are some edible and choice species such as *T. matsutake* and its close relatives, *T. sejunctum,* and *T. populinum* but also some poisonous species such as this one, *T. ustaloides, T. pardinum,* and *T. equestre* (only in Europe but not in others).

*T. ustale* is a medium-sized to relatively large species and characterized by its glabrous and viscid (when wet), reddish brown to dark brown pileus, whitish gills with brown stains where damaged, more or less farinaceous odour, the stipe which is white at first then staining brown gradually as old or when rubbed. *T. ustaloides* is very similar but differs in having a distinct white region at the stipe apex.

## ***Agaricus placomyces* Peck (s. l)**

(Eastern Flat-Topped Agaricus)

PC: Eiji Nagasawa
Local name: Awa Shamong

### *Medical Symptoms and Onset*

The toxic component is unknown. Symptoms usually appear relatively shortly after ingesting mushrooms (within 30 minutes to 2 hours) and include gastrointestinal disorders such as nausea, abdominal pain, vomiting and diarrhoea. Although generally not fatal, hospitalization may be required in severe cases.

### *Fruiting*

Gregarious or scattered, in humus-rich forests and on roadsides. Summer to Fall.

### *Main Macromorphological Characters*

**Pileus** 5-18 cm across, bell-shaped when young then convex to flat at

its maturity, surface dry, covered with radiating greyish brown fine fibres especially over the centre, yellowing when injured especially on the margin. **Odour** phenolic or not distinctive.

**Gills** free from the stipe, crowded, with frequent lamellulae, whitish when young and then becoming to pink and then eventually dark purplish brown in maturity. The gills are covered by a rubbery, whitish partial veil that can develop to yellow-then-brown stains when young.

**Stipe** 3-13 cm tall and 1-2.5 cm thick with a slightly enlarged/ bulbous base, colour whitish to brownish, bruising yellow and then slowly brown where handled, especially at the base.

**Spore print** dark brown.

***Comments***

This species is treated here in a broad sense, including *A. moelleri* (= *A. praeclaresquamosus, A. melleagris and A. pocillator.*) Its main characters include the greyish brown to blackish brown pileus with a darker centre and towards the margin densely covered with fine fibrils and fibrillose scales on whitish ground, the silky-white stipe with a membranous ring and an enlarged base, a phenolic odour in crushed flesh, and the flesh turning yellow at the base of the stipe when injured.

Members of *Agaricus* are characterized by spore print that is chocolate-coloured, gills free (not attached to the stipe), white initially, but later changing to pink to greyish pink and finally chocolate brown as the spore mature, and by having a pendent membranous ring on the upper stipe. They occur mainly in humus-rich forests, grasslands, cultivated lands, or along roads or paths in forests. *Agaricus* includes many edible species such as A. campestris, *A. angustus,* etc. but also several poisonous species that cause gastrointestinal disorders like this species. Particular attention should be paid to those such as *A. xanthodermus* (entirely white except gills coloured pinkish then chocolate brown) and this species, in which an unpleasant, ink-like or phenolic odour are present, and the damaged part turns yellow.

***Coprinopsis insignis* (Peck.) Redhead, Vilgalys & Moncalvo**

= *Coprinus insignis* Peck

PC: Yeshi Lhendup

Local name: Lueki Shamong

### *Medical Symptoms and Onset maintain*

Poisoning occurs only when combined with alcohol. Symptoms are those of alcohol intolerance with nausea, vomiting, flush, tachycardia, headache, vertigo, hypotension and appear shortly after the patient ingests an alcohol-containing product and the mushroom. For significant effects to occur, the mushroom should have been eaten within the last 24 to 72 hours. Onset usually within 30 minutes.

### *Fruiting*

Solitary or more often in small groups, on the ground in forest, often around decayed stumps or trunks. Summer to fall.

***Main Macromorphological Characters***

**Pileus** 3-6 cm high when unexpanded, 4-8 cm across when mature, oval to ellipsoid when young, expanding to conical-convex, later nearly plane with revolute margin, finally deliquescing from the margin towards the centre, yellowish brown to greyish brown, paler towards margin, or grey to dark grey near the margin, surface faintly sulcate- then plicate-striate except for the centre, at first covered with silky white, delicate fibrillose scales that easily wash off. Flesh thin, whitish, odour indistinctive, taste mild.

**Gills** adnate-seceding, close or crowded, whitish then becoming black, deliquescing with age.

**Stipe** 8-15 cm tall and 0.5-1 cm thick, equal, base attached with white mycelial strands that spread into woody to leafy debris, cartilaginous and brittle, within hollow, surface smooth or finely hairy, white, at times with a faint fibrillose annular zone near the base.

**Spore** Print black.

***Comments***

Poisoning by this ink cap species is very characteristic because it occurs only when combined with alcohol; the chemical component coprine contained in fruiting bodies of the species is responsible for the poisoning but coprine in itself is not toxic. In addition to *C. insignis,* some other ink cap species (*C. alopecia, C. atramentaria, C. variegata,* etc.) contain coprine. Ingested alone, without an alcohol product, these mushrooms are not toxic to people but edible conversely. Coprine is said to inhibit aldehyde dehydrogenase, which is responsible for the metabolism of acetaldehyde when alcohol is consumed, and accumulation of acetaldehyde causes onset of the symptoms described above.

This species may be confused with *C. atrametaria* due to its appearance but clearly different microscopically in having amygdaliform verrucose spores (vs smooth ones in the latter). *C. insignis* seems to prefer woodlands rather than lawns and grassy areas in disturbed habitats where the latter often occurs.

***Cortinarius sanguineus* (Wulfen) Gray**

(Blood-Red Web Pileus)

PC: Sabitra Pradhan (top), Dorji (bottom left) &
Eiji Nagasawa (bottom right)

Local name: No local name known

### *Medical Symptoms and Onset*

Gastrointestinal disorders, such as nausea, vomiting, and diarrhoea. Onset usually within 30 minutes to 2 hours.

### *Fruiting*

Solitary to gregarious or at times in clusters, on the ground in coniferous forests of subalpine regions.

### *Main Macromorphological Characters*

Pileus 2–5 cm across, convex when young, later flattened, dull umbonate, carmine-red to dark blood-red, surface dry, covered with silky fibres radiating from the centre to the margin.

Gills adnate, close with short ones, initially blood-red then turning brown upon aging as the spores mature.

Stipe 3–6 cm tall and 0.3–0.8 cm wide, slim and cylindrical, narrowly hollow, coloured like the pileus or sometimes a bit paler, surface fibrillose, with basal mycelium coloured pinkish orange. Veil (cortina) and its remnants red.

Flesh orange-red to blood red, exuding red juice when crushed, odour indistinctive or pleasant, taste mild.

Spore print rust-coloured.

### *Comments*

This small to medium-sized *Cortinarius* growing in coniferous forests is very distinctive in the fruiting body coloured blood red throughout and the flesh exuding a red juice when crushed. A close relative, *C. puniceus* also produces dark reddish fruiting bodies coloured like this species but differs in the habitat growing in hardwood forests.

### ***Gymnopilus junonius* (Fr.) P.D. Orton (s. lato)**

= *G. spectabilis* (Weinm.) A. H. Smith
(Showy Flame Cap, Big Laughing Mushroom)

PC: Kazuo Watanabe
Local name: No local name known

#### ***Medical Symptoms and Onset***

*G. junonius* contains indole derivatives and the following symptoms are reported after ingestion: numbness, dizziness, chills, hot flushes, blurred vision, hallucinations of colour and speed of movement. Occasionally

nausea, abdominal discomforts (vomiting and/or abdominal pain). Onset usually within 30 minutes to 2 hours.

### *Fruiting*

At the base or on stumps and trunks of dead or living broad-leaved tree, rarely conifers, usually clustered, in parks, forests, or gardens. Summer to fall.

### *Main Macromorphological Characters*

**Pileus** 5-26 cm across, convex to conico-convex with an in-rolled margin when young, becoming broadly convex or nearly flat with maturity, surface dry, nearly smooth or finely silky fibrillose, orangish to brownish yellow. Flesh yellow, thick, taste very bitter, odour mild.

**Flesh** yellow, thick, taste very bitter, odour mild.

**Gills** adnate with a short decurrent tooth, close, comparatively narrow, yellow when young, becoming brownish yellow to rusty brown from spores with age, with brown to dark brown stains where damaged.

**Stipe** 9-16 cm tall and 1.5-3 cm thick, more or less equal or swollen in the middle, often joined each other at the base, with a membranous or fibrillose-membranous ring near the apex, solid, surface dry, glabrous and smooth, pale to light yellow, turning brown in areas when handled; ring rather persistent, as a distinct skirt with rusty brown spores on the upper surface.

**Spore print** bright rusty brown.

### *Comments*

*G. junonius* is characterized by its almost overall brownish yellow to yellowish orange colour, smooth non-viscid to non-gelatinous cap, bitter taste, robust size, presence of a rather long-lasting, fibrillose-membranous ring, caespitose habit, and bright rusty brown spore print. In the combination of these characters this species can be easily separated from similar- looking ones, such as some lignicolous *Pholiota* (*P. flavida, P. malicola, P. alnicola, P. squarrosa,* etc) and *Hypholoma fasciculare,* and terrestrial *Phaeolepiota aurea.*

## ***Hypholoma fasciculare* (Huds.) P. Kumm.**

=*Naematoloma fasciculare* (Huds.) P. Karst. (Sulphur Tuft)

PC: Sabitra Pradhan

Local name: No local name known

### *Medical Symptoms and Onset*

Symptoms, such as abdominal pain, vomiting, chills and diarrhoea occur within 30 minutes to 3 hours after ingestion. In severe cases, death occurs after a series of symptoms, such as dehydration, acidosis, convulsions, and shock etc.

### *Fruiting*

On decaying wood of both broad-leaved and coniferous trees, in dense

clusters. Almost through out the year in subtropical regions and summer to fall in warm to cool temperate regions.

***Main Macromorphological Characters***

**Pileus** 2-7 cm across, broadly conical at first, soon becoming convex to plane, dull umbonate at times, surface dry to moist, smooth, sulphur yellow or becoming olivaceous when water-soaked, often tinted fulvous over the centre, margin often with fibrillose velar remnants.

**Gills** crowded, adnate, narrow, initially sulphur yellow, becoming olive-green then purplish black as spores ripen.

**Stipe** up to 10 cm tall, 3-8 (-10) mm broad, equal, often wavy or undulating and contorted, stuffed then hollow, rather firm, with a poor fibrillose ring or ring-like zone near the apex, surface smooth, dry, more or less concolourous with the cap, becoming brownish in age from the base upwards, often with an indistinct ring-like zone from veil remnants, coloured dark by the spore deposit and browner towards the base.

**Flesh** thin, yellow, taste very bitter, odour indistinct.

**Spore print** purple brown.

***Comments***

This is a common species on decayed wood and can be easily recognized even in the field by the bright sulphur yellow colour of the fruiting body, the yellow-green gills when young, and the bitter taste. The variant of *H. fasciculare* with smaller fruiting bodies can be compared with *H. subviride* distributing subtropical to tropical regions because the latter forms small (caps rarely up to 3 cm), very similarly coloured fruiting bodies. Although *H. subviride* is said to different in its smaller size and somewhat smaller spores but it seems difficult to separate the two in the field. Other similar species include *H. capnoides* (gills grey when young, taste mild, fruiting on conifers) and *H. lateritium* (= *H. sublateritium*) (cap brick-red, gills greyish to pale olivaceous grey when young, taste mild to slightly bitter, fruiting on hardwood). *H. subviride* is suspected to be poisonous but the latter two are edible species.

***Inocybe rimosa* (Bull.) P. Kumm.(s. lato)**

=*Inocybe fastigiata* (Schaeff.) Quél. (Split fibercap)

PC: Sabitra Pradhan
Local name: No local name known

### *Medical Symptoms and Onset*

Muscarine poisoning; sweating, lacrimation, excessive salivation, miosis, bradycardia, vomiting, diarrhoea, visual disorders, laboured breathing, etc. Onset is usually within 30 minutes to 2 to 4 hours after ingestion. Deaths in healthy people are very rare, but anyone with a weakened heart or respiratory problems is much more at risk.

### *Fruiting*

Gregarious, on the ground under trees (usually those of Fagaceae), in forests, parks, or gardens. Summer to fall depending on the rains.

***Main Macromorphological Characters***

**Pileus** 2-8 cm across, conical to bell-shaped, becoming broadly bell-shaped, with a distinct, sharply or obtusely conical umbo at the centre, surface yellow ochre to ochraceous brown, darker at the centre, dry, shiny, innately radially fibrillose, smooth at the umbonate centre, becoming long-rimose outwards, margin incurved then decurved, finally revolute, often more or less lobed and cracked when old.

**Flesh** thin, white, odour rather unpleasant and often spermatic, taste indistinctive.

**Gills** adnexed to nearly free, crowded, comparatively narrow, more or less ventricose, close or crowded, yellowish then olive yellow to olive brown, edges white-fimbriate.

**Stipe** 3-9 cm tall and up to 1 cm thick, more or less equal without a swollen base, solid or hollow when old, surface dry, finely silky fibrillose, flocculose at the apex, often twisted with age, whitish or staining slightly brownish yellow.

**Spore print** brown.

***Comments***

This species is interpreted here in a broad sense and characterized by its obtuse to sub-acute, yellowish to ochraceous brown cap which is radially innately fibrillose and becomes outward long rimose with age, gills slightly tinged with olivaceous yellow initially, and the whitish or staining brownish yellow, cylindrical stipe with a flocculose apex.

*Inocybe,* to which *I. rimosa* belongs, is a large genus containing hundreds of species distributed worldwide. Members of *Inocybe* are comparatively easily recognizable even in the field due to their comparatively small size, characteristically silky, fibrillose, minute scaly, and/or woolly caps which are often umbonate and seldom viscid nor glutinous, and spores of some shade of brown (generally duller than that of the closely related genus *Cortinarius)* but contrary to this, it is often difficult to identify the species. Many *Inocybe* mushrooms contain muscarine and considered poisonous and hence should be avoided.

Basidiomycetes–Gilled Mushrooms with Dark-Coloured Spores

***Panaeolus cyanescens* (Berk. & Broome) Sacc.**

= *Copelandia cyanescens* (Sacc.) Singer

(Pan Cyan, Hawaiian Blue Meanies, Laughing Mushroom)

Local name: Suli chew (Lhotshampa kha)

### *Medical Symptoms and Onset*

Symptoms, such as headache, chills, loss of balance, dizziness, low blood pressure, hallucinations, and confusion, etc., coming from central nervous system disturbance. Onset within 30 minutes to 2hours after ingestion.

### *Fruiting*

Solitary to widely scattered or in groups, on or near dung of herbivorous animals in pastures or roadsides. Summer to fall, particularly after rain.

### *Main Macromorphological Characters*

**Pileus** 1.5-4 cm across, dry, hemispheric with an incurved margin when young, expanding to campanulate to convex in maturity, light brown when young, fading to off-white or light grey at maturity, sometimes with yellowish

or brownish tones, turning greenish or blue where damaged, surface dry to moist, slightly hygrophanous and shortly translucent-striate at the margin when moist, surface smooth, developing cracks in dry weather. **Flesh** thin, greyish white, turning blue on cutting, odour farinaceous.

**Gills** broadly adnate to angular, moderately crowded, ventricose, grey then black with a purplish hue, edges white.

**Stipe** 7-12 cm tall and 0.2-0.3 cm thick, equal or slightly enlarged at the base, slender, fistulose to hollow, surface pruinose and whitish apically, smooth and concolourous with the pileus below, staining blue when bruised or where damaged.

**Spore print** black.

***Comments***

*P. cyanescens* is one of the so-called "magic mushrooms" and found in subtropical and tropical regions. Hallucinogenic effects induced by magic mushrooms are due to psilocybin and psilocin contained in their fruiting bodies. Since these compounds are similar in chemical structure to serotonin, which is one of the neurotransmitters in the brain, it is considered that they may act on serotonin receptors involved in vision in the central nervous system and cause hallucinations and mental confusion.

Magic mushrooms are dispersed in some genera of agaric mushrooms (Agaricales), such as *Conocybe* (spore print rusty brown), *Inocybe* (spore print brown), *Gymnopilus* (spore print rusty orange to bright rusty brown), *Pluteus* (spore print salmon to brownish rose), *Panaeolus* (spore print dark brown to black), and *Psilocybe* (spore print purplish brown to purplish grey), many of which belong to *Panaeolus* and *Psilocybe*, particularly those with fruiting bodies bluing on injury or in age as in this species. Among blue-staining members of *Panaeolus,* the bluing reaction in most parts (cap, stipe, flesh) of fruiting body, the cap initially brown then fading to greyish to whitish as it dries, and the stipe tinged with pale brown to pinkish to the base are characteristic.

## ***Paxillus involutus* (Batsch) Fr. (s. lato)**

(Naked Brimcap, Poison Paxillus, Brown Roll-Rim)


PC: Sabitra Pradhan
Local name: No local name known

### *Medical Symptoms and Onset*

Gastrointestinal disorders, such as abdominal pain and vomiting appear within 2 to 3 hours after ingestion, and in severe cases, haemolysis inducing jaundice, oliguria, and kidney pain occurs and this may lead eventually to death. *P. involutus* also contains muscarine in addition to the causal agent of the *Paxillus* syndrome described above. Nervous system disorders may occur as in the case of *Inocybe* species.

### *Fruiting*

Solitary to gregarious, under broadleaved (*Betula, Alnus, and Quercus,* etc.) or conifer (*Pinus, Picea*) trees, in forests and parks. Summer to fall.

### *Main Macromorphological Characters*

**Pileus** 4-15 cm across, initially convex, becoming plane to shallowly depressed or funnel shaped when old, margin with short to comparatively long, ridged striations, strongly in-rolled at first, remaining so until late, finally reflexed, surface downy, becoming smooth, dry, sticky when wet, yellowish brown to reddish brown or olive brown, with darker, often reddish-toned stains where damaged or when old. **Flesh** thick and soft, pale yellow, quickly changing to brown to reddish brown when cut, taste acidic, odour pleasant to indistinctive.

**Gills** decurrent, easily separable from the flesh of the pileus, close, rather narrow, forked and anastomosing on the stipe, pale yellow at first, later becoming yellow ochre or olive yellow, bruising brown to reddish brown.

**Stipe** 2-8 cm tall, up to 2 cm thick, usually shorter than the pileus diameter, equal to slightly tapering towards the base, stout or narrow, solid, surface dry, smooth or with fine hairs, coloured like the cap or paler, bruising brownish to reddish brown.

**Spore print** brown to reddish brown.

### *Comments*

*Paxilus involutus* is a dangerously poisonous species. It had been considered edible and eaten widely, particularly in Eastern and Central Europe, but was more recently found to cause potentially fatal autoimmune haemolysis, even in those who had consumed the mushroom for years without any ill effects. The causal agent of the Paxillus syndrome is still unidentified but regarding the poisoning mechanism, it is said that an antigen in the fruiting bodies triggers the immune system to attack red blood cells.

*Paxillus* (s.l.) was characterized by forming brown clitocyboid fruiting bodies, yellowish then tinted brown, decurrent gills, and brown spores. Recently, the saprotrophic members, such as *P. panuoides* and *P. atrotomentosus* have been transferred to the related genus *Tapinella* (as *T. panuoides* and *T. atrotomentosa,* respectively) and other ectomycorrhizal members, such as *P. involutus* and *P. rubicundulus* are retained in *Paxillus* s.str. Most of former *Paxillus* species are poisonous or suspected and as such they should not be recommended as edible.

### *Protostropharia semiglobata (Batsch) Redhead, Moncalvo & Vilgalys*

= *Stropharia semiglobata* (Batsch) Quél., =*Stropharia stercoraria* (Schumach.) Quél. (Manure Roundhead, Dung Roundhead)

PC: Sabitra Pradhan & Kazuo Watanabe (circled)

Local name: No local name known

#### *Medical Symptoms and Onset*

There is no recent report on the toxicity of *Protostropharia semiglobata* but hallucinogenic poisoning with this species is suspected. See page 80 (*Panaeolus cyanescens*) and page 74-75 (*Gymnopilus junonius*) for symptoms induced by hallucinogenic mushrooms.

#### *Fruiting*

Solitary or in small groups, on old dung of cow, horse or other herbivorous animals, on manured soil or fertilized grass, in pastures, parks, or forests. Spring to fall, particularly after the rains.

***Main Macromorphological Characters***

**Pileus** 1-4 cm across, obtuse to hemispherical or broadly convex, rarely umbonate, surface smooth, dry, strongly glutinous when moist, light yellow initially, fading to dull yellow to straw yellow in maturity. **Flesh** thick at the disc, thin at the margin, soft, watery, cream yellow and unchanging on exposure, taste and odour like cucumber.

**Gills** adnate to the stipe with a slight decurrent tooth, distant, broad, often somewhat ventricose,–initially greyish, becoming purplish brown to dark purple as spores mature, edges finely fringed and white.

**Stipe** slender (3.0-8.0 cm long and 2.0-5.0 mm thick), with a bulbous base, initially stuffed with a cottony pith then narrowly hollow, annulate with a narrow, membranous ring above the middle (superior), ring delicate, attached upwards, relatively evanescent, white at first then darkening from fallen spores, viscid below the ring, slightly fibrillose above it, whitish to yellowish. covered with fine silk-like hairs. The tissue of the stipe is white with a yellowish pith.

**Spore print** purplish brown.

***Comments***

This small to comparatively small, coprophilous species is characterized by the hemispherical, umbonate or not, smooth, viscid-slimy cap coloured straw yellow to buffish tan, the greyish then dark violet-grey, marbled gills, and the sticky (below ring or ring zone), slender stipe with a narrow, fugacious, fibrillose-membranous ring.

Although its toxicity is uncertain, *P. semiglobata* is included here because this coprophilous species is common in Bhutan and morphologically similar to some hallucinogenic species in *Psilocybe* (*P. liniformis, P. fimetaria,* etc. with blue-staining fruiting bodies when bruised and a non-slimy stipe when wet), *Panaeolus* (*P. cyanescens, P. semiobatus, P. campanulatus* s.l., etc. with a non-slimy stipe), and in *Deconica* (*D. moelleri, D. merdicola,* etc. with a non-slimy stipe and minute veil remnants scattering the cap surface at least when young), all growing on old dung of herbivorous animals and bearing dark purplish brown to dark grey, almost blackish spore prints.

***Boletus calopus* Fr.**

= *Caloboletus calopus* (Pers.) Vizzini

(Bitter Beech Bolete, Scarlet-stemmed Bolete)

PC: Sabitra Pradhan

Local name: Phap shamong

### *Medical Symptoms and Onset*

Poisoning symptoms, such as abdominal pain and diarrhoea appear within 30 minutes to 1 hour after eating, and in severe cases, dehydration, acidosis, convulsions, and shock occur. Since this species is said to contain muscarines, symptoms of muscarines poisoning may also occur. Refer to symptoms of *Clitocybe* cf. *phyllophila* (page 44-45).

### *Fruiting*

Solitary to gregarious, on the ground in coniferous forests, particularly with *Abies* and *Picea,* or less often broadleaved forests with Fagaceae trees, usually found at higher elevations. Summer to fall.

### *Main Macromorphological Characters*

**Pileus** 5-15 cm across, sub-globose when young, later expanding to convex to plane, margin incurved and in-rolled when young, with a narrow band of sterile tissue, surface dry, somewhat velvety, becoming nearly smooth at maturity, often cracking minutely in dry weather, greyish buff to olive buff, olive brown, or greyish brown. **Flesh** very thick, pale yellow or whitish, quickly changing to blue when exposed, taste distinctly bitter.

**Hymenophore** tubulose, initially pale yellow then slowly turning olive yellow to brownish yellow at maturity, quickly bluing when injured, adnate at first then deeply depressed around the stipe; tubes up to 2 cm deep, pores minute, subcircular, concolourous with the tubes.

**Stipe** 7-15 cm tall and 2-4 cm thick, either fairly equal in width throughout or thicker towards the base, solid, surface yellow apically, carmine red to nearly scarlet below, occasionally reddish throughout, often reddish brown towards the base, staining blue when handled or bruised, conspicuously reticulate with fine meshes at least over the upper portion or sometimes nearly overall, reticulation whitish at first then concolourous with the ground colour.

**Spore print** olive to olive-brown.

### *Comments*

This medium-to large-sized bolete would be distinguishable from other similarly coloured species in the following combination of features: the pale greyish brown or pale olivaceous brown, velvety, at times cracked cap, the bitter taste, the bruising blue reaction in the flesh and tubes, and the beautifully red-coloured stipe which is conspicuously reticulated at least over the upper portion. It may be comparable with *B. rubripes.* Currently this species is moved to the new genus *Caloboletus* from *Boletus* (s.l.) based on molecular data.

***Boletus* cf. *generosus* Har. Takah.**

PC: Eduardo Alvarado (top) & Sabitra Pradhan (bottom)
Local name: Phab Shamong

### *Medical Symptoms and Onset*

Nausea, vomiting, and diarrhoea are general symptoms and sometimes stomach cramps or abdominal pain occurs. Symptoms usually appear within 30 minutes to 2 hours after ingestion. In more severe reactions there may be muscle cramps and some type of circulatory disturbance. Recovery is usually complete and occurs 1 to 2 days after ingestion.

### *Fruiting*

Solitary to gregarious, on the ground in mixed broadleaved and coniferous forests. Summer to fall.

### *Main Macromorphological Characters*

**Pileus** 6-13 cm across, convex to broadly convex, margin narrowly sterile, surface viscid to sub- glutinous when wet, glabrous, smooth, at times rimose-areolate when grown in dry at first evenly coloured deep red to brownish red or somewhat paler toward the yellowish margin, when old becoming darker, often with blackish stains where injured, immediately changing to blue where bruised.

**Tubes** 5-15 mm deep, depressed around the stipe, yellow, quickly changing to blue then slowly fading to brownish when cut, pores minute, subcircular, brownish red to deep red, quickly changing to blue then slowly becoming bluish grey when bruised.

**Stipe** 50-90 mm tall, 10-30 mm thick at the apex, sub-equal or somewhat thickened toward the base, solid; surface dry, more or less similarly coloured as in the cap with a yellowish background colour, densely dotted to fine scabrous, upper portion covered with a fine reticulum concolourous with the stipe surface, quickly staining dark blue when touched.

**Flesh** firm, thick, light yellow, stained red around wormholes, staining dark blue instantly when bruised or injured, taste mild and odour indistinctive.

**Spore print** olive brown.

### *Comments*

This large bolete is attractive in the red colour of the entire fruiting body. In addition, it is characterized by its viscid to sub-glutinous cap surface (when wet), a fine reticulum at the upper stipe, and quick bluing discolouration in all parts of the fruiting body when injured. There are some similarly coloured, blue-staining boletes around *B. generosus*. These would be suspected to cause gastrointestinal disorders when ingested. Therefore, they should be avoided collecting for the table.

***Turbinellus floccosus* (Schwein.) Earle ex Giachini & Castellano**

= *Gomphus floccosus* (Schwein.) Singer

(Scaly Chanterelle, Scaly Vase Chanterelle)

PC: Sabitra Pradhan & Eiji Nagasawa (inserted above)

Local name: Ting Shamong

### *Medical Symptoms and Onset*

Gastrointestinal upset, including nausea, vomiting, and diarrhoea. Symptoms usually occur within 30 minutes to 2 hours, but sometimes many hours after ingestion. Norcaperatic acid is known as a toxic component of this species.

### *Fruiting*

Scattered or clustered, at times in troops, on the ground in coniferous forests. Summer to fall.

***Main Macromorphological Characters***

**Fruiting bodies** usually 8-15 high when mature, rarely up to 20 cm or more, initially cylindrical and depressed at the apex, later becoming funnel- to trumpet-shaped, with a perforated centre reaching almost to the base when mature, fibrous-fleshy.

**Pileus** 6-15 cm across, surface floccose (downy-woolly), breaking up into small scales with age, dry, sub-gelatinous when moist, deep reddish orange to orange, or yellowish at times, when older or grown in dry weather becoming dull in the colours and fading to greyish orange to brownish yellow.

**Gills** not true ones and consisting of blunt ridges and wrinkles which are long decurrent to the stipe and often forking or anastomosing, yellowish to cream, becoming pale buff with age.

**Stipe** short or comparatively short (mostly less than 10 cm long), single or sometimes grown together at the base, not sharply distinct from the pileus, cylindrical (1-2 cm wide) with an expanded apex, solid when very young, soon hollow, surface smooth.

**Flesh** white, **odou**r mild, **taste** indistinctive or slightly sour.

**Spore print** ochraceous.

***Comments***

When fresh and younger, this species can be easily recognizable in the field due to the trumpet- or funnel-like form, the reddish orange to orange coloured cap with floccose scales, and the pale yellowish to buffish hymenial surface consisting of fold-like blunt ridges which are often anastomosing and long-decurrent to the stipe. However, the bright colour of the cap quickly fades away with age, hence old fruiting bodies may look like those of another species.

There are different opinions about the edibility of this species. Although some people consider *T. floccosus* as edible, others have reported gastric discomfort after eating it thus it is better to avoid using the species for food.

***Turbinellus* cf. *kauffmanii* (A.H. Sm.) Giachini**

= *Gomphus kauffmanii* (A.H. Sm.) Corner

PC: Kazuo Watanabe (Top) & Shuhei Kaneko (bottom)

Local name: Ting Shamong

### *Medical Symptoms and Onset*

This species contains norcaperatic acid as a toxic component and causes gastrointestinal symptoms as in *T. floccosus*: vomiting, diarrhoea, abdominal pain, etc. Onset within 30 minutes to 2 hours.

### *Fruiting*

Solitary or gregarious, less frequently clustered, at times forming a fairy ring, in coniferous forests. Summer to fall.

### *Main Macromorphological Characters*

**Fruiting bodies** usually 8-15 cm high when mature, rarely up to up to 30 cm, initially cylindrical and depressed at the apex, later becoming funnel- to trumpet-shaped, with a conspicuously scaly pileus and a perforated centre reaching almost to the base when mature.

**Pileus** usually 5-15 cm across or rarely more, fibrous-fleshy, surface dry, not viscid when moist, coarsely and more or less concentrically scaly, scales buff, tan to cinnamon brown, somewhat darker at the recurved tips, thick, rather large, especially towards the centre and often obscuring the deep central cavity.

**Gills** not true ones and consisting of low blunt ridges and wrinkles which are long decurrent to the stipe and often forking or anastomosing, at times sub-poroid, whitish to cream, becoming pale buff to tan with age, sometimes bruising dull reddish brown to violet brown.

**Flesh** white, **odour** mild or aromatic**, taste** mild or slightly acrid.

**Spore print** ochraceous.

### *Comments*

*T. kauffmanii* is similar to *T. floccosus* but in its typical form would be recognized by the lack of reddish to orangish hues in the cap, more abundant and coarser, recurved scales, and more substantial stocky appearance. It may be found less often than *T. floccosus. T. fujisanensis,* known from Japan is also similar to *T. kauffmanii,* particularly in its colour, but the Japanese species is smaller in size and has thin, smaller scales on the cap.

***Ramaria formosa* (Pers.) Quél. (s. lato)**

(Yellow-Tipped Coral)

PC: Dorji

Local name: Bjichu Kangru

***Medical Symptoms and Onset***

Vomiting, diarrhoea, abdominal pain, etc. occur within about 3 hours then occasionally followed by symptoms, such as dehydration, acidosis, convulsions and shock.

### *Fruiting*

Solitary or gregarious, in broadleaved and coniferous forests or mixed forests. Summer to fall.

### *Main Macromorphological Characters*

**Fruiting bodies** 7-20 cm high, 3-15 cm wide, coral-like, repeatedly branched 3-4 times from a common stipe-like base, branches erect, crowded, rounded or at times more or less compressed, repeatedly branched, smooth or wrinkled, coral pink to pale salmon, fading to brownish in age, tips tinted yellow when fresh.

**Stipe** fleshy, tapering downwards, white at the base, otherwise coloured like the branches or paler.

**Flesh** whitish, coloured like the branches in age, fibrous to brittle, not gelatinous, odour not distinctive, taste mild to bitter or astringent.

**Spore print** pale brownish yellow.

### *Comments*

In Bhutan *R. formosa* is a species complex consisting of several closely related species; hence here it is treated in a broad sense and is characterized macroscopically by its fruiting body with the following characters: salmon pinkish to reddish orange, slender, relatively thick to thin branches forked moderately and repeatedly from a thick, relatively small base, the non-gelatinous, more or less brittle flesh, the tips of terminal branches coloured yellow, the surface and the flesh not changing in colour when bruised or injured, and the mild to somewhat bitter taste.

Coral fungi (*Ramaria spp.*) include not only excellent edible species, such as *R. botrytis* and *R. violaceibrunnea* var. *asiatica* but also many other species that appear to be poisonous. Ramaria fungi which are coloured red to yellow are often said to be poisonous, causing gastrointestinal disorders. Therefore, those should be avoided although people in Bhutan claim all *Ramaria* species as edible.

# Emergency measures for mushroom poisoning

The initial symptoms of mushroom poisoning generally include a heavy stomach, stomach discomfort or bloating, and stomach rumbling, which then develop into nausea, abdominal pain, weakness, chills, abnormal pulse, and lowered body temperature.

In any case, although the time between mushroom ingestion and onset of these symptoms varies from individual to individual, if you experience any of these symptoms and you suspect that the mushroom-containing food that you ate might be the cause, you, and anyone else who ate the same food, should immediately take the emergency measures below. The first priority should be to transport the patient(s) to a hospital that is equipped to perform gastric lavage. The following emergency measures should be carried out at the same time.

1. Have the patient drink 5 or 6 cups of lukewarm water and induce vomiting by inserting a finger in their throat. The quicker and the greater the volume of stomach contents vomited, the better the prognosis and recovery will be.

2. Pulverize charcoal and have the patient drink the powdered charcoal along with water. Store-bought activated charcoal of the type used for refrigerator odour control or charcoal used for charcoal grills or for camping can also be used. The powdered charcoal will absorb some of the toxin in the stomach and reduce its uptake by the stomach and intestines.

3. To encourage urination, have the patient drink large quantities of green tea thinned with warm water such as dokudami tea, Japanese herbal detox tea, or watermelon or grapefruit juice.

4. Perform an enema, have the patient take a laxative, or otherwise encourage the elimination of toxins from the body. If castor oil is available, have the patient drink one tablespoon of castor oil mixed

with a small amount of milk, or another option is to have the patient drink two tablespoons of olive oil together with an egg yolk and milk. To eliminate the toxins as quickly as possible, the patient should not be given any painkillers to reduce abdominal pain or anti-diarrhoeal agents.

5. If the patient experiences excessive vomiting or diarrhoea, the patient should be given an electrolyte solution (typically sold as a sports drink) to replace the water and electrolytes that are lost.

6. As much as possible, the patient's body temperature should be maintained at a constant temperature. In particular, be careful that the abdominal area does not become too cold.

7. Thoughts such as "it will eventually get better" or "I'm embarrassed to go to the doctor" and the idea that the patient can treat him- or herself are patently absurd. When no parts of the poisonous mushroom remain in the stomach, laxatives or vomiting will not have any effect. Professional treatment is needed, and the patient must be examined by a doctor as soon as possible.

8. At the medical exam, any remnants of the mushrooms used in the food (or uncooked remnants) must be shown to the doctor. In addition, all relevant information should be provided to the doctor, including when and how much was ingested, when symptoms started to appear, and the number of times the patient vomited or experienced diarrhoea.

### Treatment at a medical facility

In the case of mushroom poisoning involving any of the deadly poisonous mushrooms described at the beginning of this book (pages 16 to 95), prompt and appropriate medical treatment in the initial stages is essential. That said, it is uncertain whether medical facilities are equipped to provide such treatment. Few doctors have specialized knowledge of mushroom poisoning or clinical experience dealing with mushroom poisoning, and, of course, there are no mushroom poisoning specialists in Bhutan. At the risk of repeating what has been stated before, when receiving medical treatment

for mushroom poisoning, it is important to explain the circumstances in as much detail as possible to the EMTs and attending doctors and, if possible, to actually show the mushrooms that were eaten to the doctor.

The medical providers, on their part, must perform gastric lavage as soon as possible and, if it appears that the patient's condition is or will become serious, must be able to decide promptly to transfer the patient to a facility where more advanced treatment can be provided.

The majority of mushroom poisoning cases in Bhutan and elsewhere involve cytotoxins, which cause severe damage to the liver or kidney cells and result in symptoms similar to those of fulminant hepatitis. When a large portion of liver cells undergoes necrosis without concomitant regeneration, death can occur. The most important treatments for preventing the onset of fulminant hepatitis are the initial treatments and include gastric and small intestinal lavage and bile removal, which require quick and appropriate decision-making by the doctor. In addition, given that treatment, no matter how prompt, is ineffective if the patient arrives too late at a medical facility, the entire emergency medical system must be set up to handle such emergencies.

The flow charts that follow are a guideline for treating mushroom poisoning.

Flow Chart 1: Guidelines for the treatment of mushroom poisoning based on clinical symptoms

| | | | | |
|---|---|---|---|---|
| 1. Occurrence of mushroom poisoning | | | | |
| 2. Confirm time between ingestion and onset of poisoning symptoms | | | | |
| 3. State of health at the time of ingestion (alcohol/no alcohol consumption, fatigued)<br>Check medical history and history of current illnesses | | | | |
| 4. Assess severity of the following symptoms (severe / moderate/ mild) | | | | |
| 5. Clinical findings | | | | |
| Subjective symptoms (number of episodes) | Gastrointestinal symptoms | Neurologic symptoms | Circulatory and respiratory symptoms | General symptoms (including gastrointestinal symptoms) |
| | Vomiting Vomiting blood Abdominal pain Diarrhea (watery) Bloody bowel discharge Dry mouth Hypersalivation | Headache Visual hallucinations Vision impairment Delusions Gait disorder (gait ataxia) Erythromelalgia | Tachycardia Bradycardia Palpitations Arrhythmia Asthmatic response Intoxication symptoms | Nausea and chills Dizziness Weakness Fever Purpura (ecchymosis) Skin rash Chest pain Perspiration |

| | | | | |
|---|---|---|---|---|
| Objective findings | Blumberg's sign (pain when pressure is rapidly released after abdominal wall is compressed slowly) | Mydriasis Myosis Light reaction Clouding of consciousness Generalized convulsion | Jugular vein distention | Hypotension Hypoglycemia Jaundice Coma |
| | Gastrointestinal system disorder group | Nervous system disorder group Erythromelalgia group | Intoxication symptoms group Nervous system disorder group | Necrosis of liver and kidney cells group |
| In parallel with providing treatments (see Flow Chart 2) and performing laboratory tests | | | | |
| 6. Investigate mushrooms that were ingested | • Amount of mushrooms ingested (number of mushrooms, ingestion by other friends or family members)<br>• Cooking method (raw, grilled, stewed, broth, pickled in salt, dried)<br>• Morphological characteristics (appearance) of the mushrooms ingested (cap, stem, and gill color, presence/absence of cap warts or scales, presence/absence of annulus, cap size and shape, stem length and thickness, taste, smell, etc.)<br>• Ask about the amount and environment where the mushrooms were found (were multiple mushrooms present?, in tree, soil, compost, rotting tree, dead tree, etc.) | | | |

Flow Chart 2: Manual for initial treatment

| | | |
|---|---|---|
| 1. Oral and nasal cavity cleaning | Given the possibility that toxins may continue to be absorbed from food remnants or vomitus remaining in the mouth, a thorough cleaning of the mouth with copious water and soap followed by drying should be considered. | |
| 2. Emesis | 2.1 The first step in treatment is to induce vomiting, which is generally believed to remove around 30% of the toxic substance, with the applicable time frame being within 4 hours of ingestion. However, emesis is contraindicated if the patient is in a coma, experiencing convulsions, or in shock, or if an antiemetic has been administered to the patient. | |
| | 2.2 Insert a finger into the patient's pharynx and induce vomiting | |
| | 2.3 After having the patient drink an appropriate amount of water | Have the patient take ipecac syrup: 15 mL for children between 2 and 5 years of age; 30 mL for individuals 5 years and older). |
| | 2.4 During this time, adjust the patient's temperature so that it is in the normal range (35 to 40°C) | Apomorphine injected intramuscularly or subcutaneously (as this medicine affects the central nervous system, administration of large doses is not recommended) |
| | 2.5 During this time, shake the patient's body, changing the patient's posture so that the entire gastric wall is stimulated. | Vomiting is typically induced in approximately 5 minutes. |
| | 2.6 If the patient does not vomit within 20 minutes, have the patient drink the same amount of ipecac syrup as before and wait another 20 minutes. | |
| 3. Gastric lavage | For subsequent treatment, taking water metabolism into consideration, carefully perform transfusion to prevent acidosis and perform electrolyte and acid-base correction to maintain normal kidney function (80%). Remove stomach contents by suction, while keeping a portion for analysis. | |

| | |
|---|---|
| | Warm 250 to 300 mL of water or 125 to 300 mL of physiological saline to 30°C. Inject into patient's stomach and remove by suctioning. |
| | Repeat until the liquid that is suctioned becomes clear. |
| 4. Absorbent | Administer 100 g or more of activated carbon into the patient's stomach (have the patient drink |
| 5. Bowel evacuation/ colonic irrigation | 5.1 Administration of an irritant cathartic (Laxoberon solution) |
| | 5.2 Dissolve 30 g of magnesium sulfate in 1 cup of water. Alternatively, use 250 mL of 60% sorbitol. Carefully measure the infusion volume and excretion rate to ensure that the electrolyte balance in body fluids is maintained and measure the central venous pressure. |
| | 5.3 Slowly inject 1000 to 1500 mL of the electrolyte solution (over approximately 30 minutes). However, there must be no residual effect of the emetic. |
| 6. Forced diuresis | In the case of deadly toxins such as amanita toxin and gyromitrin, which cause liver and kidney damage, a diuretic or Ringer's lactate solution is administered to achieve an excretion rate of 500 mL/hour for adults with the aim of reducing toxin concentrations in the liver and kidney. The central venous pressure must be monitored during this treatment. |

# Awareness on mushroom poisoning in Bhutan

Mushroom poisoning is caused by the consumption of raw or cooked fruiting bodies of a number of species of higher fungi. There are generally no easily recognizable differences between poisonous and non poisonous species. There is no general rule of thumb for distinguishing edible mushrooms and poisonous toadstools. The toxins involved in mushroom poisoning are produced naturally by the fungi themselves, and each individual specimen of a toxic species should be considered equally poisonous. Most mushrooms that cause human poisoning cannot be made nontoxic by cooking, canning, drying, freezing, or any other means of processing. Some mushrooms normally edible can cause poisoning when not cooked properly due to the presence of thermolabile toxins which get destroyed by cooking. Thus, the only way to avoid poisoning is to avoid consumption of the toxic species.

The National Mushroom Centre under the Department of Agriculture has been creating awareness on mushroom poisoning and advising to collect those mushrooms which are regularly consumed and are familiar with and avoid look alike and new ones while collecting them. Mushroom poisonings very often occur when hunters of wild mushrooms (especially novices) misidentify and consume a toxic species and when recent migrants to new areas collect and consume a poisonous mushroom species that closely resembles an edible wild mushroom from their native land. Another concern is the urban collectors or young children who might not have adequate knowledge about mushrooms.

The mushrooms collected are either being consumed at home or sold in the market or at the roadside. As a result, if by chance poisonous mushrooms looking like the edible ones are collected with the edible ones and sold, it will be a huge risk to the consumers since a very small portion of the poisonous mushroom can be lethal.

The National Mushroom Centre (NMC) has been inspecting wild mushrooms sold in the vegetable market and along the highway regularly during the mushroom season to check for toxic and poisonous mushrooms. NMC has been conducting training to mushroom collectors to help identify the mushrooms, both edible and poisonous ones. As part of our campaign to educate the consumers on the mushrooms and the possible dangers associated awareness creation on mushrooms were conducted during Agriculture expo, Mushroom Festivals, Mountain and Nomad Festivals, World Rangers' Day, World Food Day, etc. Awareness has also been promoted through announcements in the media (newspaper, National Television, Radio). NMC also developed posters on mushrooms of Bhutan, which highlights on the various levels of risks associated with different types of poisonous mushrooms besides the edible ones. Posters, books, pamphlets and calendars were distributed to Policy makers, heads of government and Departments, Agriculture and Forestry Extension Agents, Hospitals and BHU, schools, and Gewogs for information to the public.

The NMC has been trying to bring awareness the collectors and consumers in both rural and urban population on the risk of collecting poisonous mushrooms, selling them to most innocent and ignorant consumers thus risking their life, which could be prevented through such actions as public education and awareness. As the country is progressing increasingly wild mushrooms are sold by retailers who are not actual collectors and have no idea about their edibility.

Another word of caution; Mushrooms absorb many or any substance from the substrate. If the area where the mushroom grows has been sprayed with pesticides or other chemicals even edible mushrooms can become poisonous. Industrial dumping areas are another danger zone. Even cultivated mushrooms can be dangerous if they are grown on contaminated substrate. Heavy metal contamination is quite possible in mushrooms.

Awareness campaign during mushroom festivals

Awareness to highland collectors

# The case study of Mushroom Poisoning in Bhutan

Mushroom poisoning is an incident occurring by ingesting poisonous mushrooms which have been misidentified as a harmless or edible species. Mushroom poisoning is caused due to the presence of toxins (mycotoxins) in mushrooms. Many mushrooms are a good source of food; however, some are dangerously poisonous. Therefore, proper identification of mushrooms is imperative, especially before consumption.

Every year, worldwide, many amateur mushroom collectors have poisoned themselves or their innocent family members. This is often seen where seasonal mushroom hunting is traditional such as in many European and Asian countries. From the time unknown, Bhutan is one such country where wild mushroom hunting and consumption developed as a popular tradition. In the past, before the rural urban migration started along with the development activities there were fewer mushroom poisoning cases reported in Bhutan. It has been speculated that one reason for this may be due to the traditional knowledge that the rural communities had and their robust understanding of the forest and mushrooms. With the fast pace of development in the country, migration from one part of the country to another is increasing, introducing the citizens to new habitats with unfamiliar environments and mushroom species. Another reason for an increased occurrence of poisonings may be due to the city dwellers venturing into mushroom foraging without any traditional knowledge on mushrooms and their edibility. One other reason for frequent mushroom poisoning cases in Bhutan is the strong belief by some people in myths that are believed to make any mushroom safe to eat. Examples of these myths include the belief that the addition of *Zanthoxylum piperitum* (Thingay) while cooking and/or that giving a name to any type of mushroom will render it harmless.

In the last few years less cases of mushroom poisoning in Bhutan have been observed. This could be related to an increased awareness of mushroom poisoning, mainly due to the education and information provided by the National Mushroom Centre. Many affected individuals are now seeking

medical care, rather than practising traditional treatments. Table 1 shows the number of mushroom poisoning cases reported and deaths that occurred in hospitals. A decrease in both the morbidity and mortality in recent years can be seen. This validates the effectiveness of the awareness created by the agency with people becoming more cautious of eating wild mushrooms.

*Table 1 Number of cases seen and mortality recorded by Hospitals due to mushroom poisoning.*

**Type of Cases Seen in Bhutan, 2013 – 2017**

| Code# | Name of Disease | Year | | | | |
|---|---|---|---|---|---|---|
| | | 2013 | 2014 | 2015 | 2016 | 2017 |
| Injury, Poisoning and certain other consequences of External Causes | | | | | | |
| T65 | Mushroom Poisoning (Toxic effect of other unspecified substances) | 357 | 510 | 362 | 340 | 239 |
| V01[G] | Transport Accidents | 2031 | 2344 | 2383 | 3419 | 1814 |
| W00[G] | Accidental Falls | 7908 | 8072 | 8508 | 9666 | 6730 |
| W50[G] | Other Bites and Sting (excluding dog bite) | 4227 | 4546 | 4303 | 5291 | 4134 |
| W54 | Dog Bites | 5573 | 6791 | 7099 | 7915 | 6416 |
| W65[G] | Drowning & Submersion | 41 | 156 | 74 | 99 | 126 |
| W85[G] | Exposure to Electric Current | 74 | 71 | 65 | 106 | 81 |
| X00[G] | Contact with Heat & Hot substances & exposure to smoke, fire, flames | 2786 | 2788 | 2657 | 2605 | 2291 |

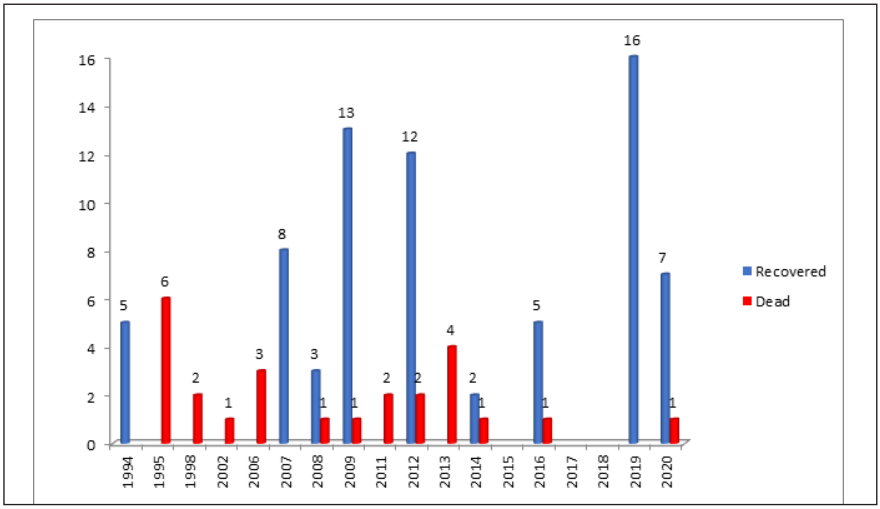
**Mortality Report from Health Facility, 2013 - 2017**

| Code# | Name of Disease | Year | | | | |
|---|---|---|---|---|---|---|
| | | 2013 | 2014 | 2015 | 2016 | 2017 |
| Injury, Poisoning and certain other co\nsequences of External Causes | | | | | | |
| T65 | Mushroom Poisoning (Toxic effect of other unspecified substances) | 6 | 3 | 2 | 4 | 0 |
| V01[G] | Transport Accidents | 8 | 14 | 9 | 20 | 16 |
| W00[G] | Accidental Falls | 10 | 7 | 9 | 14 | 14 |
| W50[G] | Other Bites and Sting (excluding dog bite) | 0 | 0 | 1 | 0 | 0 |
| W54 | Dog Bites | 0 | 0 | 0 | 1 | 4 |
| W65[G] | Drowning & Submersion | 0 | 2 | 2 | 1 | 1 |
| W85[G] | Exposure to Electric Current | 0 | 0 | 1 | 2 | 0 |
| X00[G] | Contact with Heat & Hot substances & exposure to smoke, fire, flames | 0 | 3 | 3 | 1 | 6 |

Source: Annual Health Bulletin 2018@ Ministry of Health

Although mushroom poisoning cases were said to have occurred in the past, these were not brought into the limelight due to limited media. Kuensel (one of the first newspapers) reported the first mushroom poisoning case in Bhutan in 1994, in Thimphu. Since then, the media houses have tried to capture mushroom poisoning cases (Figure 1 and Table 2). This may however be under- represented as there may have been other incidents which were miss-diagnosed as other gastrointestinal illness or were simply not reported by the media.

Figure 1 shows the mushroom poisoning cases from 1994 to 2020 with the highest number of recorded cases in 2019 followed by 2009. From 2011 there was a decrease in mushroom poisoning instances with no reported cases in 2015, 2017 or 2018 but in 2019; 16 people were poisoned in just one incident. This may suggest that people are becoming more aware of the risk of consuming unsafe wild mushrooms.



Mushroom poisoning cases in Bhutan

Table 1 shows that *Amanita* species are the most common mushrooms that have caused mushroom poisonings in Bhutan; this may be because there are some excellent edible mushrooms in this group such as *Amanita hemibapha* as well as deadly poisonous species such as *Amanita phalloides*.

*Table 1: Cases of mushroom poisoning in detail*

| Year | Place of incident accrued | Dead | Recovered | Suspected mushroom | Reported By (Source) |
|---|---|---|---|---|---|
| 1994 | Semtokha, Thimphu | | 5 | | Kuensel 6 August 1994 (Article1) |
| 1995 | Toktseri village under Dungmin gewog, and Mikuri Pemagatshel | 6 | 5 | | Kuensel 13 May 1995 (Article 2) |
| 1998 | Kidakom, Thimphu | 2 | | | Kuensel 2 August 1998 (Article 3) |
| 2002 | Membi gewog, Lhuntse | 1 | | | Kuensel 2002 (Article 4) |
| 2006 | Samtse | 3 | | | Kuensel May 2006 (Article 5) |
| 2007 | Monggar | | 8 | | Bhutan Observer 27 July 2007 (Article 6) |
| 2008 | Dagana | 1 | 3 | *Amanita* sp. | BBS news and report by LB Tamang (Article 7) |
| 2009 | Thimphu | | 3 | *Hygrophoropsis aurantiaca* | Kuensel August 31, 2009 (Article 8) |
| | Samtse | 2 | | | |
| | Mongar | 1 | 2 | | |
| | Denchi village, Pemagathsel | | 6 | | Bhutan observer August 2009 (Article 9) |
| 2010 | | 3 | | | Kuensel May 21, 2013 (Article 10) |
| 2011 | | 2 | | | |

| | | | | | |
|---|---|---|---|---|---|
| 2012 | Dagapela, Dagana | 2 | | | Kuensel July 9, 2012 (Article 11) |
| | Drujeygang, Dagana | 1 | | | BBS news July 8, 2012 (Article 12) |
| | Trongsa | | 12 | *Amanita* sp. | Kuensel June 18, 2012 (Annexure 13) |
| 2013 | Samtse | 4 | | *Amanita* sp. | Kuensel 23 May 2013, BBS news, Report by Ugyen Tshering (ICS) and Report by L. B. Tamang, NMC (Article 14) |
| 2014 | Samtse | | 2 | *Chlorophyllum molybdites* | Reported by L.B.Tamang NMC ( Article 15) |
| | Tsirang | 1 | | *Amanita* sp. | Report by Sabitra Pradhan NMC (Article 16) |
| 2016 | Samdropjongkhar | 1 | | *Hypholoma fasciculare* (Sulphur Tuft) | Kuensel April 21(Article 17) |
| | Tsulana, Thimphu | | 5 | *Boletus* sp. | Kuensel July 21 (Article 18) |
| 2017-2018 | No mushroom poisoning cases reported in 2017 & 2018 | | | | |
| 2019 | Pachhu, Phuntsholing gewog, Chhukha | | 16 | *Chlorophyllum molybdites* | Report by Sabitra Pradhan and Dawa Penjor NMC (Article 19) |
| 2020 | Upper bokray, Tsirang | 1 | 2 | *Aminita* sp. | Report by Sabitra Pradhan and Dawa Penjor NMC (Article 20) |
| | Salimji, Dagana | | 5 | *Panaeolus cyanescens* | |

# Mushroom poisoning articles from 1994 to 2020*

## Articles 1

**Articles 1**

### Poisonous mushroom

**Five men were admitted at the hospital this week for an uncomfortable high they experienced after consuming a wild mushroom picked from the forest.** 6 August 1994.

In the first incident, three of the men picked and ate the mushrooms with lunch while cutting firewood in the forest. All of them were knocked out of their senses and made it to the hospital late at night. They recovered completely the next morning.

"I felt giddy like I was drunk and vomited. My hands and legs were paralysed for the next few hours," said one of the men, Tshering Sherpa.

Earlier, two other men were admitted on Sunday in the same circumstances. They also complained of nausea and giddiness.

All the men admitted to having eaten the mushroom for the first time.

According to their description, the mushroom is shaped like an umbrella with a black top spotted with white dots and a white under-surface.

The project manager of the Mushroom Farm in Simtokha, Dorji Wangchuk, said that the mushroom, judging from description, could belong to the poisonous Amanita species. The exact identification, he said, was difficult to make without seeing it.

Dorji Wangchuk cautions against eating unknown mushrooms as of 557 types identified in the country so far, only 250 are edible.

Source: Kuensel 6 August 1994

## Articles 2

### Poisoned

Six members of a family in the Mikuri Tockchidorang village in Pemagatsel died after eating poisonous mushrooms on May 4. May 13.

According to reports from Pemagatsel, the victims included a farmer, his wife, and their four children, aged between four and 12 years. Five other children of the couple are still living. 1995

Meanwhile, a joint investigation is being conducted by the dzongkhag, hospital, and police.

Source: Kuensel 13 May 1995

## Articles 3

### Two die after eating poisonous mushroom

**BELATED treatment could not save the lives of two children when a family of seven failed to seek timely medical attention after they had mistakenly eaten poisonous mushrooms last weekend.**

Of the two children, the 10-year old boy died at the national referral hospital. His two-year old sister did not even get there.

According to the Superintendent of the hospital, Dr. Gado Tshering, the family, who were from Kharibji near Gidakom, had reported to the hospital about 48 hours after they had consumed the mushrooms. By that time, the poison had passed from the stomach into the blood and to the vital organs.

The ideal time for them to have come to us would have been within three hours of the poisoning," he said. "There was nothing that could be done for the children because their livers and central nervous systems had been badly damaged."

While the grandmother and the grand-aunt of the children have been discharged from the hospital, their mother, an uncle and a 12-year old brother are currently recuperating.

Dorji Namgay, the uncle, had gathered the mushrooms, mistaking them for the popular *sese shamu*. "It was unfortunate — they looked just like the *sese*," he said. 2-8-98

The family had cooked and eaten the mushrooms for dinner on Saturday and on the following morning. It was only on the night of Sunday that the entire family began complaining of upset stomachs, pain in the chest and excessive vomitting.

"It occurred to me then that the cause could have been the mushrooms," said Dorji Namgay. He did not know that, of the 557 species of mushrooms identified in the country, only 250 are edible.

Dr. Gado Tshering warned that people should not eat any mushroom until they are certain that it is edible. Those who begin vomitting after consuming mushrooms are advised to consult a doctor immediately, ideally within three hours of ingestion.

By Kunga T. Dorji

Source: Kuensel 2 August 1998

## Articles 4

### Girl dies

A 14-year-old girl in Unmaling village in Membi Geog, Lhuntse, died after eating a poisionous wild mushroom on July 14.

The girl belonged to a family of six who had all eaten the mushroom and were admitted to the Lhuntse district hospital with symptoms of diarrhoea and vomiting.

Source: Kuensel 2002

Articles 5

# Mushroom poisoning kills three

BY KINLEY WANGMO

On May 13 farmer Bolidhan Rai, 50, in Toribari, Samtse, plucked the dark brown fleshy mushrooms with long stems sprouting from a rotting log from the nearby forest.

He was convinced that it was not poisonous. He took it home and convinced his wife and his younger brother and his wife that it could be eaten.

They ate the mushroom for dinner.

Kumari Rai, 35, the wife of the elder brother was the first to fall ill. She was not taken to the Sibsoo hospital, the nearest health center, which is about seven kilometers away. Instead a traditional healer was summoned and a religious ritual performed.

Kumari Rai died the next day at home around 10 am on May 15. The two brothers Bolidhan Rai and Bhim Kumar Rai, 36, also fell sick that day with similar symptoms of vomiting and diarrhoea.

On May 17 the two men were taken to the

CONTINUED PAGE 12

FROM PAGE 1

Sibsoo hospital by local residents in a hired taxi. They reached the hospital at around 3 pm.

"Both the men were almost unconscious," said clinical officer Sangay Dorji. "Both blood pressure and pulse had collapsed. Both of them died two hours later."

Deomaya Rai, the wife of the younger brother, who was the last to have dinner that evening, survived the mushrooms. She said that she had had a light meal.

Deomaya Rai told health officials that Bolidhan Rai had collected the mushrooms and assured the family that it was not poisonous.

The Bhiru gup, K R Ghalley, told Kuensel that two years ago a family of two in the same gewog had survived a similar mushroom poisoning incident because they received immediate medical attention.

"Mushroom poisoning is very occasional but it occurs," said the programme director of the National Mushroom Center in Semtokha, Dawa Penjor. "We have been advising people to collect those mushrooms which they regularly consume and are familiar with and avoid look alike and new ones."

Dawa Penjor said Bhutan had thousands of mushrooms of which about 100 different kinds of mushrooms are consumed in Bhutan.

He explained that different kinds of poisonous mushrooms had different symptoms. Some mushrooms had hallucinating effects while others disturbed the stomach but could be cured by vomiting and immediate medical attention. The most lethal were the ones that affect the kidney and the lungs "because once the symptoms appear, it would be too late".

Source: Kuensel May 2006

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Articles 6

A mushroom scare

**Mongar:27 July 2007** Five people who were admitted to the Mongar hospital for food poisoning after they ate a certain type of mushroom were dischared on 23 July after receiving medical attention.

The five people were admitted a day before. They had taken a mushroom curry during lunch when they were at a house helping them to perform a funeral ritual.

Aum Tashi Zangmo, who had collected the mushroom from her maize field and also cooked the curry said that the mushroom, commonly called the nuu bamung (milk mushroom), was a common species and not poisonous.

About 12 people had taken the curry during lunch including Aum Tashi Zangmo but it affected only five. Nothing happened to seven others including Aum Tashi Zangmo. About three hours after lunch, the five people started showing obvious symptoms of food poisoning. Three started vomiting while all of them had head aches and dizziness. "We immediately called for an ambulance and took them to the hospital," Aum Tashi Zangmo said.

According to Dr. Gyembo Dorji of Mongar hospital, among the five victims, the two who had not vomited were more serious than the others. He explained that the affect will be less if one vomits. He said that all the five received medical attention.

According to the records maintained by the hospital, eight people were admitted to the hospital with mushroom poisoning so far this year. While no one brought to the hospital died, a boy in Chaskar died because he was not brought to the hospital.

By Tshering Dawa

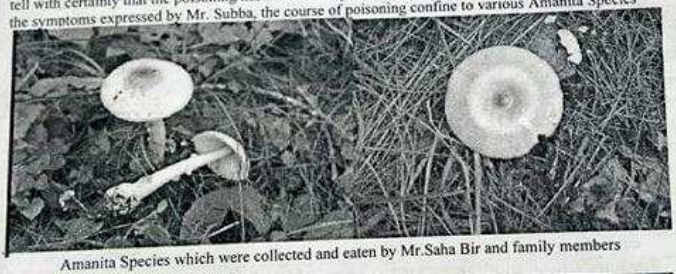
Source: Bhutan Observer 27 July 2007

Articles 7

**Report on Mushroom poisoning**

The media has broadcasted one death caused by mushroom poisoning in Tsangkha geog under Dagana Dzongkhag in last week of June 2008. On hearing from the media, traveled to Tsangkha on 3rd July 2008 and met with Mr. Saha Bir Subba on 4th July 2008 who have collected and eaten mushrooms along with other four family members on 22nd June 2008 and admitted to BHU on 23rd June at 8 PM only. They were suspected of being poisoned by mushrooms and one of his seven years old sons Amit Subba, a student of Tsangkha Community Primary School student died though the mushroom poisoning has not been proved. According to the father of the deceased, he had collected two types of mushrooms from Debreydara above Jureylung village and his children have collected other type of mushroom from their maize field. They have mixed three types of mushrooms and cooked for lunch. One of his daughters was out for compulsory labor contribution has missed the lunch and was not poisoned. Mr. Subba said that the first symptoms appeared after relatively long interval of more than twelve hours after the ingestion ( after eating mushroom curry) He told that the first symptoms of poisoning appeared as an irritation of the digestive system later with intensive vomiting and diarrhea. The abdominal pain started after repeated vomiting and diarrhea he added. All the five members were admitted in Tsangkha BHU which is more than two hours walking and later discharged after undergoing medication. Two days after, all of them were relapsed with intensive vomiting and diarrhea and admitted in BHU. But, his son, Amit was very serious as he was vomiting blood. The Tsangkha BHU has referred his son to Damphu Hospital but his son died on the way to hospital. After the death, the stomach of dead body has turned blue. The wife of Mr. Subba told that the medicine from BHU did not work and they have undergone Alay medication (Indigenous medicine prepared and practiced by Mr. Alay from Tsirand Dzongkhag)

Visited the mushroom forest where Mr. Subba have collected the mushrooms for their culinary dish and collected the samples which were Amanita species and belongs to Amanitaceae family. The mushrooms have white spores, white colored gills, a universal veil, rings on stalk and a volva in both the species. The forest coverage is mostly pine and oak. The mushrooms were plucked from under pine tree. It is difficult to tell with certainty that the poisoning has been actually caused by the above stated mushrooms. According to the symptoms expressed by Mr. Subba, the course of poisoning confine to various Amanita Species



Amanita Species which were collected and eaten by Mr.Saha Bir and family members

Source: Reported by L.B.Tamang ,National Mushroom Centre, MoAF

Articles 8

# More wild mushroom victims

## Despite lots of warnings, the season takes its toll of poisonings

Phuntsho Choden

Despite awareness messages on the dangers of eating wild mushrooms, at least three people have died and more than fifteen were hospitalised in referral and district hospitals around the country between May and August this year.

"We've been telling people and sending awareness messages to the villages through gewog centres not to pick mushrooms, which they cannot identify," said the national mushroom centre's program director, Dawa Penjor.

Three men in the thirties were treated in Thimphu referral hospital this month, after they consumed a poisonous mushroom collected from an area near Dechencholing. They told health officials that they mistook the mushroom to be the edible and local delicacy, Sisi Shamu. Six men in Pemagatshel were also treated in the district hospital after they had consumed a wild mushroom on August 21.

Pg. 2

# More wild mushroom victims

From Pg. 1

Mushroom collectors often overestimate their ability to distinguish deadly mushrooms from the edible ones, sometimes with tragic results, said officials of the mushroom centre. "Some poisonous mushrooms can be identical to non-poisonous ones," said an official. "Mushrooms should not be trifled with."

However, as the mushroom season began this year, a couple in Samtse died of mushroom poisoning in May. A 67-year-old woman also died in Mongar hospital after consuming poisonous mushrooms in June. Two people, who had consumed the mushroom with the woman, had also been hospitalised.

Seasonal rain has become more frequent, which will promote the growth of wild mushrooms, said officials. There are about 250-300 species of mushrooms in Bhutan, of which around 30 or more could be poisonous.

"We want people to be careful with the kind of mushrooms they eat or pick from the forest," said Dawa Penjor. "We're reminding people of the dangers of wild mushroom through awareness calendars, posters and brochures, which are sent to all BHUs or gewog centres." The centre has also been training farmers to identify both edible and poisonous mushrooms, as they are usually sold to ignorant customers.

According to Kuensel records, mushroom poisoning killed at least 18 people in the past five years. Several others were saved by timely medical treatment. The worst case was reported in 1995, when a family of six died of mushroom poisoning in Pemagatshel.

Nausea and stomach upset are the first symptoms of mushroom poisoning. In most cases, immediate medical attention can save lives, but there are some mushroom species that first destroy vital organs, like kidney and lungs, and then show symptoms only after three to four days, say health officials at the Thimphu referral hospital. "If you cannot make it to a medical facility, vomiting should be induced, while increasing the intake of fluids, said a medical specialist in Thimphu.

Source: Kuensel August 31, 2009

## Articles 9

# Six treated for mushroom poisoning

BY GYEMBO NAMGYAL

Six men from Denchi village in Pemagatshel were treated in the district hospital after they had consumed a poisonous mushroom on August 21. Two were brought to the hospital in a serious condition. The victims consumed a poisonous mushroom locally called *khibamung*.

"Pupil in one of the patients' eyes had constricted when they were brought to the hospital," said Dr Bhim Nath. All the victims were discharged the following day after giving necessary treatment including antidotes. They were also administered IV fluids and induced managed vomiting.

One of the victims said the mushroom is said to be edible but local people said it is poisonous.

In what could be the worst case of mushroom poisoning, six members of a family in Toktseri village under Dungmin Gewog died after consuming a poisonous mushroom in 1995. Only three other members of the family, who lived outside the village, survived.

In March 2007, some hospital staff, including the medical officer, also suffered mushroom poisoning after attending a social event. There were no fatalities, though.

According to officials from the hospital, people should only consume mushrooms which are identifiable and known to be edible. And in the event of poisoning, the victims should resort to induced vomiting followed by drinking as much fluid as possible before seeking medical help. Majority of the fatalities were supposed to have been caused by dehydration.

**Anything to be reported?**
Please call
334891/92/93/336041
OR
email:editor@bhutanobserver.bt

Source: Bhutan Observer August 2009

## Articles 10

*ncidents of death from consumption of inedible varieties have been widespread*

Sonam Peldon

"Collect mushrooms that are consumed regularly and you are familiar with," states the notification the national mushroom centre issued yesterday.

**FUNGUS**

The cautionary notification comes on the onset of mushroom season in Bhutan and on the heels of the death of four family members in Samtse, who succumbed to mushroom poisoning last week. It's however not the first case reported this year. A 10-year-old girl died of mushroom poisoning in Samdrupcholing during a visit to Samdrupjongkhar on April 27, en route to Samdrupjongkhar hospital.

"Mushroom poisoning cases aren't rare in Bhutan and have become a risk to both mushroom collectors and consumers," the notification states. "The national mushroom center requests all parents not to send young children and inexperienced collectors for collection of wild mushrooms."

The last time a family was reported to have died from mushroom poisoning was in 1995 in Pemagatshel, where six lives were lost. The family was from Mikum Tockchidorang village and, according to reports from Pemagatshel, the victims included a farmer, his wife, and their four children, aged between four and 12 years. The couple had five other children.

According to the annual health bulletin, 2012, hospitals across the country admitted 293 mushroom poisoning cases and two deaths in 2011, which means about 24 people suffer from mushroom poisoning every month. In 2010, mushroom poisoning claimed three lives.

In August 2009, the military hospital in Lungtenphug had written to the mushroom centre that three soldiers had reported with symptoms of poisoning with severe vomiting after they consumed the locally collected mushroom at Dochula outpost.

Kuensel records show that mushroom poisoning were reported from Dagana, Pemagatshel, Lhuentse, Gidakom, Samtse, Trongsa and Samdrupjongkhar since the 90s.

Last June, 12 Indian construction workers were admitted at Trongsa hospital for mushroom poisoning, while the following month, a couple in Dagana died after consuming poisonous mushrooms.

In 2006 May, mushroom poisoning killed three in Samtse while in July of 2002, it killed a 14-year old girl in Lhuentse.

Mushroom poisonings usually occur due to "mistaken identity," according to mushroom officials and similar cautionary notifications have been issued by the center in the past, for instance in 2007 in July last year and in August 2011.

Total mushroom poisoning cases in 2010-11

| 2011 | 2010 |
|---|---|
| 293 cases | 251 cases |

Mushroom poisoning in 2011



Source: Kuensel May 21, 2013

## Articles 11

# Mushroom poisoning kills husband and wife

TASHI DEMA

A husband and his wife in Pataley village, Dagana, have died after they consumed an unidentified mushroom for lunch on July 5. Their two-year-old child is recovering in Dagapela hospital.

**HEALTH**

While the former soldier, 48, died on July 6, a day after consuming the mushroom he had collected from the forest, his wife, 39, died in Dagapela hospital yesterday afternoon.

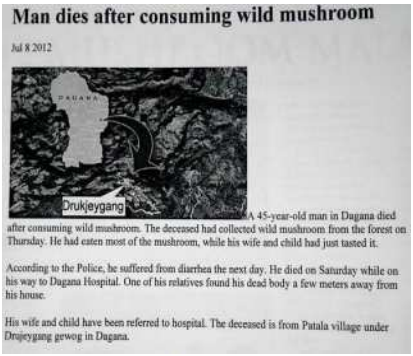
The family of four is reported to have complained of stomach pain after they had the mushroom for lunch.

Drujeygang BHU's health assistant brought the wife and daughter to hospital and referred them to Dagapela hospital. The woman's father, who didn't like the taste of the mushroom and gave it to his daughter, survived.

Sources at Dagapela hospital said the man and woman died of liver and renal toxin.

Source: Kuensel July 9, 2012

## Articles 12



# Man dies after consuming wild mushroom

Jul 8 2012



A 45-year-old man in Dagana died after consuming wild mushroom. The deceased had collected wild mushroom from the forest on Thursday. He had eaten most of the mushroom, while his wife and child had just tasted it.

According to the Police, he suffered from diarrhea the next day. He died on Saturday while on his way to Dagana Hospital. One of his relatives found his dead body a few meters away from his house.

His wife and child have been referred to hospital. The deceased is from Patala village under Drujeygang gewog in Dagana.

Source: BBS July 8, 2012

Articles 13

# Unidentified mushroom poisons 12

The unidentified mushroom

Tashi Tenzin, Trongsa

Twelve Indian construction workers were admitted at the Trongsa hospital on June 15 morning for mushroom poisoning.

## FOOD

Chief Medical Officer Dr Tashi Wangchuk said the patients complained of nausea, vomiting and haemetemesis (vomiting with blood) after they consumed unidentified mushroom they had collected from Naukilo, Dorji Goenpa, in Nubi gewog, which is few kilometers from Trongsa towards Bumthang. The men were working on an electrification project with Gamtsho construction.

Dr Tashi Wangchuk said the workers had consumed the mushroom at breakfast around 8am and reported to the hospital around 10 am.

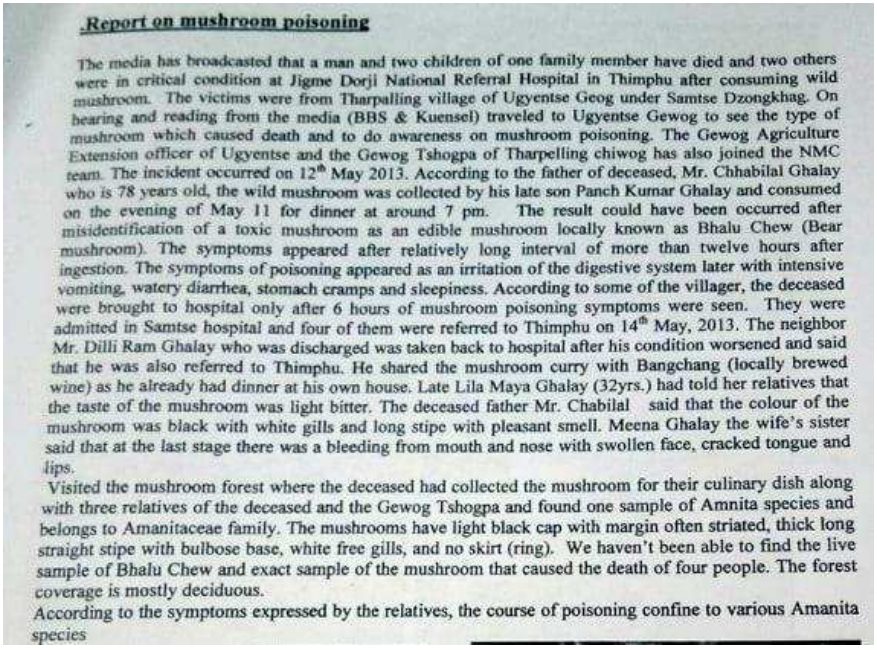
The men were kept under observation with symptomatic and supportive therapy. "There was no sign of systemic complications," he said. "Vomiting with blood is clinically considered to be because of forceful vomiting, causing tear in the mucus membrane of esophagus and not because of mushroom toxin."

All were discharged the next day but would undergo laboratory investigations to rule out any systemic complications to their liver and kidney.

Health official said the mushroom they consumed is not known in the area and is yet to be identified by the district agriculture sector. Meanwhile doctors advise consuming unidentified mushroom can be fatal with almost 95 percent of unidentified mushroom being poisonous.

Source: Kuensel June 18, 2012

Articles 14



**Report on mushroom poisoning**

The media has broadcasted that a man and two children of one family member have died and two others were in critical condition at Jigme Dorji National Referral Hospital in Thimphu after consuming wild mushroom. The victims were from Tharpalling village of Ugyentse Geog under Samtse Dzongkhag. On hearing and reading from the media (BBS & Kuensel) traveled to Ugyentse Gewog to see the type of mushroom which caused death and to do awareness on mushroom poisoning. The Gewog Agriculture Extension officer of Ugyentse and the Gewog Tshogpa of Tharpelling chiwog has also joined the NMC team. The incident occurred on 12th May 2013. According to the father of deceased, Mr. Chhabilal Ghalay who is 78 years old, the wild mushroom was collected by his late son Panch Kumar Ghalay and consumed on the evening of May 11 for dinner at around 7 pm. The result could have been occurred after misidentification of a toxic mushroom as an edible mushroom locally known as Bhalu Chew (Bear mushroom). The symptoms appeared after relatively long interval of more than twelve hours after ingestion. The symptoms of poisoning appeared as an irritation of the digestive system later with intensive vomiting, watery diarrhea, stomach cramps and sleepiness. According to some of the villager, the deceased were brought to hospital only after 6 hours of mushroom poisoning symptoms were seen. They were admitted in Samtse hospital and four of them were referred to Thimphu on 14th May, 2013. The neighbor Mr. Dilli Ram Ghalay who was discharged was taken back to hospital after his condition worsened and said that he was also referred to Thimphu. He shared the mushroom curry with Bangchang (locally brewed wine) as he already had dinner at his own house. Late Lila Maya Ghalay (32yrs.) had told her relatives that the taste of the mushroom was light bitter. The deceased father Mr. Chabilal said that the colour of the mushroom was black with white gills and long stipe with pleasant smell. Meena Ghalay the wife's sister said that at the last stage there was a bleeding from mouth and nose with swollen face, cracked tongue and lips.

Visited the mushroom forest where the deceased had collected the mushroom for their culinary dish along with three relatives of the deceased and the Gewog Tshogpa and found one sample of Amnita species and belongs to Amanitaceae family. The mushrooms have light black cap with margin often striated, thick long straight stipe with bulbose base, white free gills, and no skirt (ring). We haven't been able to find the live sample of Bhalu Chew and exact sample of the mushroom that caused the death of four people. The forest coverage is mostly deciduous.

According to the symptoms expressed by the relatives, the course of poisoning confine to various Amanita species

Source: Reported By: L.B. Tamang, National Mushroom Centre, MoAF

## Articles 15

Annual progress report of Wild Mushroom Sector of National Mushroom Centre by Sabitra Pradhan.

**Report on mushroom poisoning at Chengmari Geog under Samtse Dzongkhag By; L.B.Tamang**

Mr. Amber Ghalay, Extension Officer of Samtse Dzongkhag had informed the NMC stating that two farmers of Chengmari Geog were admitted to Samtse hospital after consuming the wild mushroom The victims were from Kaijaley village under Dophujhora Chiwog of Norbu (Chengmari) Geog under Samtse Dzongkhag. And as per the instruction of the Program Director, a team comprising of LB Tamang, Tenzin Wangmo and Tenzin Dorji traveled to Norbu (Chengmari) Gewog to see the type of mushroom which caused severe poisoning and to do awareness on mushroom poisoning. The Gewog Agriculture Extension officer of Chengmari Mrs. Kinlay Wangmo has also joined the NMC team. The incident occurred on 17th May 2014.The victims were Mr. Nar Bahadur Ghalay who is 39 years old and his wife Ms. Purna Maya Ghalay who is also 39 years old had consumed the mushroom as curry. According to the elder brother of the victim, the wild mushroom was collected by his brother while they were picking the edible ferns and consumed on the morning of May 17 for breakfast at around 7 am and also said that when mushroom was cooked, the colour of mushroom had changed to black. Only two (husband and wife) had consumed the mushroom curry as the children were out for school. The result could have been occurred after misidentification of a toxic mushroom as an edible mushroom locally known as Gobrey Chew (Button mushroom). The symptoms appeared immediately after 15 minutes of ingestion. The symptoms of poisoning appeared as an irritation of the digestive system later with intensive vomiting, watery diarrhea and stomach cramps. According to hospital staff the patients were brought to hospital on semi-unconscious condition. They were immediately treated with charcoal and other medical means and admitted in Samtse hospital on 17th May and were discharged on 20th May after their full recovery. The similar poisoning was occurred last year to their immediate neighbor where six people were sick and after their condition worsened, they were locally treated with mango leaves and mango seed juice.

Annual progress report of Wild Mushroom Sector of National Mushroom Centre by Sabitra Pradhan.

Visited the mushroom forest where they had picked the mushroom for their culinary dish along with their relatives and the Gewog Extension Officer and found abundant of *Macrolapiota* species. The mushroom was collected from under the tree locally called Gantey. According to some farmers of the locality, the Gantey tree itself is a poisonous one as the cattle would die if they feed with Gantey as fodder.

Cf. *Chlorophyllum molybdites* — Gantey tree under which mushroom was growing

The mushrooms have white cap with black scales at the centre and brown scales on cap surface with margin often striated thick long straight and hollow stipe with slightly bulbose base, white free gills, and with movable skirt (ring). Easily bruise when in touch and changes its color. We haven't been able to collect the live sample of the mushroom due to heavy raining. The forest coverage is mostly deciduous.

According to the symptoms expressed by the relatives, the course of poisoning confine to various Amanita and probably poisonous *Lapiota* species. It is difficult to tell with certainty that the poisoning has actually caused by the mushroom because even when you know a mushroom well, weather conditions or animal damage can cause differences in appearance that could lead to misidentification.

Source: Reported by: L. B.Tamang, National Mushroom Centre, MoAF

## Articles 16

### Reporting the mushroom poisoning in Tashicholing chewog of Puntenchu Geog under Tsirang Dzongkhag By Sabitra Pradhan

The death of a man due to mushroom poisoning was reported in BBS news on Thursday 3th of July 2014. Therefore the team comprising of Ms. Sabitra Pradhan and Tenzin Dorji from NMC were instructed by the Program Director to make an inventory visit to the site to study the mushrooms which has caused a death of a 59 years old man and to give awareness on the risk of collecting and eating the wild mushrooms in Tashicholing chewog of Puntenchu Geog under Tsirang Dzongkhag. The team travelled to the geog and gave awareness on risk of collecting and consuming wild mushroom whose edibility is not confirmed.

After the training the team walked to the Tashicholing chewog to late Mr. Jamtsho's house. With the man from his neighbor who has seen the mushroom collected on the day of the incident went to the forest nearby and collected the samples. The forest is mix chir pine and other broad leaf but dominated by pine. The samples were showed to the wife of the deceased which she identified and it was *Amanita* sp. She had cooked for the dinner on the day of the incident. The wife had doubt about the edibility of the mushroom thus she advised her husband to throw out the mushroom but he didn't listen to her and ate all the curry by himself. They had dinner at about 7.30 pm and slept. At about 1.30 am he woke up his wife by pushing because at that time he could not speak properly and he was already suffering from muscle cramps. His wife tried to help him stand and walk but he could not balance himself. His action was shown as if he is finding difficulty in breathing and wanted to vomit so his wife helped him stand and tried to bring him out; but he was not able to walk properly and he sat down. Then the wife went to call her neighbor but when she returned in about five minutes he was already dead.

*Amanita* sp.

Source: Reported By: Sabitra Pradhan, National Mushroom Centre, MoAF

## Articles 17

### Three in hospital after consuming poisonous mushrooms

July 21, 2016 News Leave a comment 1,204 Views

**Food poisoning:** Three people are undergoing treatment at the national referral hospital in Thimphu after consuming poisonous mushroom.

Five people of the nine who were on their way to Thimphu from Paro roasted wild mushrooms for lunch at Tsaluna in Thimphu at around 2:30pm on July 19.

Ugyen Zam, 40, from Mongar, said that they picked the mushroom known locally as on the way.

An hour after eating the mushrooms, they started feeling dizzy with headaches, got diarrhoea and started throwing up.

"I felt like I got drunk and couldn't even recognise my friends," Ugyen Zam said. "We were crawling and puking everywhere."

One of them called a taxi driver who took them to hospital.

"We added garlic and Sichuan pepper to make sure the mushroom didn't poison us," Ugyen Zam said. "I had consumed the same mushroom several times but nothing happened to me then."

In April this year, a 12-year-old girl from Gomdar in Samdrupjongkhar died after consuming poisonous mushrooms.

National Mushroom Centre is cautioning the public to avoid consuming wild mushrooms unless it is confirmed to be safe for consumption.

**Dechen Tshomo**

Source: Kuensel July 21, 2016

## Articles 18

**Report on Mushroom Poisoning Case at Pachutar in Phuentsholing Gewog (By. Sabitra Pradhan & Dawa Penjor)**

We were informed through the Social Forestry Division inquiring on the identity of the mushroom which has caused hospitalization of 16 people at the Hospital in Phuentsholing. The team led by Program Director travelled immediately to Phuentsholing hospital and then to Pachutar to collect the live specimens that had caused mushroom poisoning. The awareness on mushroom poisoning was given to the 16 persons who all ate the mushroom, RNR staff and also to 2 health staffs.

The mushroom has been identified as *Chlorophyllum molybdytes* which causes gastrointestinal poisoning to the 16 individuals who ate the mushroom on 26th May 2019 evening. The key characters that identify this species are: the scaly cap (figures a&b), the red staining flesh (figure c) and greenish gills when matured as the spore get released (figure d).

The patients have suffered severe vomiting and diarrhoea after one hour but were taken to the hospital where they were administered with charcoal and IV drips. Out of sixteen people all except five already discharged since there was no damage to the liver or kidneys but they were asked to come back for blood test the following day. The remaining five were in stable condition during our visit to the hospital. Dr. Sangay who treated the patients in Phuentsholing hospital said the main symptoms they had were vomiting, diarrhea and stomach ache.

Many could have died if they were not taken to the hospital on time due to dehydration and loss of electrolytes after continuous vomiting and diarrhoea. Older people have lost lot of blood from both vomiting and diarrhoea. Unlike this mushroom poisoning symptoms for Hepatotoxic and nephrotoxic poisoning can appear after many days and is more dangerous.

Visited the site in Pachutar where the mushrooms were collected to get specimens (2 hours walk in the forest in Pachutar. The nature of this particular mushroom is, it grows in group of ring or semicircle, and thus they have collected a basket full and in three sacks. The boy who was cow herding in the forest saw the mushroom in huge group and was tempted to eat. He then collected the sample and brought to village and asked few people about the edibility; and he was told it is edible by few village personals. After that with a friend he collected all the mushrooms and shared among the neighbourhoods. That is how huge number of people got mushroom poisoning.

Since it is mostly found in the lower area, we are not familiar with it except when another poisoning from the same mushroom happened in Chengmari, Samtse about five years ago. Created awareness both in the hospital and the village and distributed posters on wild mushroom. The Gewog Extension Officer of Phuntsholing accompanied us to Pachutar.

Young *C. molybdites* (a) Cap of the *C. molybdites* (b) Young gills of *C. molybdites* (c) Matured gills *C. molybdites* (d) Awareness to patients (e) Pasting poster in

Reported by Dawa Penjor and Sabitra Pradhan, NMC, MoAFs

**Back to Office Report on Mushroom Poisoning in Dagana and Tsirang on 15 and 16 May 2020 by Sabitra Pradhan and Dawa Penjor**

With the two consequent mushrooms poisoning in Tsirang and Dagana in May 15-17 2020, the team comprising of the advisor and the personal from Myco-diversity Program travelled to the sites to study the mushroom that caused the poisoning and to give awareness to the public.

**1. Site 1 (Salamji, Tsangkha, Dagana)**

**1.1.Background**

On the night of May 16 2020, four people from Tsangkha in Dagana were admitted to Tsirang District hospital after eating poisonous mushrooms. All of them except an 84-year-old man were sent home after keeping them under observation overnight. The 84 year old man was the patient of diabetes, thus it was difficult to predict his health status within 12hours thus he was kept under observation for one more day.

**1.2. Findings by NMC team and the health officials from Tsirang District Hospital**

The symptoms of poisoning were anxiety and different psychoactive effects as per the people who ate the mushrooms for dinner. The mushroom they ate is identified as ***Panaeolus cyanescens*** which contains psychoactive compound called "psilocybin". There were two other similar mushrooms growing together which are not poisonous, and looks like they ate all three types, since it was collected by 84 year old man who's eye sight is poor. This might have safe them from being over-dosed by the psilocybin. The following are the three different species of mushrooms that were growing together in the dung, and were collected by 84 year old man which is called locally as "Suli Chew"(meaning dung mushroom) and consumed by 4 men in Salamji village in Tsangkha, Dagana for dinner on 16.05.2020.



***Panaeolus cyanescens*** ***Panaeolus* cf. *papilionaceus*** ***Protostropharia semiglobata***

The person who ate more quantity of mushroom is a boy about twenty years old boy. He reported that they started having the symptoms almost immediately after they finished eating the mushroom. He reported also that they were feeling dizzy. Suspecting poisoning of some sort they tried to induce vomiting. They had decided to go to the hospital at Damphu immediately where they were treated by the health personel. He said that towards two or three in the morning thye wre feeling euphoric. However they were back to normal towards the next morning

**1.3. Awareness created in the locality**

The team from NMC and Tsirang District Hospital visited few households in the locality and cautioned the people not to consume any wild mushrooms unless they are very sure of its edibility. The team advised them to caution their neighbors, friends and relatives on risk of eating poisonous mushrooms if they are not careful on what they are collecting giving the example of the current incident of mushroom poisoning in their locality. The team also gave awareness on risk of collecting and selling poisoning mushroom to the retailers by the Wangdue-Tsirang High way. The posters on edibility of mushrooms were distributed to the retailers and few households to educate them and remind them to be caution always while collecting wild mushrooms.



**Awareness on mushroom poisoning and distribution of posters on edibility of different mushrooms in Bhutan**

**2. Site 2 (Upper Bokray, Kilkhorthang, Tsirang)**

**2.1.Back ground**

On 15 May 2020, family of four, including three year old child visited the Tsirang district hospital with complaints of nausea, diarrhoea and vomiting. They were discharged on the same day after they were given medications according to the symptoms. But on the next morning, the child was again admitted to the hospital after her health deteriorated. Besides showing early nonspecific signs like vomiting and diarrhoea, the child has reached to the fourth stage of Amanitin poisoning (relapse), during which kidney and liver failure occurs. She was then referred to Gelephu regional referral hospital after consultation with the paediatrician on duty at the hospital. The child passed away at around 2am on May 17.

2.2. **Findings by NMC team and the health officials from Tsirang District Hospital**

The team from NMC could not find the particular *Amanita* mushroom that the family consumed, but from the description given by the family who consumed the mushroom and the symptoms occurred after consuming it was suspected as ***Amanita*** sp. Most probably ***Amanita verna, Amanita virosa*** or ***Amanita smithiana*** with white colour (Amanitin poisoning/Amatoxin).

The team while surveying of the area the consumed mushroom was collected; found 17 different mushroom species among which the following are some of the poisoning species.



***Amanita pantherina*** ***Entoloma* sp.** ***Russula* sp.**

Similar awareness to avoid mushroom poisoning and distribution of posters were conducted in Upper Bokray (BPC colony) where the victim of mushroom poisoning resides. The posters were also handed to Tsirang District Hospital to be distributed to various BHUs to educate and caution the public in the vicinity. With such awareness program conducted, the team is expecting less or no mushroom poisoning cases to occur in the district. The three survival of mushroom poisoning caused by Anamitin, are advised to go for renal test in the nearby hospital in case the Ananitin poisonous is still in their body as some times the relapse occurs even after several days (after 21 days recorded).

**Girl dies from consuming poisonous mushroom**

**Chimi Dema** | Tsirang

A three-year old girl died on May 17 after consuming poisonous mushrooms with other three family members in Tsirang.

A family of four, including the child first visited the Tsirang district hospital on May 15 with complaints of nausea, diarrhoea and vomiting. They were discharged on the same day after they were given medications according to the symptoms.

But on the next morning, the child was again admitted to the hospital after her health deteriorated. Besides showing early nonspecific signs like vomiting and diarrhoea, the child was found to have developed seizures attack, indicating signs associated with mushroom poisoning, according to the health officials.

She was then referred to Gelephu regional referral hospital after consultation with the paediatrician on duty at the hospital. The child passed away at around 2am on May 17.

The other family members recovered without developing any complications at Tsirang hospital.

On the night of May 16, five people from Tsangkha in Dagana were also admitted to the hospital after eating poisonous mushrooms.

All of them except an 84-year-old man were sent home after keeping them under observation overnight. The official said that he is recovering now.

Health officials are cautioning the public to avoid consuming wild mushrooms unless it is confirmed to be safe for consumption.

Reported by Sabitra Pradhan and Dawa Penjor, NMC, MoAFs and Chimi Dema, Kuensel , 19th May 2020

## The list of hospitals and health posts to be informed and visit in case of mushroom poisonings

| Bumthang |
|---|
| Bumthang Hospital |
| Chokor BHU |
| Chumey BHU |
| Dhur |
| Tang BHU |
| Ura |

| Chhukha |
|---|
| Arikha BHU |
| Bongo BHU |
| Chapchha BHU |
| Chhukha BHU I |
| Chong Geykha BHU |
| Darla BHU |
| Doongna BHU |
| Gedu Hospital |
| Getana BHU |
| Khatikha BHU I |
| Loggchina BHU |
| Metakha BHU |
| Phuentsholing Hospital |
| Rangaytung BHU |
| Renchentse BHU |
| Sinchula BHU |
| Tashigatshel RBP MI Room |
| Tsimalakha Hospital |

| Dagana |
|---|
| Akhochen BHU |
| Dagana BHU I |
| Dagapela Hospital |
| Drukjeygang BHU |
| Jurugang BHU |
| Khagochen BHU |
| Lagyab BHU |
| Lhamoizingkha BHU I |
| Nyimtola BHU |
| Tsangkha BHU |

| Haa |
|---|
| Bali BHU I |
| Dorithasa BHU |
| Ngetshena BHU |
| Sangbay BHU |
| Yangthang BHU |

| Punakha |
|---|
| Goenshari BHU |
| Kabisa BHU |
| orbugang BHU |
| Punakha Hospital |
| Samadingkha BHU |
| Shelnga BHU |
| Thinleygang BHU |
| Tshochasa BHU |

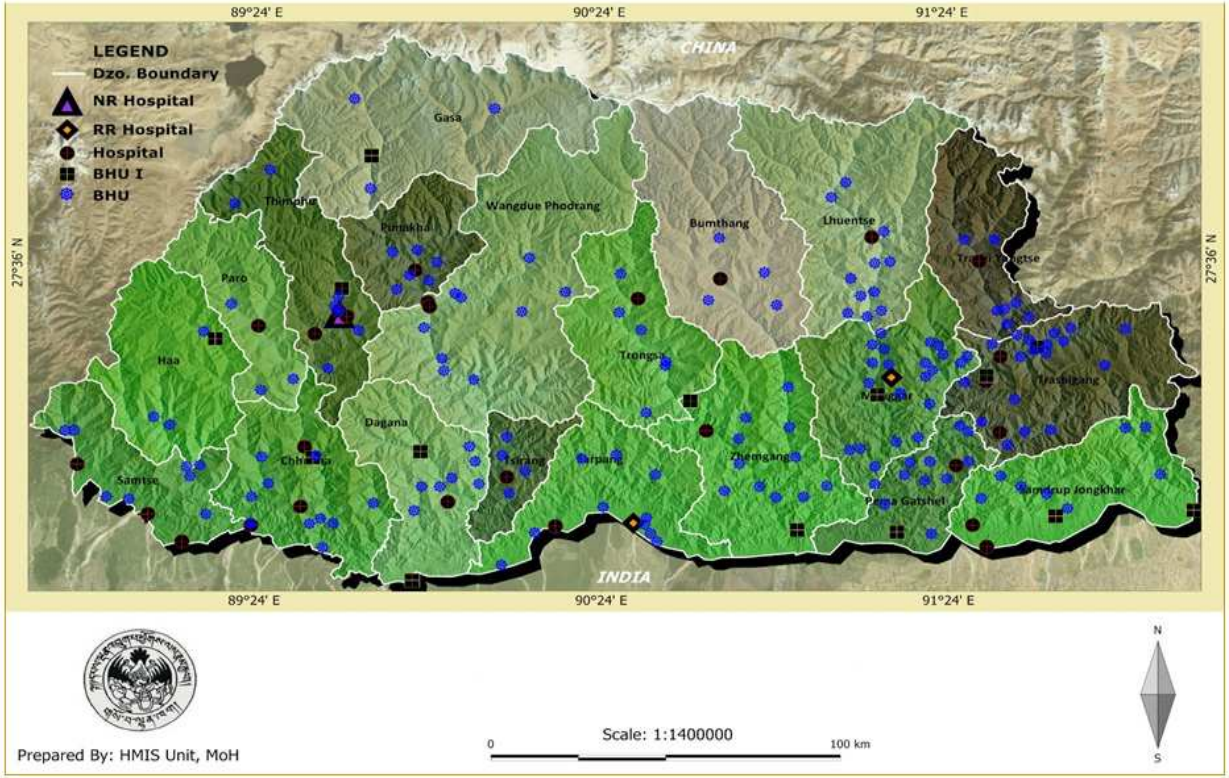
| Lhuentse |
| --- |
| Autsho BHU |
| Dangling BHU |
| Dungkar BHU |
| Ganglakhema BHU |
| Gortshom BHU |
| Khoma BHU |
| Ladrong BHU |
| Lhuentse Hospital |
| Minjey BHU |
| Ney BHU |
| Patpachhu BHU |
| Tagmachhu BHU |
| Thimyul BHU |
| Tsaenkhar BHU |
| Zangkhar BHU |

| Pemagatshel |
| --- |
| Chhimoong BHU |
| Chhoekhorling BHU |
| Dechhenling BHU |
| Dungmaed BHU |
| Gonpa Singma BHU |
| Nanong BHU |
| Nganglam BHU I |
| Norboogang BHU |
| Pemagatshel Hospital |
| Pretengma BHU |
| Thrumchung BHU |
| Tshatshi BHU |
| Yurung BHU |

| Monggar |
| --- |
| Baanjar BHU |
| Balam BHU |
| Boompazor BHU |
| Chagsakhar BHU |
| Chhaling BHU |
| Daagsa BHU |
| Dramedtse BHU |
| Ganglapong BHU |
| Gyalpoizhing BHU I |
| Jurmed BHU |
| Kengkhar BHU |
| Lingmethang BHU |
| Monggar ERR Hospital |
| Nagor BHU |
| Narang BHU |
| Ngatshang BHU |
| Resa Sub-Post |
| Senggor BHU |
| Serzhong BHU |
| Thangrong BHU |
| Tsakaling BHU |
| Tsamang BHU |
| Yadi BHU |
| Yangbari BHU |

| Paro |
| --- |
| Bueltikha BHU |
| Dawakha BHU |
| Drugyal BHU |
| Paro Hospital |

**Figure 6.2 –** Current health facilities [2017] map




Source: Annual Health Bulletin 2018@ Ministry of Health

# Glossary

**Acute:** An edge that forms a sharp angle at the apex.

**Adnate:** Gills that are attached perpendicular to the stem.

**Adnexed:** Gills that are attached to the stem by a narrow point of contact.

**Angular:** A structure that is not rounded at the edge, but forms angles.

**Annulus:** Fragments of the ruptured partial veil that remain attached to the top of the stem.

**Apex:** Top of the structure (as the stem) or of a specific fruit body.

**Apical:** Refers to the top, at the apex.

**Appendiculate:** A pileus margin that has fragments of the partial veil hanging from the edge of the expanding cap.

**Appressed:** Scales, fibres or hairs that lay flat against the surface of the cap or stem.

**Areolate:** Surface of the cap cracked into plates.

**Ascomycota:** A fungal group characterized by the presence of reproductive structures called ascus.

**Ascus:** Sac-like cell inside which spores are produced in members of the Ascomycota fungi (pl. asci).

**Basidiomycota:** A fungal group whose distinguishing characteristic is the presence of reproductive structures called basidia, covering the fertile surface of the fruit bodies.

**Basidium:** The specialized cell on which spores are formed externally, diagnostic for mushrooms of the Basidiomycota group.

**Bulbous:** A stem that bulges into an enlarged base.

**Caespitose:** Fruit bodies that grow in close groups or clusters, with stems joined together.

**Campanulate:** Bell-shaped.

**Cartilaginous:** Having the consistency of animal cartilage.

**Cerebriform:** Resembling a brain in certain species.

**Chlorophyll:** Substance present only in members of the Plant Kingdom, especially in plant stems and
**leaves.** Essential in the processes of photosynthesis and carbon fixing.

**Circular: I**n the shape of a circle.

**Clavate:** Club-shaped.

**Close:** Gills arranged very near to one another, but not crowded.

**Clustered:** Habit of fruit bodies growing very close together.

**Concentric:** In geometry, refers to several figures that have the same centre point.

**Con-colours:** Having the same colour.

**Conic:** A cap higher than wider, with a pointed apex.

**Context/Flesh:** The fleshy tissue or insides of the fruit body on the cap and stem.

**Convex:** Rounded, higher in the middle than at the margin.

**Coprophilous:** A fungus that grows on dung or manure.

**Crowded:** Gills spaced very close together.

**Crust:** A fruit body that is attached in its entirety to the substrate.

**Curved:** Curved or folded downwards.

**Cylindric:** Cylinder-shaped, a stem that has the same diameter from apex to base.

**Decurrent:** A type of gill attachment in which the gills run down the stem.

**Decurved:** Refers to a cap margin that appears to curve downwards.

**Deliquescence:** Melting to liquid occurs when the gills of certain fruit bodies digest themselves at maturity, releasing a dark substance of the same colour as the spores.

**Depressed:** A cap that has a central cavity or hollow, with the middle lower than the edge. Dichotomously: A form of branching or forking in which the tip divides into matched pairs. Dimidiate: Semi-circular or shaped like a sea shell.

**Disc:** Central portion of the cap, also, circular plate at the base of the stem.

**Distant:** Gills which are separate from one another and spaced well apart.

**Eccentric:** A stem attached off centred of the pileus.

**Ectomycorrhiza:** A beneficial plant/fungus symbiotic association in which the mycelium of the mushroom forms a sheath around the short roots and enters the plant root where they form a network between the cells of the root. The association works to bring in water, nitrogen and other nutrients to the plant, while the mushroom obtains sugar from the plant.

**Effused-reflexed:** A growth pattern in which part of the mushroom fruit body takes the shape of a crust and the other part develops caps.

**Elongate:** A structure that is longer than it is wide.

**Entire:** A cap margin that is smooth and uninterrupted.

**Equal:** A stem having the same diameter throughout its length.

**Eroded:** A cap or gills with irregular jagged edges.

**Family:** A classification group within the taxonomic system, made up of one or more related characters.

**Farinaceous:** Having a floury appearance and odour or taste, mealy.

**Fertile surface:** The surface on mushrooms where reproductive structures of the fruit body are located.

**Fibrillose:** Composed of delicate, very fine silky fibres.

**Flabelliform:** Fan-shaped.

**Forked:** Dividing into two branches.

**Free:** Type of gill attachment in which the gills do not touch the apex of the stem.

**Fruit body:** The reproductive structure that the mushroom produces on the substrate, for the purpose of dispersing spores.

**Fungicolous:** Growing on other fungi as substrate.

**Genus:** A group of closely related species, the genus is expressed in upper case as the first word in the scientific name of all it's member species.

**Glabrous:** Without hairs or ornamentation of any kind.

**Globose:** Fully or nearly spherical in shape.

**Granulose:** A surface that appears to be covered with salt-like granules.

**Gregarious:** Fruit bodies cluster in close groups within a small area.

**Habit:** The characteristic external appearance of mushrooms, and the manner in which they grow.

**Habitat:** The environment where an animal or plant population naturallygrows and develops.

**Hallucinogen:** Refers particularly to certain substances present in mushrooms, causing hallucinations.

**Hispid:** Covered with stiff hairs.

**Hymenium:** The spore-bearing surface of the Basidiomycota group.

**Hymenophore:** Structure that bears the reproductive structures that make spores, covered by the hymenium.

**Hypha:** A filament which is the fundamental structural unit of most mushrooms (pl. hyphae).

**Imbricate:** Caps that grow one above the other.

**Incised:** Having a margin that is deeply and sharply notched.

**Incurved:** A cap margin curved inwards, forming a concave shape on the inner side.

**Infundibuliform:** Funnel-shaped.

**Lacerate:** Parts of the fruit body in which the texture appears to have been irregularly torn.

**Lamellae:** A particular type of hymenophore composed of plate like structures which bear the fertile surface, located underneath the cap and containing the spores, gills.

**Lamellula:** A small lamella that does not reach to the stem (pl. lamellulae).

**Lateral:** Stem attached to the edge of the cap.

**Latex:** A milky liquid that oozes from certain mushroom species when they are cut or injured.

**Lignicolous:** Growing on a substrate of wood, whether alive or in decay.

**Lobed:** With rounded divisions on the margin.

**Margin:** The edge of the cap or gill.

**Mushrooms:** Macro fungi with a distinctive fruit body, large enough to be seen with the naked eye and to be picked by hand.

**Mycelium:** Vegetative part of mushrooms consisting of a mass of hyphae growing through the substrate.

**Mycorrhiza:** The symbiotic association of a fungus and the roots of certain types of trees, in which both organisms' benefit. The fungus provides the roots with minerals, while the tree provides food (carbohydrates) to the fungus.

**Order:** A classification group consisting of one or more related families.

**Ovoid:** Egg-shaped.

**Partial veil:** Membrane covering the fertile surface of certain mushrooms during the early stages of development, located under the cap.

**Pathogen:** An organism that attacks another living organism and is able to cause disease.

**Petaloid:** Shaped like the petal of a flower.

**Photosynthesis:** A metabolic process in certain plant organisms, allowing them to synthesize and prepare their own organic nutrients from inorganic substances, using light energy.

**Pileus:** The top part of a fruit body (pl. pilei) or cap.

**Plicate:** A folded or pleated surface.

**Pores:** The opening at the end of the tubes of the hymenophore.

**Powdery:** A surface covered with fine powder.

**Pruinose:** A surface covered with a frost-like dust, resembling flour.

**Pubescent:** A surface with short, downy hairs.

**Pungent:** Having a strong or penetrating odour.

**Pyramidal:** A structure with a polygonal base, which several faces join at the top in a point.

**Radicating:** A stem with a root like base.

**Resupinate:** Fruit bodies that grow in the form of a crust, without a cap.

**Reticulate:** Veins, lines or edges in bas-relief, forming a weave that appears net-like.

**Reticulum:** Small net.

**Revolute:** A cap margin that is rolled up towards the cap face.

**Ring:** Circular ring around the stem that is thinner and smaller than the annulus.

**Rugose:** Having deep wrinkles in an irregular formation.

**Rugulose:** Having fine wrinkles in an irregular formation.

**Rust:** The common name of a fungus that attacks the leaves of crop plants. Has a powdery, rust- coloured appearance.

**Saddle-shaped:** Bending down at the sides so as to give the upper part a rounded form.

**Scabers:** A specific type of a small pointed scale formed of aggregated hyphae. Typically found on stems.

**Scabrous:** A surface with scabers.

**Scales:** A type of ornamentation on the cap or stem of a mushroom formed from the surface tearing, from hyphae in the surface clumping together and becoming uplifted, or from fragments of the universal veil that remain attached to the surface of the cap or stem.

**Scattered:** Growth habitat of mushroom where it is separate or dispersed around a certain area.

**Semi-circular:** In the shape of a half-circle.

**Sessile:** Fruit bodies that lack either a stem or extensions attaching it to the substrate (without a stem).

**Shelf:** A mushroom that attaches laterally to wood or other substrate.

**Sinuate:** Gills that have a small depression at the point of attachment to the stipe.

**Smooth:** A surface that has no ornamentation.

**Solitary:** The growth habit of mushrooms producing a single fruit body.

**Spathulate:** Shaped like a spatula.

**Species:** The smallest taxonomic group made up of individuals that have a single common ancestor.

**Spore print:** The spore mass formed by placing a mushroom cap on white paper and letting the spores accumulate. Used to tell spore colour for identifying many groups of mushrooms.

**Spores:** Specialized cells produced by the fungus as part of its reproductive system, dispersed primarily by wind and water.

**Squamosa:** Furnished with scales; scaly.

**Squamulose:** A surface with very small scales.

**Stipe:** The stalk on which the pileus rests, holding it above the substrate.

**Striate:** Surface markings consisting of parallel lines or grooves.

**Strigose:** A surface ornamented with stiff hairs.

**Sub-bulbous:** A somewhat bulbous stem.

**Subclavate:** A slightly club-shaped stem.

**Sub-decurrent:** Slightly decurrent gills.

**Sub-distant:** Gill spacing which is slightly distant.

**Sub-globose:** A somewhat spherical- shaped fruit body.

**Substrate (substratum):** The surface through which the fungi grow; the material that a fungus digests and uses as food.

**Sulcate:** A grooved or furrowed surface.

**Symbiotic association:** A mutually beneficial relationship between two organisms.

**Tapered:** A stem that thins in diameter from the apex to the base.

**Teeth:** Small pointed structures found in the hymenium, on the surface of which the basidia are formed.

**Terrestrial:** Growing on the ground.

**Tomentose:** Having filaments or hairs, whether simple or branched.

**Toxic:** Capable of causing poisoning.

**Translucent:** A surface that transmits light diffusely, through which thing can be seen clearly.

**Tubes:** A particular type of hymenophore comprised of cylindrical structures, visible when the cap is cut lengthwise, where the spores develop. Umbo: A bulge or knob at the centre of the cap.

**Umbonate:** A cap that has a bulge or raised knob at the centre.

**Ungulate:** A horseshoe-shaped cap.

**Universal veil:** A membrane that fully covers the fruit body of the mushroom in the early stages of development.

**Uplifted:** The growth pattern of the mushroom in which the margin of the cap turns upward.

**Veil remnants:** Fragments of the partial or universal veil.

**Velutinous:** A surface covered with a compact layer of short, fine, soft hairs.

**Velvety:** Refers to surfaces that are covered with fine hairs, having the consistency of velvet.

**Venations:** A complex of veins (folds, lines or edges) on a surface. Ventricose: A structure that is wider in the middle than at either end. Verrucose: A surface containing wart-like growths.

**Viscid:** A cap or stem that has a slimy or viscous consistency.

**Volva:** A cup-like or sac-like structure that remains at the base of the stem as part of the universal veil.

**Wart:** A bulge or outgrowth found on the surface of the cap or stem.

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# Species Index

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