

**DIVERSITY, DISTRIBUTION AND MORPHOLOGICAL
CHARACTERIZATION OF WILD MACRO FUNGI FROM GAJNI
FOREST**

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CHARACTERIZATION OF WILD MACRO FUNGI FROM GAJNI
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BY

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CERTIFICATE

This is to certify that thesis entitled, “ Diversity, Distribution And Morphological Characterization Of Wild Macro Fungi From Gajni Forest ” submitted to the Faculty of AGRICULTURE, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of MASTER OF SCIENCE (MS) in PLANT PATHOLOGY, embodies the result of a piece of bona fide research work carried out by Registration No. 13-05284 under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.

I further certify that such help or source of information, as has been availed of During the course of this investigation has duly been acknowledged.

Dated: 02/12/19
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**DEDICATED TO
MY ALMIGHTY, BELOVED
FAMILY AND FARMERS
WHO FEED THE NATION**

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ABSTRACT

A detailed survey on macro fungi was made in Gajni forest, Sherpur, Mymensingh, which is located in between 24°18' and 25°18' north latitudes and in between 89°53' and 90°91' east longitudes. It is bounded by Meghalaya state of India on the north, Mymensingh and Jamalpur districts on the south with a wide range of ecosystem. The survey was conducted on July to December, 2018 to collect and record the biodiversity, distribution and morphology of wild Macro fungi. Collected macro fungi were washed with water and dried by drier. Permanent glass slides were also made from rehydrated basidiocarp for microscopic characterization. Morphology of basidiocarp and characteristics of basidiospore were recorded. Ecological features of those collected wild mushrooms and the collection sites such as location of collection, habit, host, frequency of its presence, density and environmental temperature, soil type and soil moisture conditions were also recorded during collection time. In this survey a total of 20 samples were collected and identified to fourteen species belonging eight families. Dominant species was *Ganoderma* species. The identified four species were from Ganodermataceae family and these are *Ganoderma applanatum*, *Ganoderma lucidum*, *Ganoderma tropicum* and *Ganoderma lobetum*. Another dominant species were from Agaricaceae family and these were *Agaricus bitroquis*, *Macrolepiota procera* and *Agaricus* spp. Other recorded species were *Chanterella cibarius*, *Termitomyces* sp, *Boletus edulis*, *Entoloma* sp, *Phlebopus marginatus*, *Russula crustosa* and *Russule nobilis*. Among them the highest frequency (85.75%) was recorded for *Ganoderma applanatum* and lowest frequency (7.14%) was recorded for *Phlebopus marginatus*. Similarly highest density (20.25%) was recorded for *Agaricus bitroquis* and followed by (15.85%) for *Ganoderma lucidum*. The lowest density was (2.14%) for *Phlebopus marginatus*. Collected macro fungi specimens were deposited to Sher-e-Bangla Agricultural University Herbarium of Macro fungi (SHMF). Findings of the present survey emphasized the importance and diversity of macrofungi in the Gajni forest, Sherpur, Bangladesh.

CONTENT

CHAPTER	TITLE	PAGE NO.
	ACKNOWLEDGEMENT	i-ii
	ABSTRACT	iii
	CONTENTS	iv-v
	LIST OF TABLE	vi
	LIST OF PLATES	vii
	LIST OF FIGURE	viii
I	INTRODUCTION	1-4
II	REVIEW OF LITERATURE	5-16
III	MATERIALS AND METHODS	17-21
	3.1.Experimental site	18
	3.2. Sampling Procedure	18
	3.3.Survey area and collection of mushroom samples	18
	3.4. Collection Site	18
	3.5.Morphological observation during collection	20
	3.6. Mushroom processing	20
	3.7. Drying	20
	3.8. Storage	20
	3.9. Morphology and microscopic characterization	20
	3.10. Habitat, distribution and diversity analysis	21

CHAPTER	TITLE	PAGE NO.
IV	RESULTS	22-51
	4.1 <i>Chanterelle cibarius</i>	23-25
	4.2 <i>Agaricus bitroquis</i>	26-27
	4.3 <i>Ganoderma applanatum</i>	28-29
	4.4 <i>Ganoderma lucidum</i>	30-31
	4.5 <i>Ganoderma tropicum</i>	32-33
	4.6 <i>Ganoderma lobetum</i>	34-35
	4.7 <i>Termitomyces</i> sp.	36-37
	4.8 <i>Phlebopus marginatus</i>	38-39
	4.9 <i>Macrolepiota procera</i>	40-41
	4.10 <i>Russula crustosa</i>	42-43
	4.11 <i>Boletus edulis</i>	44-45
	4.12 <i>Russulanobilis</i>	46-47
	4.13 <i>Entoloma</i> sp.	48-49
	4.14 <i>Agaricus</i> spp	50-51
v	DISCUSSION	56-60
VI	SUMMARY AND CONCLUSION	61-62
VII	REFERENCES	63-70

LIST OF TABLE

SL. NO	TITLE OF THE TABLE	PAGE NO
01	Morphological characteristics of collected macro fungi from Gajni forest, Sherpur.	52-55

LIST OF PLATES

SL NO	TITLE OF THE PLATES	PAGE NO
01	<i>Chanterelle cibarius</i>	25
02	<i>Agaricus bitroquis</i>	27
03	<i>Ganoderma applanatum</i>	29
04	<i>Ganoderma lucidum</i>	31
05	<i>Ganoderma tropicum</i>	33
06	<i>Ganoderma lobetum</i>	35
07	<i>Termitomyce ssp.</i>	37
08	<i>Phlebopus marginatus</i>	39
09	<i>Macrolepiota procera</i>	41
10	<i>Russula crustosa</i>	43
11	<i>Boletus edulis</i>	45
12	<i>Russule nobilis</i>	47
13	<i>Entoloma sp.</i>	49
14	<i>Agaricus spp</i>	51

LIST OF FIGURE

SL NO	TITLE OF THE FIGURE	PAGE NO
01	Survey area of Mushroom collection from Gajni forest, Sherpur.	19



CHAPTER I
INTRODUCTION

CHAPTER I

INTRODUCTION

A mushroom or toadstool is the fleshy, spore bearing fruiting body of a fungus, typically produced above ground on soil or on its food sources. Typical mushrooms are the fruiting bodies of the order Agaricales, Family Agaricaceae whose type genus is *Agaricus*, Basidiomycota division. There is a great diversity of mushrooms species. Mushrooms are the reproductive bodies or fruits of a fungus. The main body of the fungus is in the form of white thread like structures called mycelium.

This mycelium and its individual parts are microscopic. Since the body of the mushroom is usually dispersed over a relatively large area it is rarely noticed. In nature some species of mushrooms may have a body that spreads over hundreds of square miles.

Mushrooms contain no chlorophyll and most are considered saprophytes. That is, they obtain their nutrition from metabolizing non living organic matter. This means they break down and "eat" dead plants, like compost pile does.

The body of the mushroom stores nutrients and other essential compounds, and when enough material is stored and the conditions are right they start to *fruit* - produce mushrooms. It is a hidden kingdom. The part of the fungus that we see is only the "fruit" of the organism. The living body of the fungus is a mycelium made out of a web of tiny filaments called hyphae. The mycelium is usually hidden in the soil, in wood, or another food source. A mycelium may fill a single ant, or cover many acres. The branching hyphae can add over a half mile (1 km) of total length to the mycelium each day. If the mycelium produces microscopic fruiting bodies, people may never notice the fungus.

Mushrooms are macromycetes, they forming macroscopic fruiting bodies such as agarics, boletes, coral fungi, stinkhorns, bracket fungi, jelly fungi, puffballs and bird's nest fungi. They are fleshy, sub fleshy or sometimes they are leathery, woody and bear fertile surface either on lamellae or lining the tubes, opening out by means of pores. The tube bearing poroid members, as boletes and polypores and the lamellate members are called agarics. Among macrofungi, Basidiomycotina in particular they have attracted considerable attention as they have lot of source of new and novel metabolites with antibiotic, antiviral, phytotoxic and cytostatic activities. Mushrooms all alone are represented almost about 41,000 species, where approximately 850 species are already recorded from India (Deshmukh, 2004) and they are mostly belonging to Agaricales, which is also known as gilled mushrooms its because of their distinctive gills, or euagarics. The Agaricales has 33 extant families, 413 genera and over 13000 described species (Kirk *et al.*, 2008).

Basidiomycetes mushroom have been valued as both food and medicine for thousands of years. Basically Mushrooms not only counted as food, but also their wastage can be recycled into fertilizers and additives that utilized for tree plantations and improving soil conditions. They are low calorie food with a very little fat and are highly suitable for grossly fatty persons (Hyseyin *et al.*, 2009). They have high nutritive and medicinal values and contribute to a healthy diet, because of their rich source of vitamins, minerals and proteins (Garcha *et al.*, 1993). Many genera of microfungi are edible and rich in essential nutrients, such as carbohydrates, proteins, vitamins, mineral, fat, fibers and various amino acids (Okwulehie and Odunze, 2004). A major portion of the population consume mushrooms, because of its flavor, meaty taste, easy availability, and medicinal values (Moore and Chiu, 2001). The wild mushrooms are greater sources of protein and have a lower amount of fat than commercial mushrooms (Lillian *et al.*, 2008). Wild mushroom protein also hold considerable amounts of non-essential amino acids, such as arginine, glycine, glutamic acid, alanine, aspartic acid, proline and serine. These can be used for the food to effectively dealing with the malnutrition

problem (Manandhar, 2003). Mushrooms generally possess most of the quality of nutritious food as they contain many essential nutrients in good quantity (Fukushima, 2000). Several number of reviews were published on the nutritional value of mushrooms, so we shall not elaborate about the subject here (Kurtzman,1993; Kurtzman, 1995; Kurtzman, 1997).Therefore, it is essential to give an efforts to introduce new mushrooms as a source of food and medicinal interest (Suseem and Mary, 2013).

The species diversity of fungi and their natural beauty occupy prime place in the biological world. The scope is limitless and this is high time to survey, collect, conserve, record and identifying the biodiversity, habitat and morphology in general and fungal diversity in particular as no one knows when and how some these valuable forms might be lost for forever. With the view in mind, the research work was undertaken to study the biodiversity and habitat of mushroom grown in forest regions of Bangladesh and to study the morphological characteristics of different mushrooms identified in selected forest of Bangladesh.

Objectives of this studies

- To collect and identify the wild Macro fungi up to the genus and species level from Gajni forest, Sherpur, Bangladesh.
- To determine the diversity, distribution, habitat and morphology of wild Macro fungi of Gajni forest, Sherpur, Bangladesh.



CHAPTER II

REVIEW OF LITERATURE

CHAPTER II

REVIEW OF LITERATURE

Forests of Bangladesh can be grouped into four broad categories depending on their location, nature and type of management. They are (i) mangrove forest, (ii) tropical moist deciduous forest, (iii) tropical evergreen and (iv) semi evergreen forest and village forests. Among them the mushroom biodiversity of tropical moist deciduous forest region is described here.

Marzana *et al.* (2018) carried out a survey which was made in Rangamati district of Chittagong hill tracts to collect and record the morphological and ecological variability of macrofungi fruiting body. Collected macrofungi were washed with water and dried by electric air flow drier. Permanent glass slides were made from rehydrated basidiocarp for microscopic characterization. Morphology of basidiocarp and characteristics of basidiospore were recorded. Ecological features of the collected macrofungi and the collection sites such as location of collection, host, habit, frequency of occurrence, density and environmental temperature, soil type and soil moisture conditions were also recorded during collection time. A total of 66 samples of macrofungi were collected, recorded, photographed and preserved. Twenty species of macrofungi were identified under 17 genera and 15 families. The highest frequency of occurrence (44.44%) was recorded for *Xylaria polymorpha*. The highest density was found for *Xylaria polymorpha* also (55.56%) followed by *Coprinus disseminatus* (52.78%), *Auricularia cornea* (38.89%), *Xylaria hypoxylon* (27.78%) and *Clavulina coralloides* (16.67%). This is the first detail reports on macrofungi collected from Rangamati Hill Tracts forest of Bangladesh.

Rubina *et al.* (2017) investigated in National Botanical Garden, Dhaka located at 24°00' N (Latitude), 90°00' E (Longitude) to document the morphology, diversity and distribution of macro fungi during the rainy seasons. Total of 23 macro fungi samples were collected and identified to 20 species under 10 genera and 10 families. The predominant genera were *Ganoderma* sp., *Lepiota* sp., *Daedaleopsis*

sp., *Russula* sp., *Psathyrella* sp., *Lycoperdon* sp., *Crepidotus* sp., *Psilocybe* sp., *Flammulina* sp. and *Cantharellus* sp. The survey revealed that six species are edible, thirteen species are inedible but among them nine species have medicinal value and only one species of unknown uses. The maximum density of occurrence was exhibited by *Psilocybe cubensis* (45%) followed by *Lepiota* sp. (40%), *Ganoderma pfeifferi* (35%) and *Ganoderma lucidum* (25%).

Das and Aminuzzaman (2017) conducted a study on Diversity Of Fleshy macro fungi in Mangrove Forest region of Bangladesh they collected 72 macro fungi and identified to 21 genera and 32 species. The dominant species were *Agaricus campestris*, *Agaricus xanthodermus*, *Agaricus silvicola*, *Agaricus aungustus*, *Agaricus arvensis*, *Agaricus bitorquis*, *Coprinus silvaticus*, *Coprinus plicatilis*, *Marasmius* sp., *Marasmius siccus*, *Marasmius nigrodiscus*, *Marasmiellus albuscorticis*, *Volvariella hypopithys*, *Volvariella speciosa*, *Crepidotus alabamensis* and *Crepidotus applanatus*. The maximum frequency (75%) was recorded for *Agaricus silvicola*, *Lepiota* sp., *Marasmiellus albuscorticis* and *Volvariella speciosa*. The maximum density was 287.5% recorded for *Coprinus silvaticus*. The predominant families were Agaricaceae, Marasmiaceae, Pluteaceae, Crepidotaceae and Mycenaceae.

Rashid *et al.* (2017) was conducted a survey to study the biodiversity, habitat and morphology of mushroom grown in leaved, deciduous and mixed forest of Bangladesh. A total of 117 samples were collected from nine selected districts of Bangladesh viz. Barisal, Borguna, Patuakhali, Pirojpur, Jhalokathi, Bandorban, Dhaka, Gazipur and Tangail. About 12 different species were found under 10 families viz. Amanitaceae (*Amanita bisporigera*), Pyronemataceae (*Aleuria aurantia*), Boletaceae (*Boletus subvelutipes*), Agaricaceae (*Agaricus* sp.), Tricholomataceae (*Callistosporium* sp.), Marasmiaceae (*Gymnopus* sp.), Cortinariaceae (*Cortinarius corrugatus*), Mycenaceae (*Mycena eipterygia*), Entolomataceae (*Nolanea strictia*), Ganodermataceae (*Ganoderma lucidum*,

Ganoderma applanatum, *Ganoderma tsuage*). The predominant genera were *Amanita*, *Aleuria*, *Agaricus*, *Boletus*, *Mycena*, *Cortinarius*, *Nolanea* and *Ganoderma*.

Das and Aminuzzaman (2017) conducted a survey at Sundarban (Mangrove), the largest tidal halophytic forest in the world lies a little south to the Tropic of Cancer between the latitudes 21°30'N and 22°30'N, and longitudes 89°00'E and 89°55'E. This forest is the greatest source of diverse xylotrophic fungi. In a survey program 20 species of xylotrophic fungi belongs to 13 genera were identified under seven families such as Polyporaceae, Ganodermataceae, Hymenochaetaceae, Fomitopsidaceae, Xylariaceae, Steccherinaceae and Gloeophyllaceae. The predominant genera were *Ganoderma*, *Trametes* and *Inonotus*. The maximum frequency (75%) was recorded for *Daedaleopsis confragosa* and 50% for *Trametes elegans*, *Trametes conchifer*, *Polyporus sanguineus*, *Ganoderma curtisii* and *Irpex lacteus*. The maximum density was 31.82% for *Pycnoporus sanguineus* which was found on the Sundari (*Heritiera fomes*) tree. This is the first detailed investigation on Xylotrophic fungi in mangrove forest regions of Bangladesh.

Aminuzzaman and Das (2017) conducted an investigation that was carried out in Bogra district under the Social forest region of Bangladesh to study the biodiversity, distribution and morphology of wild macro fungi. A total of 32 fungal samples were collected and identified to 16 species belong to two genera under 7 families. The polypore genera were *Ganoderma* sp. (87.5% of collected samples) and *Polyporus* sp. (12.5%). The maximum frequency of occurrence (75%) was exhibited by *Ganoderma lucidum*, *Ganoderma multipileum*, *Ganoderma boninense*, *Ganoderma* sp. and the maximum density was exhibited by *Ganoderma resinaceum* (66.67%).

Rumainul and Aminuzzaman (2016) conducted a study on Macro Fungi Biodiversity at the Central and Northern Biosphere Reserved Areas of Tropical Moist Deciduous Forest Region of Bangladesh. They were identified 8 genera and

9 species. The predominant genera were *Trametes*, *Daedaleopsis*, *Collybia* and *Armillaria*.

Rashid *et al.*(2016)conducted a survey to study the biodiversity as well as the distribution of wild mushrooms,which naturally grow, in different localities, at different seasons, in the southern region of Bangladesh. A total 24 species of mushrooms belonging to 17 genera and 14 families wereidentified. Those mushrooms were collected between July and October, 2013 and 2014, accordinglyfrom 16 sub-districts of Barisal, Patuakhali, Borguna, Pirojpur, Jhalokhathi districts, which situated inthe southern region of Bangladesh. The identified genera were *viz.*, *Amanita* sp., *Agaricus* sp., *Ganoderma* sp., *Armillaria* sp., *Coprinus* sp., *Cortinarius* sp., *Hebeloma* sp., *Mycena* sp., *Lepiota*sp., *Lycoperdon* sp., *Macrolepiotia* sp., *Daldinia* sp., *Tuber* sp., *Volvariella* sp., *Steccherinum* sp., *Hypholoma* sp. and *Coprinellus* sp. Moreover, the maximum frequency of occurrence in this surveywas exhibited by *Ganoderma applanatum*, *Amanita vaginata* and *Agaricus silvicola* (18.75%),whereas, the maximum density was recorded for *Coprinus silvaticus* (48.83%).

Rahaman *et al.*(2016) was conducted a survey in 5 districts namely Kushtia, Chuadanga, Jessore, Satkhira and Khulna. A total of 16 mushroom species belong to 10 genera, under 8families were recorded during the survey. *Lepiota cristata* was found abundantly in the survey areas among the other collected species and it exhibited the maximum frequency of occurrence (25%), whereas the maximum density (13.51%) was recorded for *Hypholoma fasciculeare* and *Coprinellus micaceus*, followed by *Lepiota cristata*, *Coprinus comatus* and *Mycena californiensis* (10.81%). Furthermore, the density of *Gymnopiluspurpuratus*, *Coprinus sterquilinus*, *Marasmius oreades*, *Hypholomacapnoides* and *Coprinellus plagioporus* were recorded as 8.10%. Moreover, *Lepiota cristata* was distributed in Daulatpur of Kushtia and Koira of Khulna districts in the south western region of Bangladesh. This is the first report of macro fungi biodiversity and their distribution in the south western region of Bangladesh.

Hosen *et al.* (2015) first identified *Hygrocybe umbilicata*, which is a new waxcap of Hygrophoraceae, is formally described from Bangladesh based on morphological data and molecular evidence of the nuclear ribosomal internal transcribed spacer (ITS) region. This species represents the first record of the genus *Hygrocybe* for this country. It can be easily recognized by its brilliantly scarlet red with umbilicate pileus, lemon yellow stipe, white short decurrent and distant lamellae, subglobose basidiospores, and abundant clamp connections in tissues. This species belongs to genus *Hygrocybe* subg. *Pseudohygrocybe* sect. *Coccineae* subsect. *Squamulosae*.

Rumainul *et al.* (2015) identified 24 Macro fungi species under 14 genera from tropical moist deciduous forest region of Bangladesh and they have reported some predominant genera as *Ganoderma* sp., *Lepiota* sp., *Marasmius* sp. And *Collybia* sp. from the same forest region.

Kinge and Mih (2015) studied the diversity and distribution of species of *Ganoderma* in south western Cameroon and after morphological and after morphological and molecular characterization of 57 species they found 17 species of *Ganoderma*. They reported two species *G. tornatum* and *G. chalceum* as known record for Cameroon and four species viz. *G. weberianum*, *G. cupreum*, *G. steyaertanum* and *G. zonatum* are new records for Cameroon.

Hosen *et al.* (2015) identified new species of *Amanitacinereovelatais* found associated with *Shorea robusta* and recently reported from Bangladesh .

Egbe *et al.* (2013) collected a total number of 177 macro fungal species belonging to 83 genera and 38 families were recorded. Those Species richness was higher in the rainy seasons (134 species) than in the early dry seasons (89 species) and tended to decrease with altitude, with 116 and 112 species for low and high altitudes, respectively. Eighty-eight species were recorded only in the rainy seasons, 43 species in the early dry seasons only, and 46 species were common to both seasons. Sixty-five species were found only in the low altitude, 61 species only in the high altitude, and 51 species were common to both altitudes.

Auricularia auricular was the most abundant species during the rainy seasons, while *Coltricia cinnamomea* was rare during the rainy seasons, and the most abundant during the dry seasons.

Hosen *et al.* (2013) identified A new monotypic genus in the Boletaceae, *Borofutus*, typified by *B. dhakanus*, is described using morphological and molecular evidence. This is a putatively ectomycorrhizal fungus associated with *Shorea robusta* and which is in Bhawal National Park, Gazipur, Bangladesh.

Hosen and Yang (2013) recorded *Coniolepiota spongodes* (Agaricaceae, basidiomycota) from Bangladesh and China.

Chandulal *et al.* (2013) identified 17 species were identified belonging to two different classes namely, Gastromycetes - *Daldinia concentrica* [(Xylariaceae) (cramp ball)], *Lycoperedon pyriforme*[(Lycoperdaceae, edible) (wood or stump puff ball)], *Scleroderma citrinum* (Sclerodermataceae, edible); Hymenomycetes *Cantharellus umbonatus*, *Coriolus versicolor* (Polyporaceae, inedible), *Schizophyllum commune* (Schizophyllaceae, inedible) (the split gill), *Ganoderma lucidum* (Ganodermataceae), *Ganoderma applanatum* (ganodermataceae), *Laetiporus sulphureus*(Polyporaceae, edible), *Lepiota organensis*, *Collybia butyracea*, *Lentineullus cochleatus* (Auriscalpinaeae, edible), *Galerina unicolor* (Hymenogatraceae), *Citocybe flaccida* (Trichomataceae, edible), *Oudemansiella redicata* (Physalacriaceae, edible), *Hygrophorus eburnes* (Hygrophoraceae, edible) and *Agaricus campestris* (Agaricaceae, edible). Their investigation proved that there existance of a distinct fleshy fungi biodiversity in South Gujarat, India.

Tapwal *et al.* (2013) was conducted a survey in Jeypore Reserve Forest located in Assam, investigated the diversity of a macro fungi associated with different tree species. The diversity of broad leaves trees and high humidity during monsoon period favours Â ideal growth of diverse group of macrofungal fruiting bodies. Almost 30 macro fungal species representing 26 genera belonging to 17 families were collected from six different sites in the study area. There maximum six genera

assignable to family Polyporaceae, five genera to Russulaceae, three genera to Agaricaceae, two genera to Ganodermataceae and Cantharellaceae each and rest of the families were represented by single genus only. The ecological preference of the species revealed that maximum (17) species were saprophyte, living on dead substrates or decaying wood debris, ten species were found associated with roots of higher trees, while three species were found parasitic. Overall 20 species were found edible including some species having medicinal utilization. The present study revealed that maximum frequency of occurrence was exhibited by *Trametes versicolor* and *Schizophyllum commune* (83.33%), followed by *Microporus xanthopus*, *Pycnoporus sanguineus* (66.67%) and *Coprinus disseminates* (50%). The rest of the species exhibited the frequency distribution ranging between 16.67-33.33%. The maximum density was recorded for *Schizophyllum commune* (126.67%) followed by *Trametes versicolor* (120%) and *Xylaria polymorpha* (93.33%). The density of rest of the species were ranged between 3.33- 6.67%.

Farid *et al*, (2013) conducted a survey and forty four species of mushrooms belonging to twenty nine genera were collected and identified from different localities in Erbil Governorate of Kurdistan region. The identified species and varieties spread over in following genera viz., *Agaricus* spp., *Clitocybe* spp., *Collybia* spp., *Coprinus* spp., *Cortinarius* spp., *Craterellus* sp., *Crepidotus* sp., *Exidia* sp., *Fomes* spp., *Galerina* sp., *Hebeloma* sp., *Helvella* sp., *Auricularia auricula-judae*, *Hygrocybe pratensis*, *Inocybe* sp., *Lactarius* spp., *Laccaria* sp., *Mycena* sp., *Peziza* sp., *Pluteus* sp., *Psathyrella* sp., *Panellus* sp., *Paxillus atrotomentosus*, *Russula fellea*, *Scutellinia scutellata*, *Trichloma* spp., *Tyromyces* spp., *Lepiota* sp. and *Cystoderma*, the last two genera were the new record in Erbil, Kurdistan region-Iraq.

Pushpa and Purushothama (2012) conducted an experiment in Bangalore, India and they investigated to give a broad picture of biodiversity of mushrooms belonging to the class Basidiomycetes in Bangalore. The survey was conducted from June 2007 to November 2010 in 8 different places which included scrub jungles and urban

places in around Bangalore. A total of 90 species in 48 genera belonging to 19 families in 5 orders were recorded, 28 species were found to be recorded for the first time India. Among the collected species *Coprinus disseminates* followed by *Coprinus fibrillosis* and *Schizophyllum commune* was found to be abundant in their occurrences.

Dwivedi *et al*, (2012) deals with the diversity of macrofungi in semi evergreen and moist deciduous forest of Amarkantak where more than 50 samples were collected which is situated in Madhya Pradesh in India. Amarkantak is located at 22°40'N 81°45'E/ 22.67°N 81.75°E. The mean daily temperature ranges from 10.9°C (January) to 39.1°C (May) with relative humidity of 60%. Amarkantak region is known for diverse macro fungal population. Extensive surveys were conducted from July 2010 to September 2010. Where collection, characterization, preservation and photo of macro fungal carried the genera like are *Agaricus*, *Amanita*, *Nyctalis*, *Russula*, *Boletus*, *Macrolapiota*, *Ganoderma*, *Termitomyces* were identified.

Srivastava *et al*, (2011) found four species of *Termitomyces* in the Gorakhpur forest division, India naming *Termitomyces heimii*, *Termitomyces clypeatus*, *Termitomyces mammiformis* and *Termitomyces microcarpus* characterized by different morphological traits.

Onyango *et al*, (2011) carried out the morphological characteristics and spawn production procedures of 3 Kenyan native strains of wood ear mushroom [*Auricularia auricula*(L. ex Hook) Underw]. And then he was selected and morphologically characterized nine basidiocarps in three forest reserves within Kakamega Forest in Western Kenya. In this experiment mycelia were raised on 2% malt extract agar and bottle culture technology was used for spawn production. He also found variations in external basidiocarps features such as color, texture, shape and presence of veined surfaces where microscopic analysis of internal basidiocarp structures did not reveal significant differences.

Karwa and Rai (2010) Tapping into the edible fungi biodiversity of Central India. *Biodiversitas* 11: 97-101. Melghat forest in Central India was surveyed for occurrence of wild edible fungi and their prevalent favorable ecological factors. Studies were carried out for three consequent years in the months of June to February (2006-2008). A total of 153 species of mushrooms were recorded, collected, photographed and preserved. The enormous biomass in the forest favors variety of edible and medicinal mushrooms. Dominating species belong to genera *Agaricus*, *Pleurotus*, *Termitomyces*, *Cantharellus*, *Ganoderma*, *Auricularia*, *Schizophyllum*, *Morchella*, etc.

Hanlon *et al.* (2010) studied The diversity and distribution of agaricomycete species in the Republic of Ireland (ROI) is examined and the records are compared with similar records from Northern Ireland, England, Scotland and Wales. They recorded number of agaricomycete species from Ireland is much lower than in the other countries examined. ROI has 100, 700, 1300 and 2200 less species than NI, Wales, Scotland and England respectively. Those species records according to major taxonomic clades are examined, it is evident that under-recording of agaricomycete species from ROI is common throughout all of the clades. Estimates of potential agaricomycete diversity in ROI indicate that 25 of the 26 counties have less than half of their likely agaricomycete diversity recorded. Agaricomycete clades which have been reasonably well recorded and those which suffer from severe under-recording in Ireland have been identified, and preliminary lists of the 50 most common agaricomycete and of possibly threatened agaricomycetes in ROI have been created. One of the main reasons for the low number of species recorded in ROI is the lack of both professional and amateur mycologists conducting periodic surveys. This paper makes recommendations as to how the true agaricomycete diversity of Ireland can be discovered.

Ram *et al.* (2010) collected Several edible fleshy fungi grow wild in Eastern Uttar Pradesh forest during the rainy season on dead and decaying plant or animal remains. These fleshy fungi are obviously nontoxic as these have been intimate

human consumption since antiquity. However there are only few species of fleshy fungi which have been accepted as safe food by the civilized world, while many fleshy fungi have not yet recognized. Field survey was conducted for collection of various edible fleshy fungi from different localities of the Eastern Uttar Pradesh forest. The collected edible fleshy fungi were studied for their macroscopic detail partening the habit, habitat, morphology and other phenotypic parameter noted in fresh form.

Niazi *et al*, (2006) investigated the Biodiversity of Mushrooms and ectomycorrhizas from Himalayan Moist Temperate Forests of Pakistan, *Russula brevipes* was found associated with *Pinus wallichiana*. *Russula brevipes* and its morphotypes/ ectomycorrhiza have been described and illustrated. The fungus and its mycorrhiza are new records for Pakistan.

Agrahar and Subbuakshi (2005) conducted an experiment on Meghalaya mushrooms. Meghalaya is a hilly state projecting like a monument between the two plains of Assam in the north and Bangladesh in south. It has a wide variation in altitude, topography and agro climate. The region in general is blessed with a rich forest growth, with about 0-50% of the geographical area covered with lush green forest. These forest abound in macro fungi which are found growing on the forest floor, wigs and branches, rotting plant parts, in mycorrhizal association with higher plants, etc. They conducted a survey to identify the edible fungi of this region with respect to their morphological distribution, habitat and edibility.

Chang and Miles (1988) conducted that there are about 3000 different species of edible mushroom in this world. But among them about 80 have been grown experimentally, 20 cultivated commercially and 4-5 produced on industrial scale throughout the world. Moreover humans have been consuming fungi for sustenance, medicine and culinary delight since ancient times. Some fungi are purposely cultivated, but most edible fungi are gathered from the wild.

Nilsson and Presson (1978) recorded the color, shape and size of the fruiting body of fleshy fungi can vary tremendously and to avoid a poisonous species it is most important to properly identify the mushrooms. They reported mushroom species as the indicators of the forest life system. Data of different vegetation types is important for planning to determine biodiversity and habitat at the community and species level they reported. Their habitat and climate are major factors that indicate their biodiversity.

Jacob *et al.* (1796) described *Agaricus emeticus* (most gilled fungi were placed in the *Agaricus* genus in the early days of fungal taxonomy), this mushroom was later transferred to the genus *Russula*.



CHAPTER III

MATERIALS AND METHODS

CHAPTER III

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3.1. Experimental site

The experiment was conducted in the Laboratory, Department of Plant Pathology , Sher e Bangla Agricultural University (SAU), Dhaka.

3.2. Sampling Procedure

A pre-designed collection procedure and data analysis procedure was applied to collect information on biodiversity, distribution, habitat and morphology of mushrooms from the above mentioned regions of Bangladesh.

3.3. Survey area and collection of mushroom samples

Survey was carried out in Gajni forest , Sherpur, Mymensingh, Bangladesh during July to December 2018 to determine the morphological variability in the mushrooms population following Hailing (1996). All of those mushrooms were collected from their natural habitat, minutely inspected, collected and brought to laboratory for detailed analysis. The collected fleshy fungi were studied for their habit, habitat, distribution , morphology and other phenotypic parameter in fresh form.

3.4. Collection Site

Collection sites was Gajni forest, Sherpur, Mymensingh. Minimum and maximum temperature was 30°C and 34°C (Fig:1). The dominant tree species of this area were Teak/Segun (*Tectona grandis*), Gamari(*Gmelina arborea*), Koroï (*Albizia procera*), Mahogany (*Macrophylla mahogoni*), Sisso (*Dalbergiasissoo*), Rain tree (*Albizialebeck*), Akashmoni (*Acacia auriculiformis*), Banyan (*Ficus benghalensis*) and Jackfruit (*Artocarpus heterophyllus*).

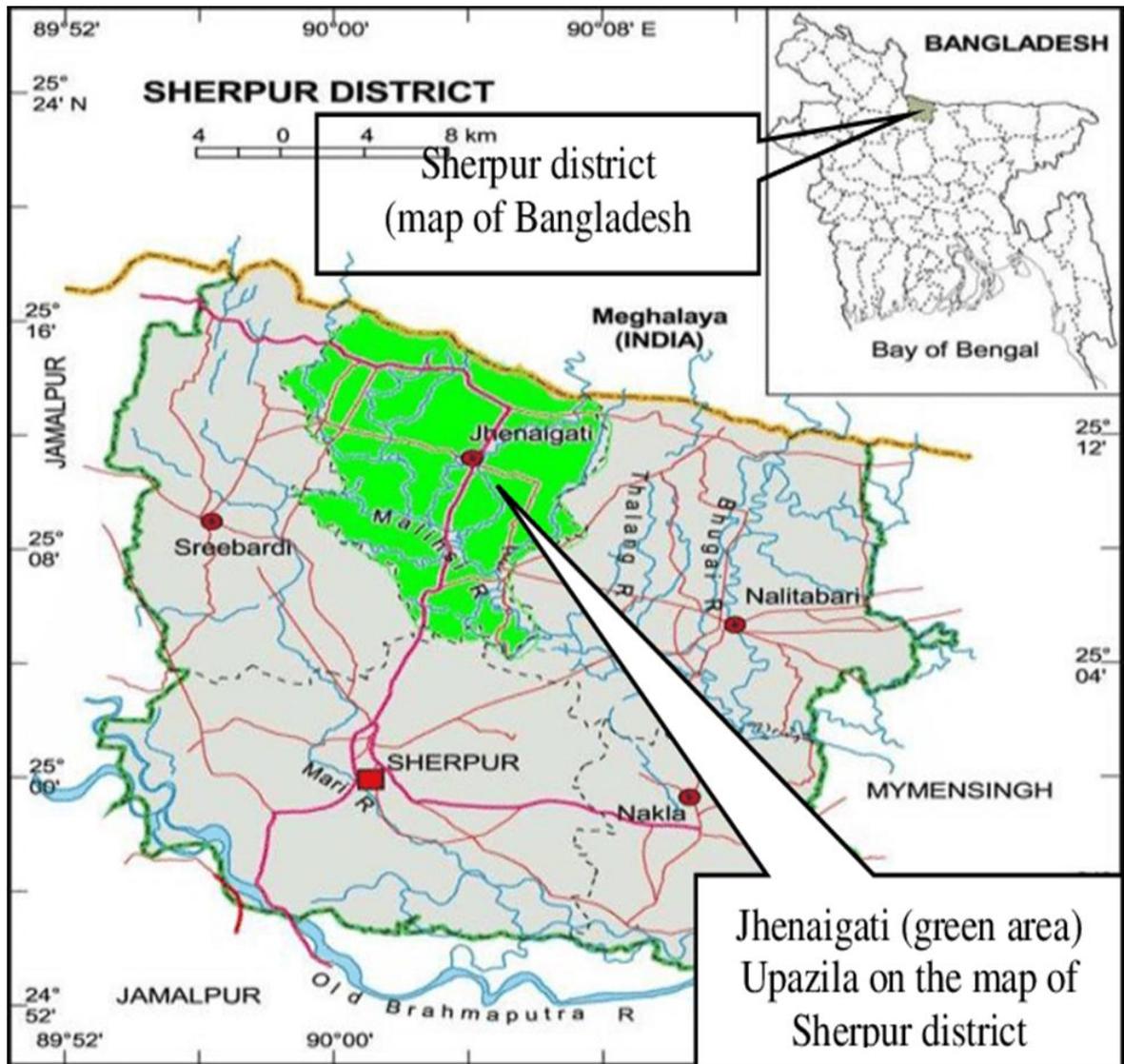


Fig 1: Survey area of Mushroom collection from Gajni forest, Sherpur.

3.5. Morphological Observation during Collection

Data on the following parameters were recorded after collection of the specimens for identification of mushrooms such as locality, habitat, type of soil, forest type, size of the fructification, carpophores shape, umbo, scale, the gills, color, gills edges, stipes, length, width, color, shape, type of veil, annuls (position), volva Cap color, cap surface, cap margin, cap diameter, stipe length, gill attachment, gill spacing following Srivastava *et al.* (2010).

3.6. Mushroom processing

After collection of mushrooms photographs were taken in different angle and some morphological data viz. size of fructification, pileus diameter, stipe length, and their color were recorded. Mushrooms were dried and processed following (Kim, 2004).

3.7. Drying

Collected samples were cleaned and dried by dryer which easily remove moisture from collected mushroom within 5-7 days depending on the structure and texture of the species. (Kim, 2004)

3.8. Storage

Storage of dried mushroom specimen was done in Ziploc poly bag during research period for further study. Silica gel was used at the rate of 10% of dry basis during the storage period (Kim, 2004).

3.9. Morphology and Microscopic Characterization

The basidiocarps were rehydrated by soaking in water for few minutes before analyzing their morphology. Qualitative characters such as color, shape, and presence of hymenia were evaluated by eye observation while texture was determined by feeling the back and top surfaces using fingers. Most of the morphological data were recorded during collection period that is when the mushroom was in fresh form. Permanent glass slides were made from rehydrated basidiocarps with the aid of a sharp surgical blade for the microscopic

characterization. Basidiocarps were immersed in cotton blue stain and glycerin and placed on glass slides and covered with cover slips. Furthermore, the spore size was measured using Motic microscope with the magnification of 40x (Svrcek, 2000). The final identification and classification done by comparing the previously recorded characteristics of mushroom following the color dictionary of mushroom written by Dickinson and John (Dickinson and John, 1982), the mushroom guide and identifier by Jorden (Jorden, 2000) and the mushroom identifier by Pegler and Spooner (Pegler and Spooner, 1997).

3.10. Habitat, Distribution and Diversity Analysis

The mushrooms were found in an association with various substrata. The surrounding environment, temperature, soil pH, moisture condition and vegetation were recorded for the biodiversity of mushroom. The soil pH and moisture were measured by pH meter. On the other hand, the air temperature was measured by thermometer during the collection. Collected samples were wrapped with polybag and brought into the laboratory for further study. The distribution of mushrooms on the locality was also recorded. The frequency and density of different species has been determined by the following formulas (Zoberi, 1973).

$$\text{Frequency of fungal species (\%)} = \frac{\text{Number of site in which the species is present}}{\text{Total number of sites}} \times 100$$

$$\text{Density (\%)} = \frac{\text{Total number of individual of a particular species}}{\text{Total number of species}} \times 100$$



CHAPTER IV

RESULTS

CHAPTER 4

RESULTS

Present investigation was carried out to determine biodiversity and distribution of wild macro fungi from Gajni forest region of Bangladesh during July to December, 2018. The minimum and maximum temperature was 31°C and 34°C accordingly, during the survey period. Furthermore, the average annual rainfall was about 1809.4mm. The dominant tree species in the survey areas were Sisso (*Dalbergiasissoo*), Rain tree (*Samanea saman*), Mehogoni (*Swietenia macrophylla*), Babla (*Acacia nilotica*), Koroi (*Albiziarichardiana*), Coconut (*Cocos nucifera*), Akashmoni (*Acacia auriculiformis*), Banyan (*Ficus benghalensis*) and Jackfruit (*Artocarpus heterophyllus*).

Biodiversity, distribution and morphological characterization of collected mushrooms were described below:

Collection no: 4.1

Name : *Chanterelle cibarius*

Family : Cantharellaceae

Locality : Gajni Forest

Temperature of the Location: 34⁰C

Division/Region : Mymensingh

Macroscopic Characters:

Colour (young) was creamy, Colour (mature) was creamy, Length 3cm, Width 3.5cm, Spore bearing surface under cap was Gills.

Pileus

Cap of the carpophores shape was Umbilicate, Pileus size was 3.5cm. Pileus colour was white, surface characters and zonation was smooth. Pileus margin was regular, pileus cuticle was half peeling, texture of the fruiting body was soft, Flesh odor was Fairnaceous.

Lamellae present, Gill attachment was Adnate, Gill color was white, shape and width was moderately broad, gill spacing was close, lamellulae was present, forking pattern was branched.

Stipe

Stipe present, size was 1.5cm, shape was equal, position was central, surface characteristics was moist, colour and colour changes was cream, firmness fleshy, annulus was absent, volva was absent, scale was absent, umbo was absent.

Cultural Characteristics

Colony growth pattern was irregular. Colony colour was creamy, colour changes during the growth of mycelium on medium was white, no smell from culture was emitted.

Ecology

Found on soil, forest type mixed, Type of association habit is Scattered. Constancy of occurrence was Abundant. Type of soil was Clay Loom. Factors affecting their distribution was moderately moist weather. Size of fructification was 2.4×3.4 cm. The frequency of its presence was 14.28% and density was 7.5%.

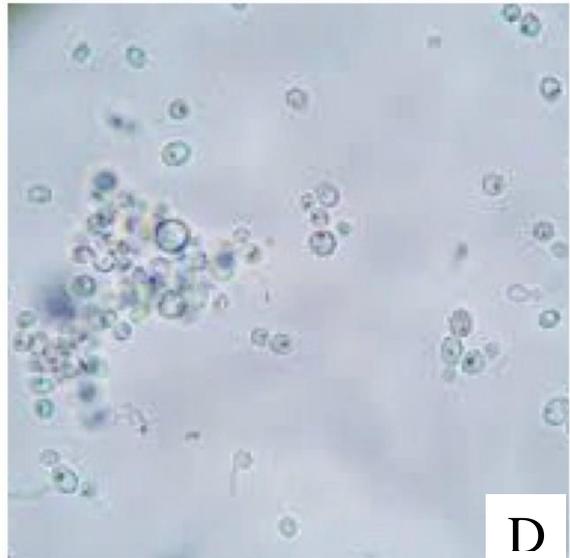


Plate no 1: *Chanterelle cibarius*; Fruiting bodies from different angle (A,B,C), Spores (D) ($\times 100$).

Collection no: 4.2

Name : *Agaricus bitroquis*

Family : Agaricaceae

Locality : Gajni Forest

Temperature of the Location: 34⁰C

Division/Region : Mymensingh

Macroscopic Characters:

Colour (young) was white, Colour (mature) was creamy, Length 3.5 cm, Width 4 cm, Spore bearing surface under cap was Gills.

Pileus

Cap of the carpophores shape was depressed, Pileus size was 3.5cm. Pileus colour was white, surface characters and zonation was smooth. Pileus margin was regular, pileus cuticle was half peeling, texture of the fruiting body was soft, Flesh odor was Fairnaceous.

Lamellae present, Gill attachment was Adnate, Gill color was white, shape and width was moderately broad, gill spacing was close, lamellulae was present, forking pattern was branched.

Stipe

Stipe present, size was 1.5cm, shape was equal, position was central, surface characteristics was moist, colour and colour changes was cream, firmness fleshy, annulus was absent, volva was absent, scale was absent, umbo was absent.

Cultural Characteristics

Colony growth pattern was irregular. Colony colour was creamy, colour changes during the growth of mycelium on medium was white, no smell from culture was emitted.

Ecology

Found on soil, forest type mixed, Type of association habit is Scattered. Constancy of occurrence was Abundant. Type of soil was Clay Loom. Factors affecting their distribution was moderately moist weather. Size of fructification was 3.1×4.5 cm. The frequency of its presence was 70% and density was 20.25%.

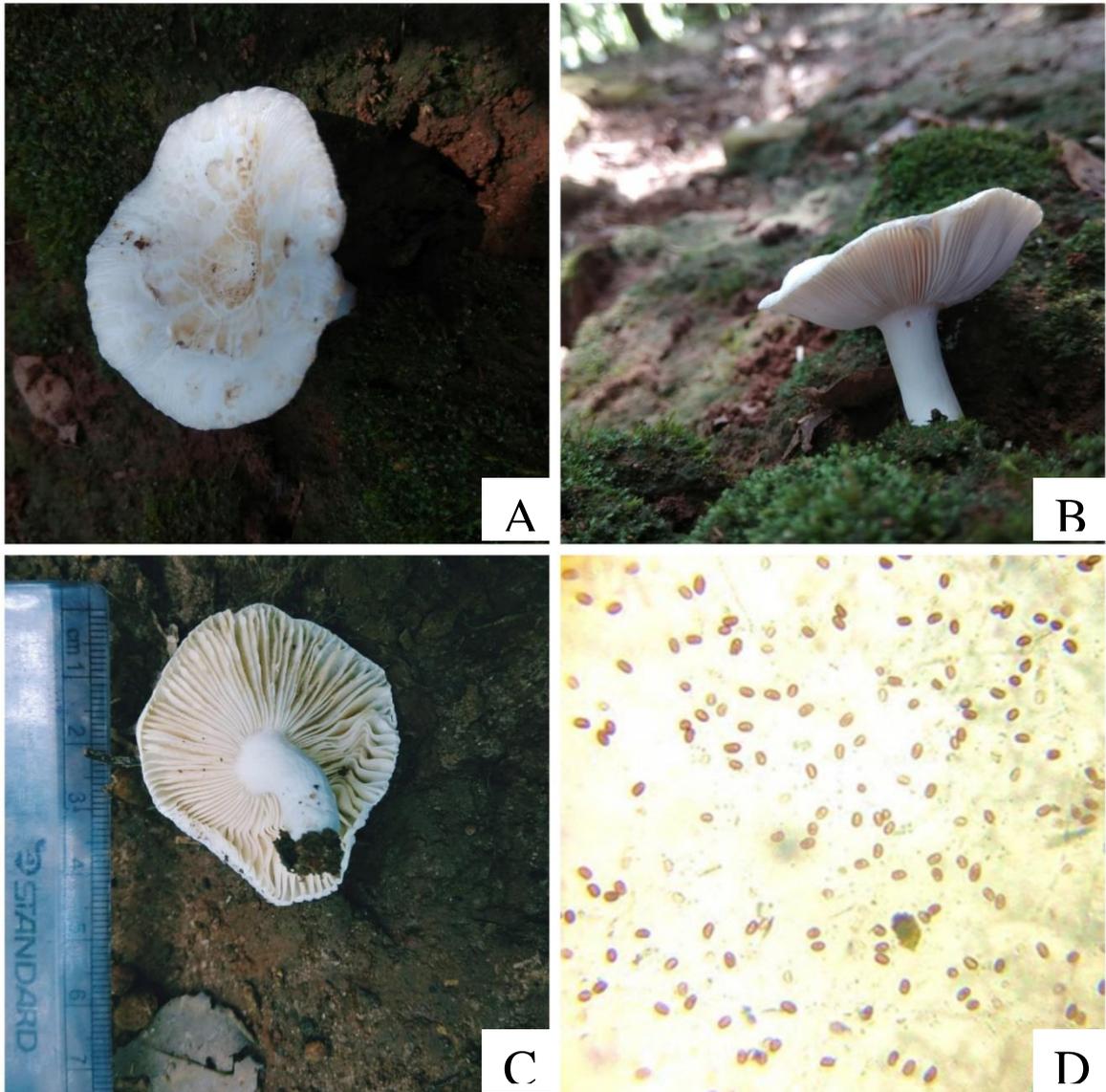


Plate no 2: *Agaricus bitroquis*; Fruiting bodies from different angle (A,B,C), Spores (D) (×100).

Collection no:4.3

Name : *Ganoderma applanatum*

Family : Ganodermataceae

Locality : Gajni Forest

Temperature of the Location: 32⁰C

Division/Region : Mymensingh

Macroscopic Characters:

Colour (young) was brown, Colour (mature) was brown, length 13cm,width 20 cm, Spore bearing surface under cap was Ridge .

Pileus

Cap of the carpophores shape was Infundibuliform, Pileus size was 20 cm. Pileus colour was Brownish, surface characters and zonation was Dry. Pileus margin was incurved, pileus cuticle was not peeling,texture of the fruiting body was tough, flesh odor was Disagreeable. Lamellae absent.

Stipe

Stipe ansent, veil absent. Annulus was absent, volva was absent, scale was absent, umbo was absent.

Cultural Characteristics

Colony growth pattern was irregular. Colony colour was brown. colour changes during the growth of mycelium on medium was brown, Emitted smell from culture was present.

Ecology

Habitat was bark wood of the *Shorea robusta*, forest type mixed, Type of association habit is Caepitose Cluster. Constancy of occurrence habitat was Abundant. Type of soil was clay loom. Factors affecting their distribution was More Moist weather. Size of Fructification was 5-6 × 6-8cm. The frequency of its presence was 85.72% and density was 14.28%.

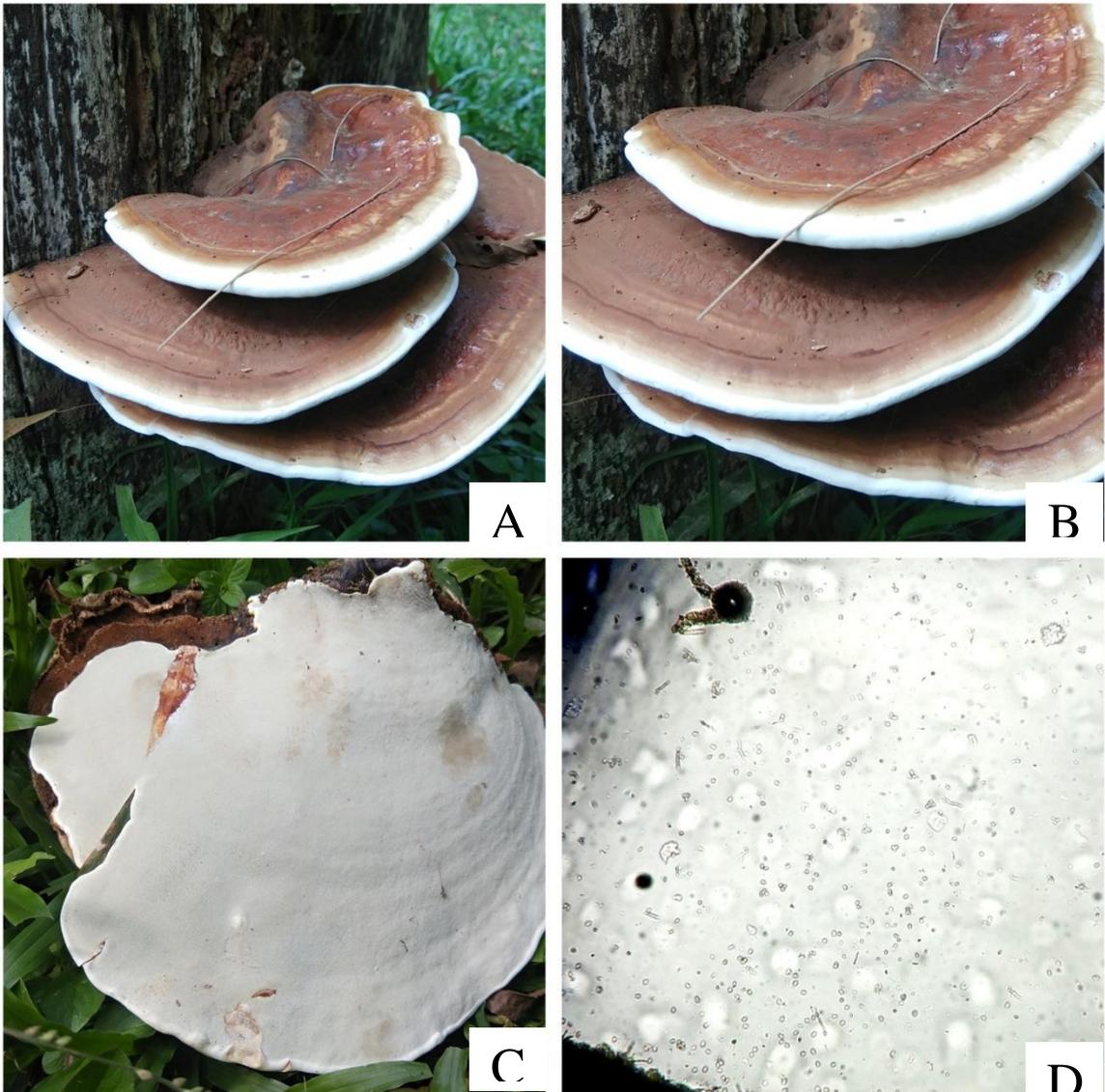


Plate no 3: *Ganoderma applanatum*; Fruiting bodies from different angle (A,B,C), Spores (D) ($\times 100$).

Collection no: 4.4

Name : *Ganoderma lucidum* (Reishi Mushroom)

Family : Ganodermataceae

Locality : Gajni Forest

Temperature of the Location: 30⁰C

Division/Region : Mymensingh

Macroscopic Characters:

Colour (young) was Brown, Colour (mature) was Brown, Length 11.5 cm, Width 12 cm, Spore bearing surface under cap was Gills.

Pileus

Cap of the carpophores shape was Infundibuliform, Pileus size was 12 cm. Pileus colour was Brownish, surface characters and zonation was Dry. Pileus margin was incurved, pileus cuticle was not peeling, Texture of the fruiting body was tough, Flesh odor was Disagreeable. Lamellae absent.

Stipe

Stipe ansent, veil absent. Annulus was absent, volva was absent, scale was absent, umbo was absent.

Cultural Characteristics

Colony growth pattern was irregular. Colony colour was brown. colour changes during the growth of mycelium on medium was brown, Emitted smell from culture was present.

Ecology

Found on bark wood of the *Shorea robusta*, forest type mixed, Type of association habit is Caepitose Cluster. Constancy of occurrence in specific habitat was

Abundant. Type of soil was clay loom. Factors affecting their distribution was More Moist weather. Size of Fructification was 5-6×6-8cm. The frequency of its presence was 42.85% and density was 15.85%.

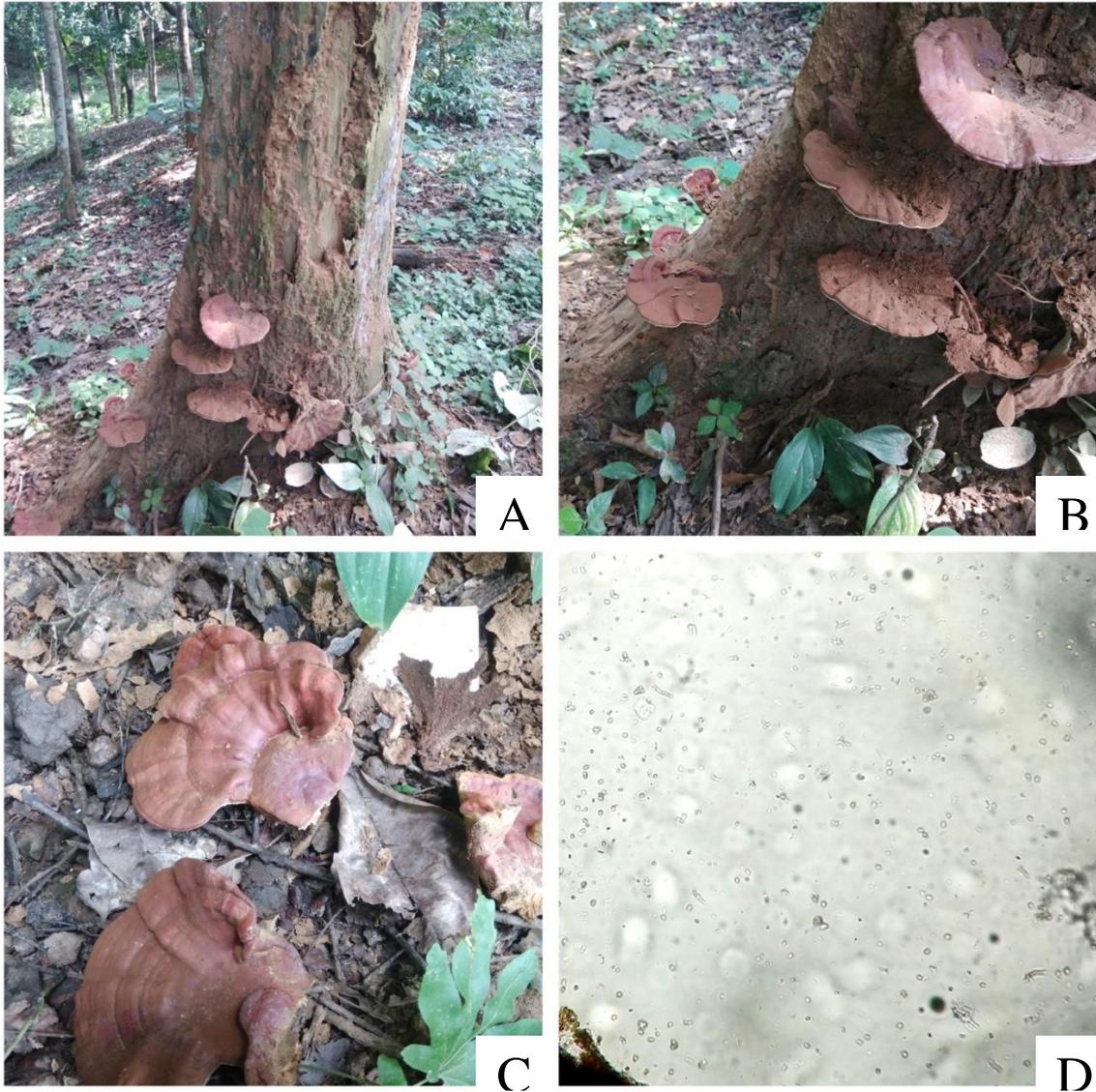


Plate no 4: *Ganoderma lucidum*; Fruiting bodies from different angle (A,B,C), Spores (D) ($\times 100$).

Collection no: 4.5

Name : *Ganoderma tropicum*

Family : Ganodermataceae

Locality : Gajni Forest

Temperature of the Location: 30⁰C

Division/Region : Mymensingh

Macroscopic Characters:

Colour (young) was red, Colour (mature) was Dark red, Length 12.5 cm, Width 13.5cm, Spore bearing surface under cap was Gills.

Pileus

Cap of the carpophores shape was flat, Pileus size was 7.5 inch. Pileus colour was Brownish, surface characters and zonation was Dry. Pileus margin was incurved, pileus cuticle was not peeling, Texture of the fruiting body was tough, Flesh odor was Disagreeable. Lamellae absent.

Stipe

Stipe ansent, veil absent. Annulus was absent, volva was absent, scale was absent, umbo was absent.

Cultural Characteristics

Colony growth pattern was irregular. Colony colour was brown. colour changes during the growth of mycelium on medium was brown, Emitted smell from culture was present.

Ecology

Found on bark wood of the *Acacia auriculiformis*, forest type mixed, Type of association habit is Caepitose Cluster. Constancy of occurrence in specific habitat

was Abundant. Type of soil was clay loom. Factors affecting their distribution was More Moist weather. Size of Fructification was 7.5×6.5 inch. The frequency of its presence was 50% and density was 8.5%.

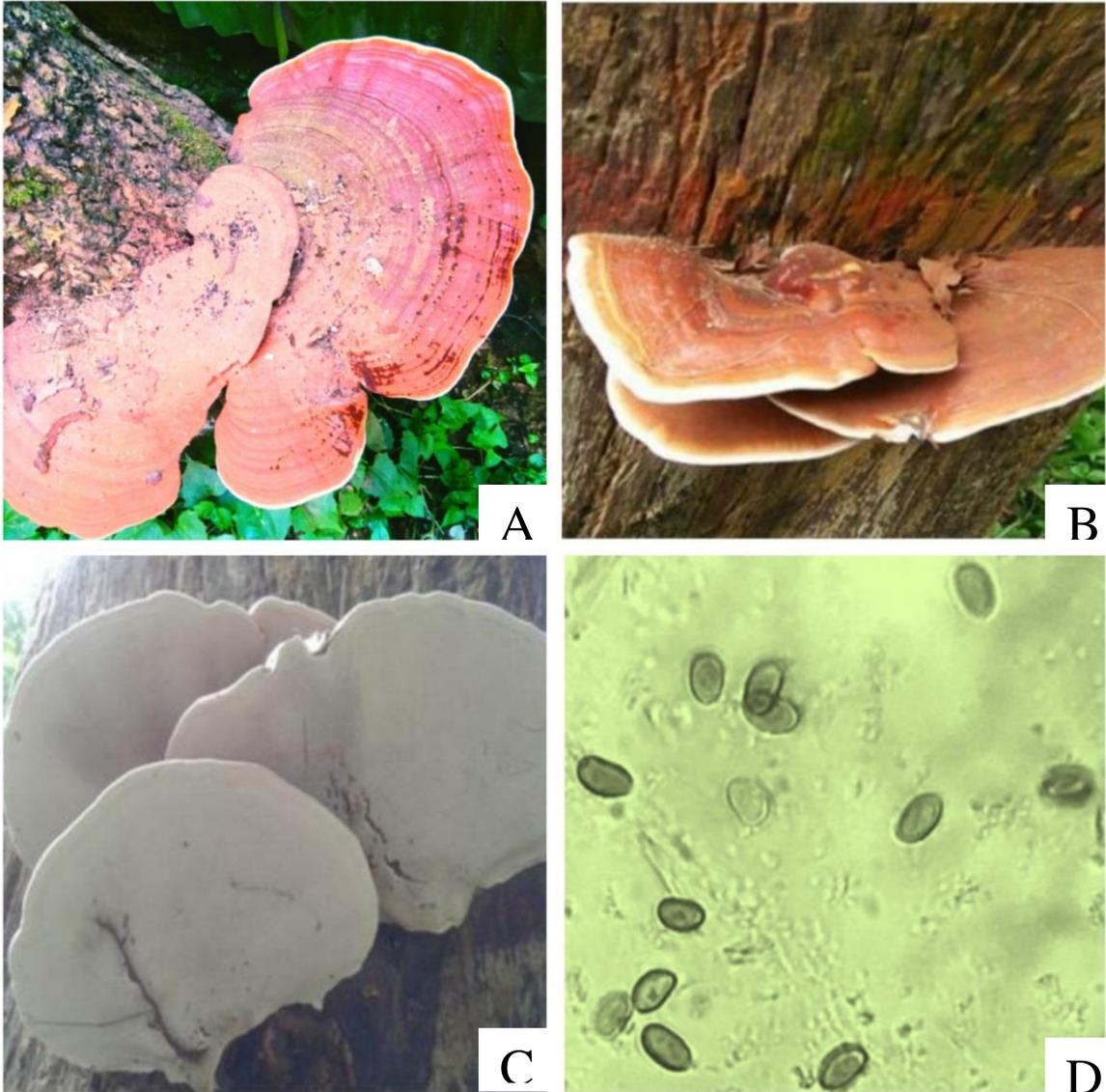


Plate no 5: *Ganoderma tropicum*; Fruiting bodies from different angle (A,B,C), Spores (D) (×100).

Collection no: 4.6

Name : *Ganoderma lobetum*

Family : Ganodermataceae

Locality : Gajni Forest

Temperature of the Location: 30⁰C

Division/Region : Mymensingh

Macroscopic Characters:

Colour (young) was brown, Colour (mature) was cocoa brown, Length 12.5 cm, Width 13.5cm, Spore bearing surface under cap was Gills.

Pileus

Cap of the carpophores shape was flat, Pileus size was 12.5 cm. Pileus colour was Brownish, surface characters and zonation was Dry. Pileus margin was incurved, pileus cuticle was not peeling, Texture of the fruiting body was tough, Flesh odor was Disagreeable. Lamellae absent.

Stipe

Stipe ansent, veil absent. Annulus was absent, volva was absent, scale was absent, umbo was absent.

Cultural Characteristics

Colony growth pattern was irregular. Colony colour was brown. colour changes during the growth of mycelium on medium was brown, Emitted smell from culture was present.

Ecology

Found on bark wood of the *Shorea robusta*, forest type mixed, Type of association habit is Caepitose Cluster. Constancy of occurrence in specific habitat was

Abundant. Type of soil was clay loom. Factors affecting their distribution was More Moist weather. Size of Fructification was 8.3×9.8 inch. The frequency of its presence was 50% and density was 10.75%.

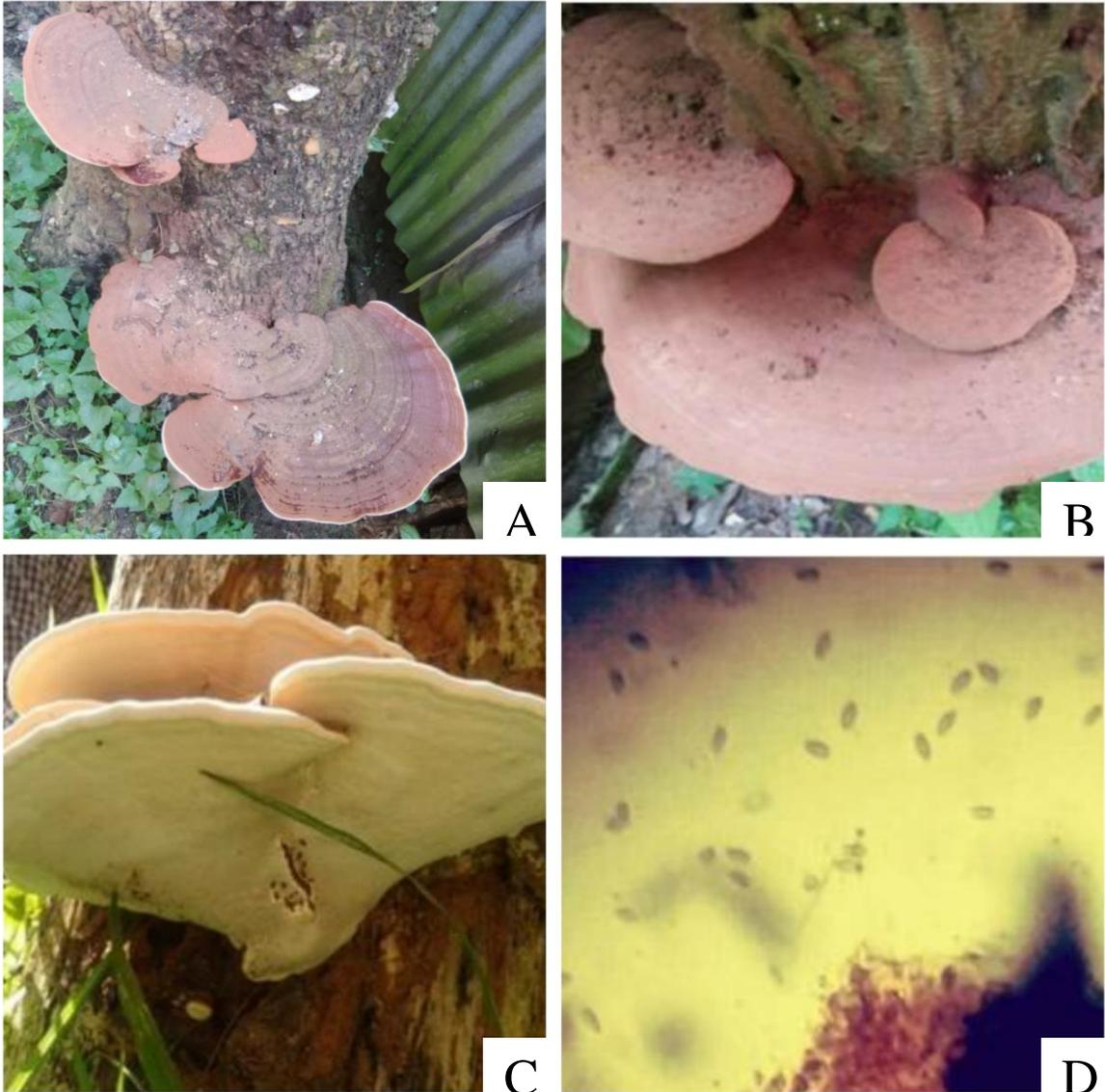


Plate no 6: *Ganoderma lobetum*; Fruiting bodies from different angle (A,B,C), Spores (D) (×100).

Collection no: 4.7

Name : *Termitomyces* sp.

Family : Lyophyllaceae

Locality : Gajni Forest

Temperature of the Location: 34⁰C

Division/Region : Mymensingh

Macroscopic Characters:

Colour (young) was creamy, Colour (mature) was creamy, Length 3.2 cm, Width 3.5cm, Spore bearing surface under cap was Gills.

Pileus

Cap of the carpophores shape was Depressed, Pileus size was 3.5cm. Pileus colour was cream, surface characters and zonation was scaly. Pileus margin was incurved, pileus cuticle was half peeling, Texture of the fruiting body was soft, Flesh odor was Fairnaceous.

Lamellae present, Gill attachment was Adnate, Gill color was yellowish white, Shape and width was narrow, gill spacing was close, lamellulae was present, forking pattern was branched.

Stipe

Stipe present, size was 1.4cm, shape was bulbou, position was central, surface characteristics was moist, colour and colour changes was cream, firmness fleshy, annulus was absent, volva was absent, scale was absent, umbo was absent.

Cultural Characteristics

Colony pattern was irregular. Colony colour was creamy, colour changes during the growth of mycelium on medium was white, Emitted smell from culture was present.

Ecology

Habitat was on soil, forest type mixed, type of association habit is Solitary. Constancy of occurrence in specific habitat was Abundant. Type of soil was Clay Loom. Factors affecting their distribution was Moderately Moist weather. Size of Fructification was 2.4×3.4 cm. The frequency of its presence was 14.28% and density was 7.14%.

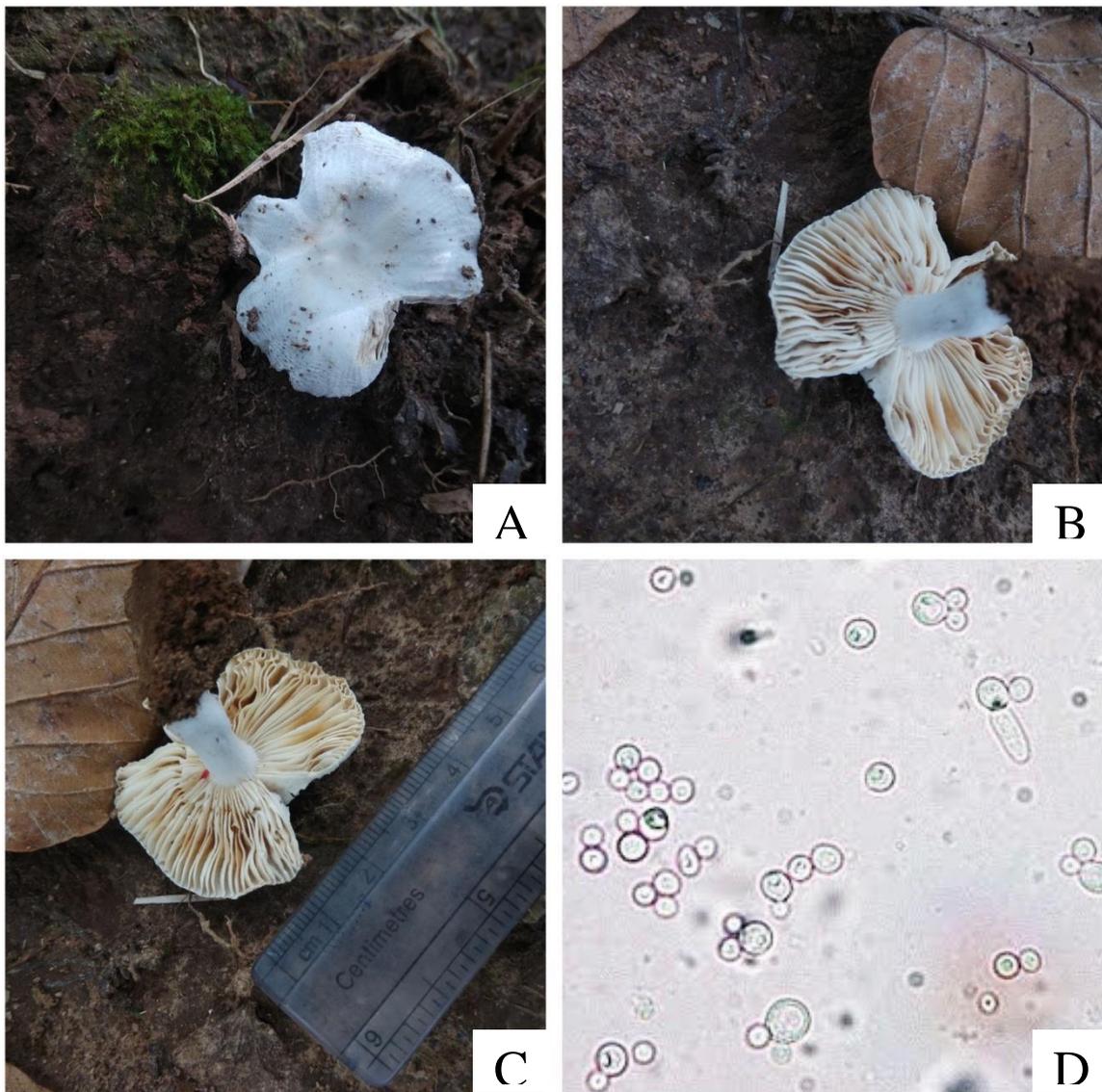


Plate no 7: *Termitomyces* sp.; Fruiting bodies from different angle (A,B,C), Spores (D) (×100).

Collection no:4.8

Name : *Phlebopus marginatus*

Family : Boletinellaceae

Locality : Gajni Forest

Temperature of the Location: 34⁰C

Division/Region : Mymensingh

Macroscopic Characters:

Colour (young) was Greenish, Colour (mature) was olive, Length 5.5cm, Width 4 cm, Spore bearing surface under cap was pores.

Pileus

Cap of the carpophores shape was uplifted, Pileus size was 6 cm. Pileus colour was deep brownish, surface characters and zonation was glabrous. Pileus margin was incurved, pileus cuticle was not peeling, Texture of the fruiting body was spongy, Flesh odor was Disagreeable.

Lamellae absent.

Stipe

Stipe present, size was 5.5 cm, shape was clavate/cap, position was central, surface characteristics was moist, colour and colour changes was white, firmness fleshy, annulus was absent, volva was absent, scale was absent, umbo was absent.

Cultural Characteristics

Colony pattern was Regular. Species colour was white, colour changes during the growth of mycelium on medium was white, Emitted smell from culture was absent.

Ecology

Habitat was on soil, forest type mixed, Type of association habit is Solitary. Constancy Of occurrence of a particular Mushroom in specific habitat was Abundant. Type of soil was clay loom. Factors affecting their distribution was Moderately Moist weather. Size of Fructification was 5.7×4.6 cm. The frequency of its presence was 7.14% and density was 2.14%.

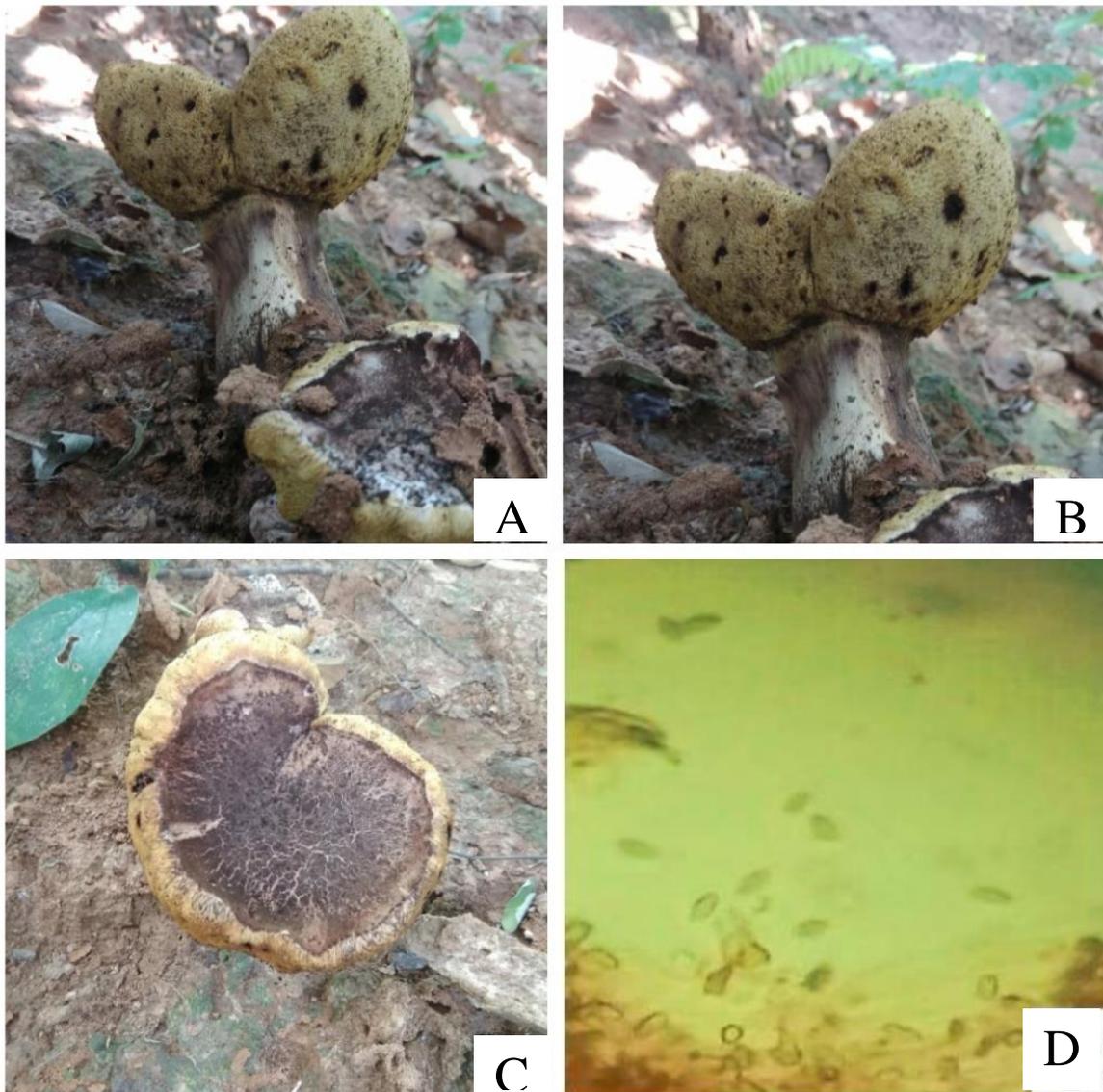


Plate no 8: *Phlebopus marginates*; Fruiting bodies from different angle (A,B,C), Spores (D) ($\times 100$).

Collection no:4.9

Name : *Macrolepiota procera*

Family : Agaricaceae

Locality : Gajni Forest

Temperature of the Location: 34⁰C

Division/Region : Mymensingh

Macroscopic Characters:

Colour (young) was creamy, Colour (mature) was creamy, Length 4 cm, Width 4.5cm, Spore bearing surface under cap was Gills.

Pileus

Cap of the carpophores shape was Depressed, Pileus size was 4.5cm. Pileus colour was cream, surface characters and zonation was scaly. Pileus margin was incurved, pileus cuticle was half peeling, Texture of the fruiting body was spongy, Flesh odor was Fairnaceous.

Lamellae present, Gill attachment was adnate, gill color was white, Shape and width was moderately broad, gill spacing was close, lamellulae was present, forking pattern was branched.

Stipe

Stipe present, size was 1.4cm, shape was equal, position was central, surface characteristics was moist, colour and colour changes was cream, firmness fleshy, annulus was absent, volva was absent, scale was absent, umbo was absent.

Cultural Characteristics

Colony pattern was Regular. Species colour was white, colour changes during the growth of mycelium on medium was white, Emitted smell from culture was absent.

Ecology

Habitat was *Shorea robusta*, forest type mixed, Type of association habit is Solitary. Constancy of occurrence in specific habitat was Abundant. Type of soil was clay loom. Factors affecting their distribution was Moderately Moist weather. Size of Fructification was 2.4× 3.4 cm. The frequency of its presence was 40% and density was 10.15%.

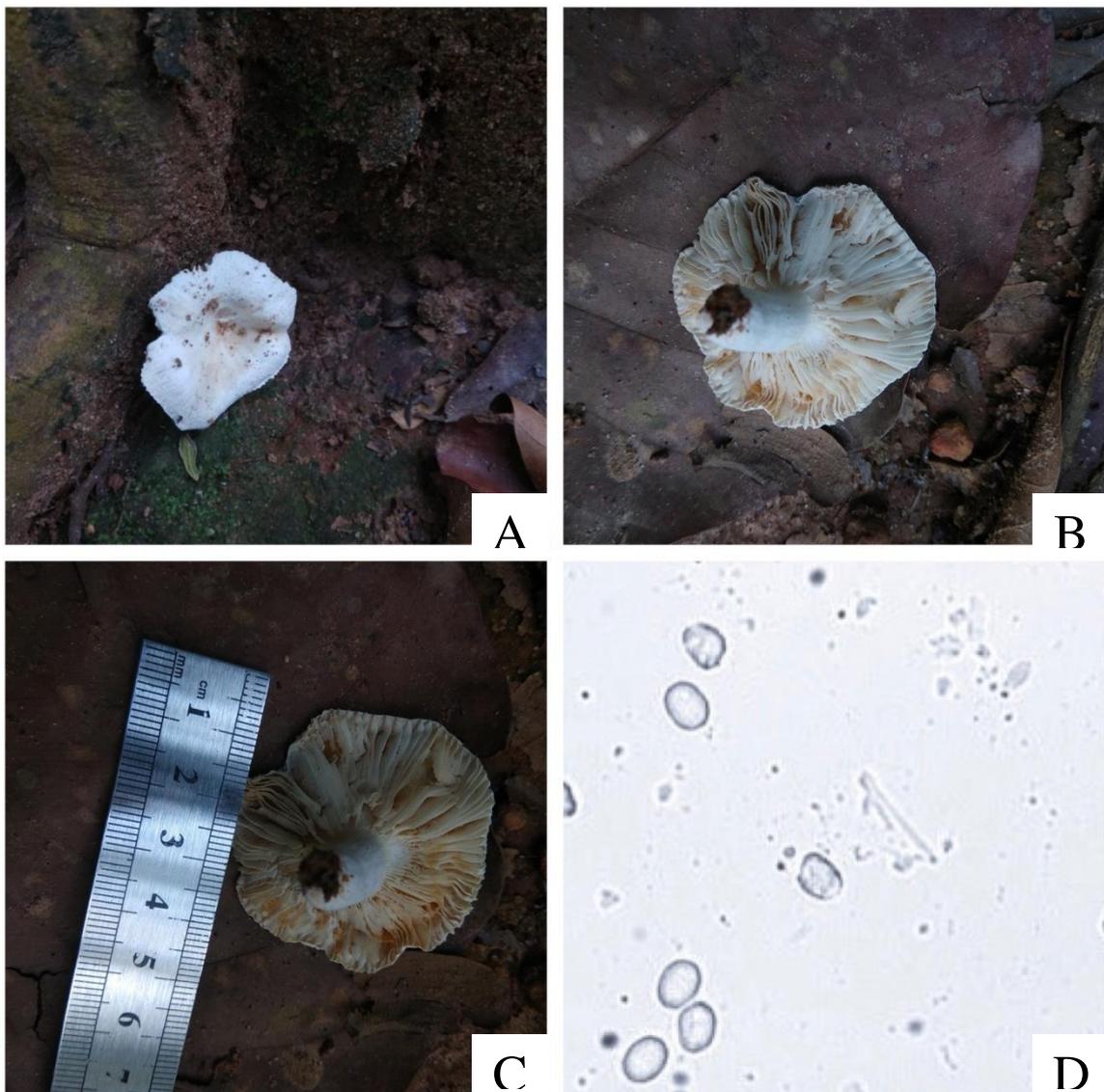


Plate no 9: *Macrolepiota procera*; Fruiting bodies from different angle (A,B,C), Spores (D) (×100).

Collection no: 4.10

Name : *Russula crustosa*

Family :Russulaceae

Locality : Gajni Forest

Temperature of the Location: 34⁰C

Division/Region : Mymensingh

Macroscopic Characters:

Colour (young) was white, Colour (mature) was white, Length 2 cm,Width 4 cm, Spore bearing surface under cap was Gills.

Pileus

Cap of the carpophores shape was Depressed or flat, Pileus size was 4 cm. Pileus colour was white, surface characters and zonation was fibrillose. Pileus margin was incurved/weavy, pileus cuticle was half peeling, Texture of the fruiting body was leathery, Flesh odor was Fairnaceous.

Lamellae present, Gill attachment was Adnexed, Gill color was white, Shape and width was moderately broad, gill spacing was crowded, lamellulae was present, forking pattern was branched.

Stipe

Stipe present, size was 1.5 cm, shape was clavate/cap, position was central, surface characteristics was moist, colour and colour changes was white, firmness fleshy, annulus was absent, volva was absent, scale was absent, umbo was absent.

Cultural Characteristics

Colony pattern was Regular. Species colour was white, colour changes during the growth of mycelium on medium was white, Emitted smell from culture was absent.

Ecology

Habitat was on soil, forest type mixed, Type of association habit is Solitary. Constancy Of occurrence of a particular Mushroom in specific habitat was Abundant. Type of soil was clay loom. Factors affecting their distribution was Moderately Moist weather. Size of Fructification was 2.4×3.4 cm. The frequency of its presence was 12.25% and density was 3.75%.

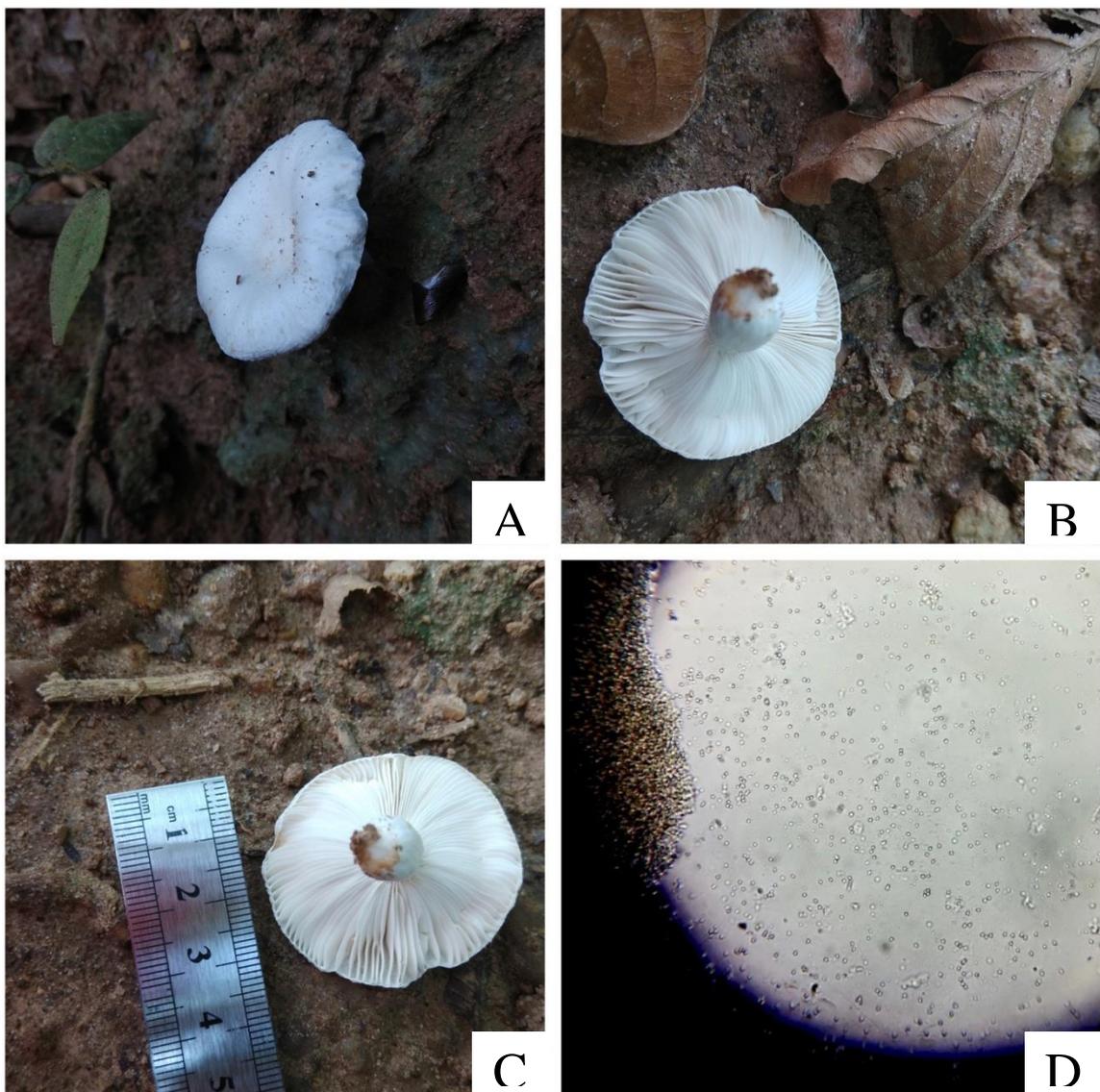


Plate no 10: *Russula crustosa*; Fruiting bodies from different angle (A,B,C), Spores (D) (×100).

Collection no:4.11

Name : *Boletus edulis* (Bolete mushroom)

Family : Boletaceae

Locality : Gajni Forest

Temperature of the Location: 34⁰C

Division/Region : Mymensingh

Macroscopic Characters:

Colour (young) was brown, Colour (mature) was brown, Length 7 cm, Width 6 cm, Spore bearing surface under cap was pores.

Pileus

Cap of the carpophores shape was uplifted, Pileus size was 6 cm. Pileus colour was deep brownish, surface characters and zonation was glabrous. Pileus margin was incurved, pileus cuticle was not peeling, Texture of the fruiting body was spongy, Flesh odor was Disagreeable.

Lamellae absent.

Stipe

Stipe present, size was 5.5 cm, shape was clavate/cap, position was central, surface characteristics was moist, colour and colour changes was white, firmness fleshy, annulus was absent, volva was absent, scale was absent, umbo was absent.

Cultural Characteristics

Colony pattern was Regular. Species colour was white, colour changes during the growth of mycelium on medium was white, Emitted smell from culture was absent.

Ecology

Habitat was on soil, forest type mixed, Type of association habit is Solitary. Constancy Of occurrence of a particular Mushroom in specific habitat was Abundant. Type of soil was clay loom. Factors affecting their distribution was Moderately Moist weather. Size of Fructification was 5-7× 4-6 cm. The frequency of its presence was 20 % and density was 5.50%.

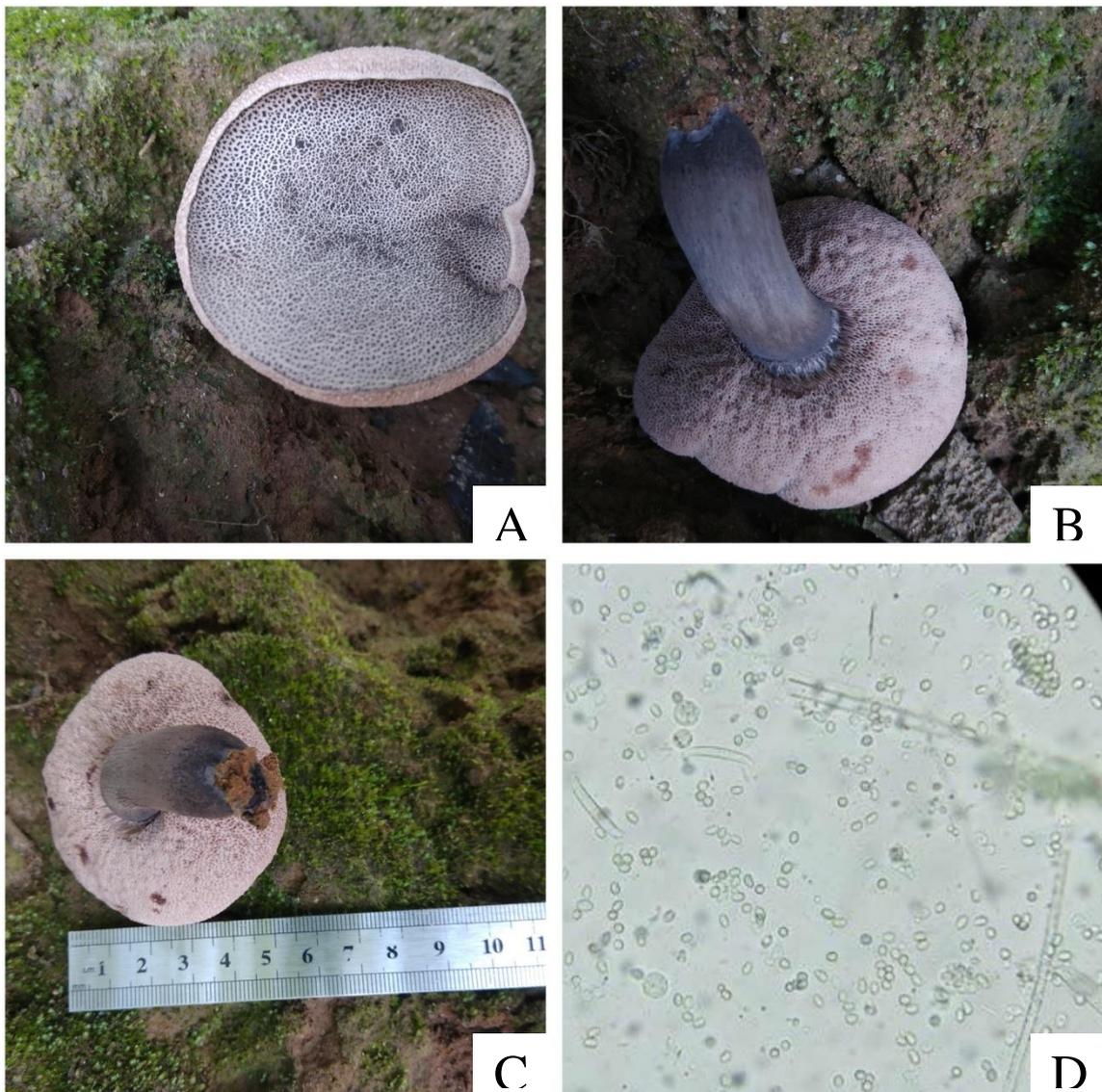


Plate no 11: *Boletus edulis*; Fruiting bodies from different angle (A,B,C), Spores (D) (×100).

Collection no: 4.12

Name : *Russula nobilis*

Family : Russulaceae

Locality : Gajni Forest

Temperature of the Location: 34⁰C

Division/Region : Mymensingh

Macroscopic Characters:

Colour (young) was pink and purple, Colour (mature) was pink and purple, Length 2.2 cm, Width 3.5 cm, Spore bearing surface under cap was Gills.

Pileus

Cap of the carpophores shape was infundibuliform, Pileus size was 3.5cm. Pileus colour was deep pinkish, surface characters and zonation was smooth. Pileus margin was incurved, pileus cuticle was not peeling, Texture of the fruiting body was spongy, Flesh odor was farinaceous.

Lamellae present, Gill attachment was Adnate, Gill color was white, Shape and width was narrow, gill spacing was crowded, lamellulae was present, forking pattern was branched.

Stipe

Stipe present, size was 1.5 cm, shape was clavate, position was central, surface characteristics was moist, colour and colour changes was white, firmness fleshy, annulus was absent, volva was absent, scale was absent, umbo was absent.

Cultural Characteristics

Colony pattern was Regular. Colony colour was pinkish, colour changes during the growth of mycelium on medium was white, Emitted smell from culture was absent.

Ecology

Habitat was on soil, forest type mixed, Type of association habit is Solitary. Constancy of occurrence habitat was Un- Abundant. Type of soil was Clay Loom. Factors affecting their distribution was Moderately Moist weather. Size of Fructification was 2.4×3.4 cm. The frequency of its presence was 10% and density was 3.75%.

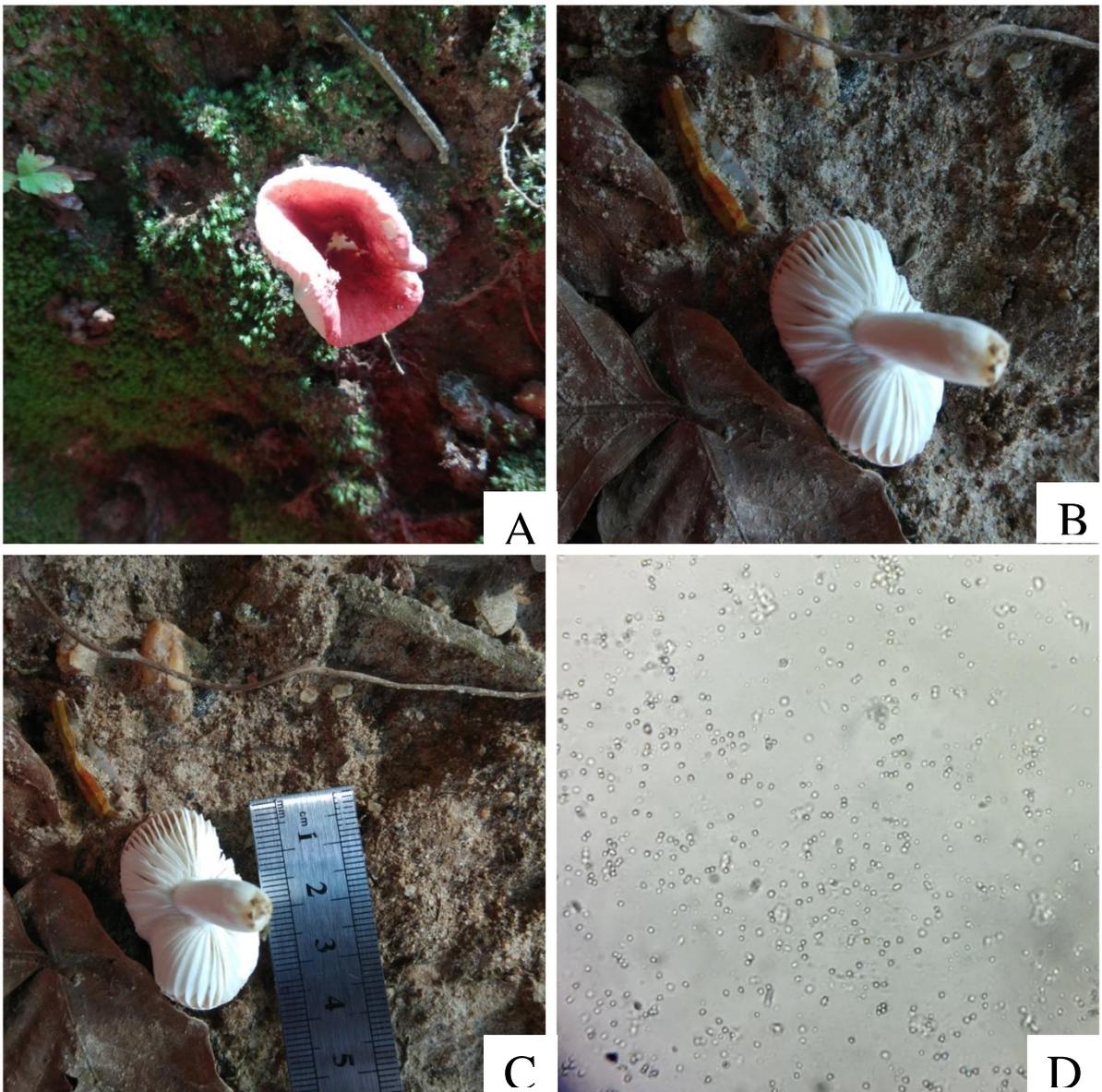


Plate no 12: *Russule nobilis*; Fruiting bodies from different angle (A,B,C), Spores (D) (×100).

Collection no: 4.13

Name : *Entoloma* spp
Family : Entolomataceae
Locality : Gajni Forest
Temperature of the Location: 34⁰C
Division/Region : Mymensingh

Macroscopic Characters:

Colour (young) was pink and purple, Colour (mature) was pink and purple, Length 4.2 cm, Width 2.7cm, Spore bearing surface under cap was Gills.

Pileus

Cap of the carpophores shape was convex, Pileus size was 2.7 cm. Pileus colour was deep purple, surface characters and zonation was silky. Pileus margin was incurved, pileus cuticle was not peeling, Texture of the fruiting body was leathery, Flesh odor was farinaceous.

Lamellae present, Gill attachment was subdecurrent, Gill color was brown, Shape and width was narrow, gill spacing was crowded, lamellulae was present, forking pattern was branched.

Stipe

Stipe present, size was 3cm, shape was equal, position was central, surface characteristics was moist, colour and colour changes was white, firmness fleshy, annulus was absent, volva was absent, scale was absent, umbo was slightly present.

Cultural Characteristics

Colony pattern was Regular. Colony colour was pinkish, colour changes during the growth of mycelium on medium was white, Emitted smell from culture was absent.

Ecology

Habitat was on soil, forest type mixed, Type of association habit is Scattered. Constancy of occurrence habitat was Un- Abundant. Type of soil was Clay Loom. Factors affecting their distribution was Moderately Moist weather. Size of Fructification was 2.4×3.4 cm. The frequency of its presence was 70% and density was 15.25%.



Plate no 13: *Entoloma* spp; Fruiting bodies from different angle (A,B,C), Spores (D) (×100)

Collection no: 4.14

Name : *Agaricus* spp

Family : Agaricaceae

Locality : Gajni Forest

Temperature of the Location: 34⁰C

Division/Region : Mymensingh

Macroscopic Characters:

Colour (young) was creamy, Colour (mature) was creamy, Length 3 cm, Width 5 cm, Spore bearing surface under cap was Gills.

Pileus

Cap of the carpophores shape was depressed, Pileus size was 5 cm. Pileus colour was deep creamy, surface characters and zonation was scaly. Pileus margin was incurved, pileus cuticle was not peeling, Texture of the fruiting body was soft, Flesh odor was farinaceous.

Lamellae present, Gill attachment was adnate, Gill color was creamy, Shape and width was narrow, gill spacing was close, lamellulae was present, forking pattern was branched.

Stipe

Stipe present, size was 2 cm, shape was equal, position was central, surface characteristics was moist, colour and colour changes was white, firmness fleshy, annulus was absent, volva was absent, scale was absent, umbo was slightly present.

Cultural Characteristics

Colony pattern was Regular. Colony colour was creamy, colour changes during the growth of mycelium on medium was white, Emitted smell from culture was absent.

Ecology

Habitat was soil, forest type mixed, Type of association habit is Scattered. Constancy Of occurrence habitat was Abundant. Type of soil was Clay Loom. Factors affecting their distribution was Moderately Moist weather. Size of Fructification was 2.4×3.4 cm. The frequency of its presence was 50% and density was 12.15%.

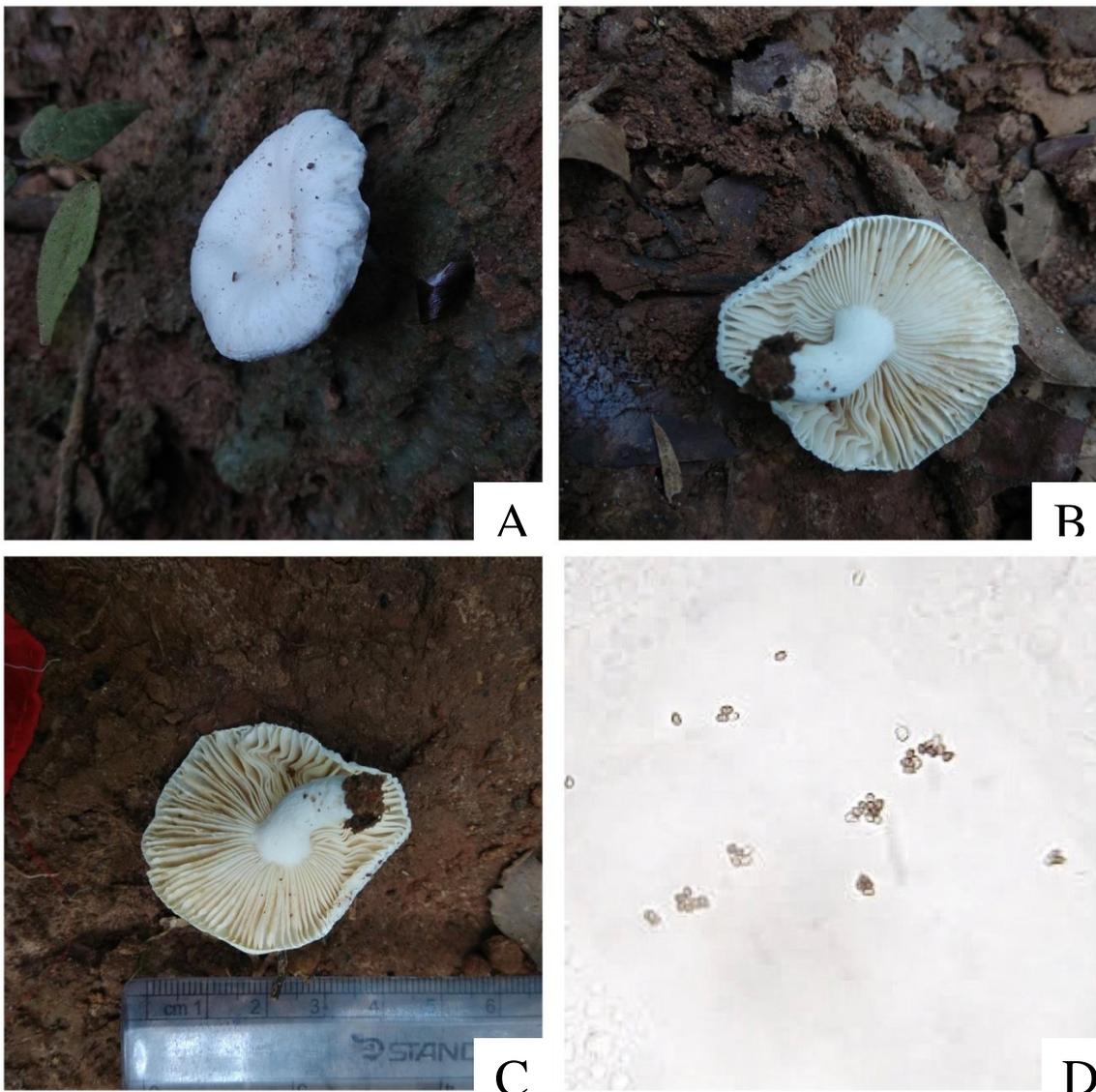


Plate no 14: *Agaricus* spp; Fruiting bodies from different angle (A,B,C), Spores (D) ($\times 100$).

Table 1: Morphological characteristics of collected macro fungi from Gajni forest, Sherpur.

Sample no	Name of the mushroom	Morphological Characters	Size of Fructification
1.	<i>Chanterelle cibarius</i>	Colour (young) was creamy, Colour (mature) was creamy. Cap of the carpophores shape was Umbilicate. Pileus margin was Regular, pileus cuticle was half peeling. Lamellae present, Gill attachment was Adnate. Stipe present, shape was equal, position was central.	Size of Fructification was 2.4×3.4 cm.
2.	<i>Agaricus bitroquis</i>	Colour (young) was white, Colour (mature) was creamy, Cap of the carpophores shape was ovate, pileus margin was regular, Stipe present, shape was equal, position was central.	Size of Fructification was 3.1×4.5 cm.
3.	<i>Ganoderma applanatum</i>	Colour (young) was Brown, Colour (mature) was Brown. Cap of the carpophores shape was Infundibuliform. . Pileus margin was incurved. Lamellae absent. Stipe ansent, veil absent.	Size of Fructification was 5-6 ×6-8cm.
4.	<i>Ganoderma lucidum</i>	Colour (young) was Brown, Colour (mature) was Brown. Cap of the carpophores shape was Infundibuliform. Pileus margin was incurved. Lamellae absent. Stipe ansent, veil absent.	Size of Fructification was 5-6×6-8cm.

Sample no	Name of the mushroom	Morphological Characters	Size of Fructification
5.	<i>Ganoderma tropicum</i>	Colour (young) was Redish, Colour (mature) was Dark red. Cap of the carpophores shape was flat. Pileus margin was incurved. Lamellae absent. Stipe absent, veil absent.	Size of Fructification was 7.5×6.5 inch
6.	<i>Ganoderma lobetum</i>	Colour (young) was Brown, Colour (mature) was Cocoa brown. Cap of the carpophores shape was flat. Pileus margin was incurved. Lamellae absent. Stipe absent, veil absent.	Size of Fructification was 8.3×9.8 inch
7.	<i>Termitomyces</i> sp	Colour (young) was creamy, Colour (mature) was creamy. Cap of the carpophores shape was Depressed. Pileus margin was incurved. Lamellae present, Gill attachment was Adnate. Stipe present, shape was bulbou, position was central.	Size of Fructification was 2.4×3.4 cm.
8.	<i>Phlebopus marginatus</i>	Colour (young) was Olive, Colour (mature) was Green. Cap of the carpophores shape was Convex. Pileus margin was incurved. Lamellae present, Gill attachment was Adnate. Stipe present, position was central.	Size of Fructification was 5.5×2.1 cm.

Sample no	Name of the mushroom	Morphological Characters	Size of Fructification
9.	<i>Macrolepiota procera</i>	Colour (young) was creamy, Colour (mature) was creamy. Cap of the carpophores shape was Depressed. Pileus margin was incurved. Lamellae present, Gill attachment was Adnate. Stipe present, shape was equal.	Size of Fructification was 2-4×3-4 cm.
10.	<i>Russula crustosa</i>	Colour (young) was white, Colour (mature) was white. Cap of the carpophores shape was Depressed or flat Pileus margin was incurved/weavy. Lamellae present, Gill attachment was Adnexed. Stipe present, shape was clavate/cap.	Size of Fructification was 2-4×3-4 cm.
11.	<i>Boletus edulis</i>	Colour (young) was brown, Colour (mature) was brown. Spore bearing surface under cap was pores. Cap of the carpophores shape was uplifted. Pileus margin was incurved. Lamellae absent. Stipe present, shape was clavate/cap.	Size of Fructification was 5-7×4-6 cm.
12.	<i>Russulanobilis</i>	Colour (young) was pink and purple, Colour (mature) was pink and purple. Cap of the carpophores shape was infundibuliform. Pileus colour was deep pinkish. Pileus margin was incurved. Lamellae present, Gill attachment was Adnate. Stipe present, shape was clavate, position was central.	Size of Fructification was 2-4×3-4 cm.

Sample no	Name of the mushroom	Morphological Characters	Size of Fructification
13.	<i>Entoloma</i> spp	Colour (young) was pink and purple, Colour (mature) was pink and purple. Cap of the carpophores shape was convex. Pileus colour was Pileus margin was incurved as deep purple. Lamellae present, Gill attachment was subdecurrent. Stipe present, shape was equal, position was central.	Size of Fructification was 2-4×3-4 cm.
14.	<i>Agaricus</i> spp	Colour (young) was creamy, Colour (mature) was creamy. Cap of the carpophores shape was Pileus colour was deep creamy depressed, zonation was scaly. Lamellae present, Gill attachment was adnate. Stipe present, shape was equal, position was central. annulus was absent, volva was absent.	Size of Fructification was 2-4×3-4 cm.



CHAPTER V

DISCUSSION

CHAPTER V

DISCUSSION

The survey on wild Macro fungi was conducted during July to December, 2018 in Gajni forest in Sherpur, Sherpur district which is bounded on the north by India, on the east by Mymensingh district, on the south and west by Jamalpur district, Bangladesh, to record the morphological variability, habitat, distribution and biodiversity.

A total of 20 wild Macro fungi samples were collected and identified to fourteen species under eight families.

In the present study *Chanterelle cibarius* was found associated with humus with a frequency 14.28% and density 7.5%. Previously this species was found in Indo – BD region of North East India (Jayashree *et al.*, 2015).

Agaricus bitroquis was found with the frequency of its presence was 70% and density was 20.25%. It was associated with the soil.

Ganoderma applantum was found with the frequency of its presence was 22.25% and density was 60%. It was associated with *Dalbergia sissoo*. Previously it was found in Kalai, Jaipurhat which was associated with *Acacia auriculiformis*. It was from tropical moist deciduous forest region of Bangladesh (Rumainul *et al.*, 2015). Later then, it was recorded in Gangni of Meherpur district and associated with *Bambusa vulgaris* (Mostafizur *et al.*, 2016).

Ganoderma lucidum was found with the frequency of 9.25% and density of 55%. It was associated with *Samanea saman*. This species previously reported from Gazipur, Dhaka, under Tropical Moist Deciduous Forest region, Bangladesh and in association with *Acacia auriculiformis* (Rumainul *et al.*, 2015). Later then, it was also found in Gangni of Meherpur district and there it was associated with *Bambusa vulgaris* (Mostafizur *et al.*, 2016). Korat *et al.* (2013) also recorded this species in Navsari (South Gujarat), India.

Ganoderma tropicum was found with the frequency of 50% and density of 8.50%. It was associated with *Albizia lebbeck*. Previously it was also recorded by Rubina *et al.*,(2017) from National Botanical Garden, Dhaka which is situated in tropical moist deciduous forest region of Bangladesh. It was associated On dead plant wood, Aurjun (*Terminalia arjuna*) with the frequency and density of 20% and 10%.

Ganoderma lobetum was found with the frequency of 50% and density of 10.75%. It was associated with *Acacia auriculiformis*. Previously it was also recorded by Rubina *et al.*,(2017) from National Botanical Garden, Dhaka which is situated in tropical moist deciduous forest region of Bangladesh. It was associated On the root of the Neem (*Azadirachta indica*) plant with the density of 20% .

Termitomyces sp was found with the frequency of 10.25% and density was 15%. It was associated with *Albizia richardiana*. Mostafizur *et al.*, (2016) previously recorded this from Sadar of Meherpur district and it was associated with *Musa acuminata*. Rumainul *et al.*,(2015) also recorded *Termitomyces* sp. from tropical moist deciduous forest region of Bangladesh associated with *Mangifera indica*. *Termitomyces heimii* also reported in Kanyakumari district of India (Davidson *et al.*, 2012). This species was also recorded from Huai Khayeng, Kanchanaburi, Thailand (Jiranan *et al.*, 2007).

Phlebopus marginatus was found with the frequency of 7.14% and density was 2.14%. It was associated with the soil. Previously it was found in Western Australia and known as salmon gum mushroom.

Macrolepiota procera was found with the frequency of 5.25% and density was 2.15%, Which was associated with root zone of *Swietenia macrophylla*. Rajesh *et al.*, (2013) investigated *Macrolepiota procera* as a new generic record of edible mushroom for Nagaland, Northeast India. It was collected from the Puliebbie forest range in Kohima District of Nagaland state of India. In Bangladesh, *Macrolepiota procera* was found in Barisal, Jhalokhathi. A total of nine *Macrolepiota procera*

were found during collection. In which those mushroom was also found on the root zone of Mehogoni (*Swietenia macrophylla*) which is recored by Rashid *et al.*,(2016).

Russula crustosa was found with the frequency of 10.25% and density was 8.10%. It was associated with *Dalbergia sissoo*. Previously a study was conducted in which *Russula crustosa* was found in Modhupur, Patuakhali and Pathorghata. Themushroom was also found on the root zone of *Dalbergia sissoo* and the Forest type was mixed. (Rashid *et al.*, 2017).

Boletus edulis was found with the frequency of its presence was 11.25% and density was 2.70%. It was associated with humus. Prviously Rashid *et al.*,(2017) was recordedone species of *Boletus* in Modhupur and Patuakhali in his survey and that was *Boletus subvelutipes*. This mushroom was found on the root zone of *Acacia auriculiformis*. This type of *Boletus* sp. was collected from East district of Sikkim and occurrences under *Lithocarpus* sp. (Dyutiparna *et al.*, 2017).

Russula nobilis was found with the frequency of 12.25% and density was 10.81%. It was associated with *Albiziarichardiana*.Beforethat, it was found in Sujanagar, Pabna; which was On soil; in an association with the Golden shower (*Acacia auriculiformis*) Romainul *et al.* (2015).*Russula nobilis* Velen also reported in Southern Kashmir Himalayas, India (Shauket *et al.*, 2006)

Entoloma sp. was found on top of the hill side with the frequency was 13.25% and density was 8.10%. This mushroom was present scatteredly with the soil .*Entoloma sinuatum* is fairly common and widespread across North America as far south as Arizona (Ammirati *et al.*, 1985) It also occurs throughout Europe and the British Isles including Irelandthough it is more common in southern and central parts of Europe than the northwest. In Asia, it has been recorded in the Black Sea region,(Sesli *et al.*, 2007) and Adiyaman Province in Turkey, (Kaya *et al.*, 2010) Iran, (Asef *et al.*, 2010) and northern Yunnan in China (Horak *et al.*, 1987).

Agaricus spp was found with the frequency was 16.25% and density was 18.15%. It was associated with *Acacia nilotica*. Previously a survey was conducted in which a total nine number of *Agaricus* mushrooms were found during collection. *Agaricus* sp. was found in Modhupur Dhaka, Dashmina and Pathorghata. The frequency of its presence was 22.22% and the density was 40%. mushroom was found on the root zone of *Leucaena leucocephala*. (Rashid *et al.*, 2017). This species was also found Daulatpur, Kushtia district in south western region of Bangladesh. This genus *Agaricus* was also reported from India (Mohanana, 2011; Thiribhuvanamala *et. Al.*,2011).



CHAPTER VI
SUMMARY AND CONCLUSION

CHAPTER VI

SUMMARY AND CONCLUSION

Bangladesh has basically four types of forest. They are mangrove forest, tropical moist deciduous forest, tropical evergreen and semi evergreen forest and village forests. A survey on wild Macro fungi was conducted in Gajni forest, Sherpur district located in between 24°18' and 25°18' north latitudes and in between 89°53' and 90°91' east longitudes. This forest under Tropical moist deciduous forest. In this survey ten species belonging 8 families were collected and identified. Dominant species was *Ganoderma* species. The identified four species were from Ganodermataceae family and these are *Ganoderma applanatum*, *Ganoderma lucidum*, *Ganoderma tropicum* and *Ganoderma lobetum*. Another dominant species were from Agaricaceae family and these were *Agaricus bitroquis*, *Macrolepiota procera* and *Agaricus* spp. Other recorded species were *Chanterella cibarius*, *Termitomyces* sp, *Boletus edulis*, *Entoloma* sp, *Phlebopus marginatus*, *Russula crustosa* and *Russule nobilis*. Among them the highest frequency (85.75%) was recorded for *Ganoderma applanatum* and lowest frequency (7.14%) was recorded for *Phlebopus marginatus*. Similarly highest density (20.25%) was recorded for *Agaricus bitroquis* and followed by (15.85%) for *Ganoderma lucidum*. The lowest density was (2.14%) for *Phlebopus marginatus*. Dominant host species was Teak/Segun (*Tectona grandis*), Gamari(*Gmelina arborea*), Koroi (*Albizia procera*), Mahogany (*Macrophylla mahogoni*), Sisso (*Dalbergiasissoo*), Rain tree (*Albizialebeck*), Akashmoni (*Acacia auriculiformis*), Banyan (*Ficus benghalensis*) and Jackfruit (*Artocarpus heterophyllus*). Findings of the present survey emphasized the importance and diversity of macrofungi in the Gajni forest, Sherpur, Bangladesh. This survey need to be made for further consecutive yeats to redine the present findings with the relevant information.



CHAPTER VII
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