MORPHOLOGICAL CHARACTERIZATION AND DISTRIBUTION OF MACROFUNGI IN GAJNI FOREST OF BANGLADESH

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MORPHOLOGICAL CHARACTERIZATION AND DISTRIBUTION OF MACROFUNGI IN GAJNI FOREST OF BANGLADESH

BY

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CERTIFICATE

This is to certify that the thesis entitled, **"MORPHOLOGICAL CHARACTERIZATION AND DISTRIBUTION OF MACROFUNGI IN GAJNI FOREST OF BANGLADESH"** submitted to the Department of Plant Pathology, Faculty of Agriculture, Sher-e-Bangla Agricultural University, Dhaka, in the partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE (M. S.) IN PLANT PATHOLOGY,** embodies the result of a piece of bonafide research work carried out by **MOUMITA MOMI** bearing **Registration No. 10-04117** 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.

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DEDICATED TO

MY

BELOVED SON

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ABSTRACT

Jhinaigati forest area locally called Gajni forest which is covered near about 9660 acres of lands located in northern hilly areas of Bangladesh. In a survey program 51 samples of macrofungi were collected and identified to 18 species belongs to 24 genera under 16 families. The dominant families were Agaricaceae, Polyporaceae, Ganodermataceae, Marasmiaceae, Psathyrellaceae and Tricholomataceae. The predominant genera were *Agaricus, Trametes, Ganoderma, Marasmius* and *Clitocybe.* The maximum density of 120.45, 111.36 and 95.45% were recorded for *Psathyrella candolleana, Cortinarius semisanguineus* and *Dacryopinax spatularia,* respectively. This is the first detailed investigation on macrofungi in Gajni forest of Bangladesh which showed appreciable results for further study.

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INTRODUCTION

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INTRODUCTION

Macrofungi is a fleshy spore bearing fruiting body of a fungus. Macrofungi are found everywhere typically produced above ground on soil, on its food sources mostly in oil palm estates, front yards, parks, fields and forest. They are common in rainy season, the first occurs between March – May and the second, a less regular one between September – October. It is perhaps the most well-known and documented edible forest product. (Simon *et al.*, 1989). The fruiting body of different species are edible and highly priced in different parts of the globe. The fleshy basidiocarp is gelatinous, elastic, smooth, translucent, velvety and veined. When water become deficient, the basidiocarp dries up and become horny; on wetting, it quickly regains its shape and within few hours starts discharging basidiospores (Dube, 1984).

The species diversity of fungi and their natural beauty occupy prime place in the biological world and India has been a cradle for these species. Defining the number of fungi on earth has been a point of discussion and several studies have focused on enumerating the world fungal diversity (Crous *et. al.,* 2006). Only a fraction of total fungal wealth has been subjected to scientific scrutiny and mycologists continue to unravel the unexplored and hidden wealth one third of fungal diversity of the globe exists in India and of this only 50% are characterized until now (Manoharachary *et al.,* 2005).

Wild edible macrofungi have been included in the human diet for centuries because of their specific taste and flavour. They have been considered

nutritionally healthy foods due to the high contents in carbohydrates, proteins, minerals and vitamins, and low fat levels (Kalac, 2009).

Nowadays, they attract attention because of their bioactive compounds, beneficial effects and possible use in the prevention or treatment of diseases, being classified as functional foods and sources of nutraceuticals (Mattilla *et al.*, 2000; Kumari and Atri, 2014). Some of the macrofungi bioactive properties are related with their antioxidant activity and antioxidant compounds (Ferreira *et al.*, 2009). In fact, antioxidants are in constant activity in living organisms, being required to be in sufficient amounts to neutralize the toxic effects of reactive oxygen species (ROS), reactive nitrogen species (RNS) and reactive sulphur species (RSS) that are produced continuously (Dubost *et al.*, 2007; Carocho and Ferreira, 2013).

Sherpur district which is bounded on the north by India, on the east by Mymensingh district, on the south and west by Jamalpur district. Jhinaigati forest area locally called Gajni forest which is covered near about 9660 acres of lands located in northern hilly areas of Bangladesh. The annual average temperature of this district varies from maximum 33.3°C to minimum 12°C. The annual rainfall is 2174 mm. There is an urgent need to explore this area for mushroom emanating in different seasons under varying environment and conserve the biodiversity prevailing in this area covered with the locations of Sherpur district. Floral species include - Haldina (*Haldina cordifolia*), Koroi (*Albizia lebbek*), Satain (*Chloroxylon swietenia*), Kadam (*Tibetan buddhism*), Dewa (*Phaleria macrocarpa*), Neem (*Azadirachta indica*), Shimul (*Bombax ceiba*), Hartaki (*Terminalia chebula*), Bohera (*Terminalia belerica*), Arjun (*Terminalia arjuna*) and Kurchi (*Holarrhena*

antidysentrica). Besides many more undergrowth herbs of medicinal importance, like Shothi (*Curcuma zedoaria*), Bon-ada (*Curcuma amada*) etc.

Macrofungi species are the indicators of the forest life support system (Stamets, 2000). The presence or absence of fungal species is a useful indicator to assess the damage or the maturity of an ecosystem. Data on their diversity in different vegetation types is important for planning and managing ecosystem biodiversity (Engola *et al*., 2007). The knowledge of biodiversity at the community and species level is more important for monitoring the effectiveness and effects of natural and artificial disturbances (Packham, 2002).

The purpose of the present survey was conducted in the Gajni forest region of Bangladesh with the following objectives –

i. To identify the macrofungi up to the genus and species level from Gajni forest region of Bangladesh.
ii. To study the morphology and distribution of macrofungi in Gajni forest region of Bangladesh.

CHAPTER II

REVIEW OF LITERATURE

CHAPTER II
REVIEW OF LITERATURE

Das and Aminuzzaman (2017) studied the largest tidal halophytic forest in the world lies a little south to the Tropic of Cancer and found the predominant families were Polyporaceae, Ganodermataceae, Hymenochaetaceae, Fomitopsidaceae, Xylariaceae, Steccherinaceae and Gloeophyllaceae accordingly. The maximum frequency (75%) was recorded for *Daedaleopsis confragosa* and 50% for *Trametes elegans*, *Trametes conchifer*, *Polyporus sanguineus*, *Ganoderma curtisis* and *Irpex lacteus.* The maximum density was 31.82% for *Polyporus sanguineus* which was found on the Sundari (*Heritiera fomes*) tree.

Rubina *et al.* (2017) conducted a survey in National Botanical Garden and identified total of 23 macrofungi samples were collected and identified to 20 species under 10 genera and 10 families. The predominant genera were *Ganoderma* sp., *Lepiota* sp., *Daedeleopsis* sp., *Russula* sp., *Psythyrella* sp., *Lycoperdon* sp., *Crepidotus* sp., *Psilocybe* sp., *Flammulina* sp. and *Cantharellus* sp. The survey revealed that five species are edible, six species have medicinal value, three species are inedible and three are unknown. The maximum density of occurrence was exhibited by *Psilocybe cubensis* (45%) followed by *Lepiota* sp. (40%), *Ganoderma pfeifferi* (35%) and *Ganoderma lucidum* (25%).

Aminuzzaman and Das (2016) carried out a research work in Bogra district under the Social forest region of Bangladesh and collected 32 fungal samples were collected and identified to 16 species belong to 2 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 boninens, Ganoderma* sp. and the maximum density was exhibited by *Ganoderma resinaceum* (66.67%).

Das *et al.* (2016) investigated the largest single block of tidal halophytic forest Mangrove (Sundarban) and collected 72 macrofungal samples were collected 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, Marasamius* sp., *Marasamius siccus, Marasmius nigrodiscus, Marasmiellus albuscorticis, Volvariella hypopithys, Volvariella speciosa, Crepidotus alabamenis* and *Crepidotus applanatus*. The maximum frequency (75%) was recorded for *Agaricus silvicola, Lepiota* sp., *Marasmiellus albuscorticus* and *Volveriella speciosa.* The maximum density was 287.5% recorded for *Coprinus silvicatus.* The predominant families were Agaricaceae, Marasmiaceae, Pluteaceae, Crepidotaceae and Mycenaceae.

Sharareh *et al.* (2016) reported that the wild mushrooms provide a significant source of nutritional and medicinal bioactive compounds. They have been collected and consumed by people from many countries for thousands of years. However, there is a shortage of information in the literature regarding Iranian wild mushrooms. Thus, this mini-review tries to outline recent efforts made in order to collect, identify and maintain wild mushrooms of Iran. This review may also encourage more research on

collection, assessment, and biochemical analysis of Iranian wild mushrooms in order to establish a germplasm bank of wild mushrooms.

Joob and Wiwanitkit (2016) stated that Linzhi (*Ganoderma lucidum)* is a well-known medicinal mushroom. The usefulness to kidney is mentioned in the literature. Linzhi (*Ganoderma lucidum*) is a well-known medicinal mushroom. This mushroom originated from China becomes the widely used supplementation worldwide. The active ingredient in the mushroom is mentioned for anti-oxidative, glucose controlling and anti-cancerous proliferative activities. In nephrology, the advantage of Linzhi on kidney is also mentioned. However, the evidence in human beings is limited.

Deepak *et al.* (2016) reported that mushrooms are well known for their nutritional as well as therapeutic values worldwide. They have been reported to be the most valuable ones for humans. Investigations on the therapeutic and nutritional properties of mushrooms are underway throughout the world. Researchers are providing crucial data on the array of bioactive compounds found within these fascinating fungi. People are now accepting mushrooms more as food and food supplements.

Rahaman *et al.* (2016) surveyed at the south western region of Bangladesh and identified 16 mushroom species belong to 10 genera, under 8 families 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 *Gymnopilus purpuratus*, *Coprinus sterquilinus*, *Marasmius oreades*, *Hypholoma capnoides* and *Coprinellus plagioporus* were recorded as 8.10%.

Vanessa *et al.*(2016) studied that the wild mushroom *Leucopaxillus candidus* (Bres.) free from sugars, fatty acids, tocopherols, organic and phenolic acids were analysed by chromatographic techniques coupled to different detectors. *L. candidus* methanolic extract was tested regarding antioxidant potential (reducing power, radical scavenging activity and lipid peroxidation inhibition). *L. candidus* was shown to be an interesting species in terms of nutritional value, with high content in proteins and carbohydrates, but low fat levels, with the prevalence of polyunsaturated fatty acids. Mannitol was the most abundant free sugar and tocopherol was the main tocopherol isoform.

Rumainul *et al.* (2015) investigated mushrooms flora in seven different areas of tropical moist deciduous forest region of Bangladesh namely Dhaka, Gazipur, Bogra, Rajshahi, Pabna, Jaipurhat and Dinajpur. Mushroom flora associated with these forest regions were collected, photographed and preserved. A total of fifty samples were collected and identified to fourteen genera and twenty four species. The predominant genera were *Ganoderma* sp., *Lepiota* sp., *Marasmius* sp. and *Collybia* sp.

Krishna *et al*. (2015) collected the fruiting bodies of macrofungi from some forests, fences, waste fields, timber depots of Telangana state during rainy season. This is an attempt to give a broad picture of diversity of macrofungi belonging to the class Basidiomycetes in some forest areas of Telangana

region. A total number of 50 fruiting bodies were collected and cultured and among them only ten were identified based on their macroscopic features and molecular identification since they showed good lignolytic activity.

Kinge and Mih (2015) studied the diversity and distribution of species of *Ganoderma* in south western Cameroon. Four species, *Ganoderma weberianum, Ganoderma cupreum, Ganoderma steyaertanum, Ganoderma zonatum* are new records for Cameroon. The remaining 11 species belong to *Ganoderma ryvardense, Ganoderma lobenense* and *Ganoderma* species 1-9 with different affinities might be new to science. Six plant species were identified as hosts to different species of *Ganoderma.* They are *Elaeis guineensis, Cassia* sp., *Acacia* sp., *Pinus sylvestris, Avocado* sp. and unidentified hardwood, with *E. guineensis,* hosting the highest number of species.

Manna *et al*. (2014) reported that among 18 mushroom species related to tribal use, the most usable species were *Astraeus hygrometricus*, *Amanita vaginata* var. *alba, Amanita banningiana, Russula nigricans*, *Termitomyces eurrhizus* and *Termitomyces microcarpus.* Monsoon and post-monsoon periods which fall during the second half of August are found to be the optimum time for the production of 11 wild edible mushrooms. Out of the total calculated production, 47.2% of the same was noted during this time.

Vyas *et al*. (2014) conducted an experiment on Patharia forest which is mixed and dry deciduous type, dominated by *Acacia* sp., *Butea monosperma, Tectona grandis* and ground flora consisting of *Biophytum sensitivum, Cynodon dactylon, Lanata camara* etc. During the period of July 2011-July 2013, wild mushrooms were collected from Patharia forest and 18

mushroom species belonging to 12 families were identified viz. *Vascellum pretense, Lycoperdon pyriform, Coniphora puteana*, *Clitocybe geotrapa, Ganoderma tsugae, Microglossum virde, Panaeolus sphinctrinus, Pleurotus cornucopiae, Fomes fomentarius*, *Tyromyces lacteus*, *Lenzites betulina, Hypholoma elongatum, Pholita highlandensis, Serpula lacrymans, Tremella mesenterica, Lepisa nuda, Collybia butyracea* and *Omphalina ericetorum*.

Chelela *et al.* (2014) conducted a survey to assess mycological knowledge and socio-economic benefits along the wild edible mushrooms value chain among *Benna* and *Hehe* ethnic groups in the Southern Highlands of Tanzania. They collected wild edible mushrooms in the *Miombo* wood land surrounding six villages during rainy season in January 2014. From the survey, mushroom collection and selling was gender oriented dominated by women at 70 and 93.5%, respectively.

Andrew *et al.* (2013) reported 177 macrofungal species belonging to 83 genera and 38 families. 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. *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. Six of the 12 morpho-groups identified occurred across the sites, with the gilled fungi being the most frequent. *Cyathus striatus* was found only in Buea Town during the rainy seasons.

Pandey *et al.* (2013) conducted a study in Jeypore Reserve Forest located in Assam, India to investigate the diversity of macro fungi associated with different tree species. Thirty macro fungal species representing 26 genera belonging to 17 families were collected from six different sites in the study area. The 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%.

Farooq *et al.* (2013) carried out an experiment on Soon Valley Sakasar located in District Khushab of the province Punjab, Pakistan and identified 25 mushroom species belonging to 9 families and 14 genera were identified from the study area. Among the collected mushroom species Agaricus was found as most dominant genus (36%) followed by *Innocybe* (12%). All the mushroom species exhibited remarkable variation in terms of habitat, season and locations. Ethnological survey revealed that 12 species are edible, 9 inedible and 4 act as poisonous ones.

Chandulal *et al.* (2013) identified 17 species 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 – *Cantharrellus umbonatus, Coriolus versicolor* (polyporaceae, inedible), *Schizophyllum commune* (Schizophyllaceae,

inedible) (the split gill), *Ganoderma luncidum* (Ganodermataceae), *Ganoderma applanatun* (Ganodermataceae), *Laetiporus sulphureus* (Polyporaceae, edible), *Lepiota organensis, Collybia butyracea, Lentineullus cochleatus* (Aurisclpinaceae, edible), *Galerina unicolor* (Hymenogatraceae), *Citocybe flaccid* (Trichomataceae, edible), *Oudemansiella redicata* (Physalacriaceae, edible), *Hygrophorus eburnes* (Hygrophoraceae, edible) and *Agaricus campestris* (Agaricaceae, edible).

Das *et al*. (2013) reported three species namely *Russula sharmae*, *R. dubdiana* and *R. sikkimensis* as new taxa in west district of Sikkion (India), located in the Eastern Himalaya. Macro and micromorphological illustrated descriptions of these species are given along with their taxonomic positions and relations to allied species.

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

Hosen *et al.* (2013) described a new monotypic genus in the boletaceae, *Borofutus*, typified by *B. dhakanus*, using morphological and molecular evidence. This is a putatively ectomycorrhizal fungus associated with

Shorea reobusta. *Borofutus* is sister to Spongi forma in molecular phylogenetic analysis using DNA nucleotide sequences of single or multiple loci. They presented a description, line drawings, phylogenetic placement and comparison with allied taxa of macrofungi.

Kumar *et al.* (2013) reported that, the macrofungal diversity and nutrient content of some edible mushrooms and collected young and matured carpophores of 15 wild edible mushroom species from 12 locations in different districts of Nagaland. Out of the four species belongs to family Agaricaceae, two belongs to Tricholomataceae and rest belongs to Boletaceae, Cantherallaceae, Russulaceae, Sarcoscyphaceae, Auriculariaceae, Polyporaceae, Schizophyllaceae, Pleurotaceae and Lyophyllaceae.

Shannon (2013) found that the Truffles (true and false) are fruiting bodies of ectomycorrhizal fungi and some of them produce appealing aromas, are recreationally and commercially harvested, and even cultivated. Until recently, commercial truffles have all been Mediterranean in distribution but some of these species are now cultivated around the world and other native species are being collected and marketed. While cultivation of black truffles can be complicated by horticultural challenges, production of other species appears to be less problematic.

Pushpa and Purushothama (2012) conducted a survey on the biodiversity of mushrooms belonging to the class Basidiomycetes in Bangalore and identified total numbers of 90 species in 48 genera belonging to 19 families in 05 orders were recorded, 28 species were found to be recorded for the first time in India. Among the collected species *Coprinus disseminates* followed

by *Coprinus fibrillosis* and *Schizophyllum communae* was found to be abundant in their occurrence. The Simpson and Sannon diversity biodiversity index was found to be 0.8 and 1.24, respectively.

Pithak and Pukahute (2012) conducted a survey on the diversity of mushrooms in dry dipterocarp forest at Phuphan National Park to study the variety of mushrooms grown in the Dry Dip- terocarp forest during the year 2008-2009 by releve method and to study the relationship between *Shoreasia mensis* Miq. and ectomycorrhizal of the Amanitaceae and the Belotaceae families. The findings of the study reveals the presence of a total 34 types of mushrooms in Dry Dipterocarp forest at the Phuphan where found 26 types in both years during survey.

Dwivedi *et al.* (2012) studied on the taxonomy and diversity of macrofungi in semi evergreen and moist deciduous forest of Amarkantak where more than 50 samples were collected viz. *Agaricus, Amanita, Nyctalis, Russula, Boletus, Macrolapiota, Ganoderma and Termitomyces.* Out of 50 samples only 16 samples were identified up to species level.

Bankole and Adekunle (2012) conducted an experiment on biodiversity of mushrooms in Lagos State, Nigeria and collected *Agaricus campestris, Coprinus comatus, Daldinia concetrica, Ganoderma adspersum, Ganoderma applanatum, Ganoderma lucidum, Mycena haematopus, Mycena* sp., *Pleurotus ostreatus, Pleurotus tuber-regium, Polyporus* sp., *Polyporus squamosus, Polyporus sulphureus, Trametes versicolor, Xylaria polymorpha* and *Xylaria* sp.

Onyango and Ower (2011) investigated morphological characters and spawn production procedures of three Kenyan native strains of wood ear mushroom [*Auricularia auricula* (L. ex Hook.) Underw]. Nine basidiocarps were selected from collections made in three forest reserves within Kakamega Forest in Western Kenya and morphologically characterized.

Srivastava *et al.* (2011) found four species of *Termitimyces* in the Gorakpur forest division using morphological characterization and phenotypical appearance. Four species naming *Termitomyces heimii, Termitomyces clypeatus, Termitomyces mammiformis* and *Termitomyces microcarpus* characterized by different morphological traits. Results indicated that all the four species of *Termitomyces* showed great diversity in their morphological characters.

Karwa and Rai (2010) reported on the tapping into the edible fungi biodiversity of Melghat forest in Central India and 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 and Harrington (2010) conducted study on diversity and distribution of Agaricomycete species in the Republic of Ireland (ROI) and the records are compared with similar records from Northern Ireland, England, Scotland and Wales. The number of Agaricomycete species recorded from Ireland is much lower than in the other countries examined. The ROI has 100, 700,

1300 and 2200 fewer species than Northern Ireland, Wales, Scotland and England respectively.

Ram *et al*. (2010) conducted a field experiment for collection of various edible fleshy fungi from different localities of Eastern Uttar Pradesh forest during the rainy season on dead and decaying plant or animal remains. However there are only few species of fungi which have been accepted as safe food by the civilized world, while many fleshy fungi have not yet recognized. The collected edible fleshy fungi were studied for their macroscopic detail partening the habit, habitat, morphology and other phenotypic parameter noted in fresh form.

Ge *et al*. (2008) carried out the morphological, phylogenetic and biogeographic studies on Chinese collections of *Flammulina.* It was revealed that at least four *species* [*F. rossica*, *Flammulina* sp. (*HKAS 51191*), *F. velutipes* and *F. yunnanensis*] occur in China. *Flammulina yunnanensis* was described as new based on morphological and molecular data. *F. rossica*, a new record to China, was confirmed to have a Holarctic distribution. *Flammulina* sp. had a hymeniform suprapellis but is phylogenetically close to *F. velutipes*. Analyses of the ITS/5.8S rDNA sequences of *Flammulin*a species suggested that collections of *F. velutipes* from China were more closely related to a Canadian population rather than to those of Europe and the USA.

Antonín *et al.* (2006) recorded twenty six collections representing 19 taxa of the genus *Marasmius* from Madagascar, Mauritius and Réunion where they described *Marasmius andasibensis*, *Marasmius andasibensis* var. *obscurostipitatus*, *M. brunneoaurantiacus* and *M. curreyi* var. *bicystidiatus*

in sect. *Marasmius*; *M*. *cecropiformis* and *Marasmius neosessiliformis* (introduced as a *nom*. *prov*. because of the absence of the macroscopic description) in sect. *Neosessiles*; *M*. *pseudocyphella* in sect. *Hygrometrici* and *M*. *eyssartieri* in sect. *Sicci.*

Niazi *et al.* (2006) reported that, the biodiversity of mushrooms and ectomycorrhizas from Himalayan moist temperate forests of Pakistan where *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.

CHAPTER III

MATERIALS AND METHODS

CHAPTER III

MATERIALS AND METHODS

Field survey was conducted for collection of various fleshy and woody macrofungi from Gajni area of Sherpur district. The collected macrofungi was studied for their habit, habitat, morphology and other phenotypic parameter noted in fresh form. Standard methods of collection, preservation, macroscopic and microscopic observations were recorded. Collected samples were preserved as dried specimens in the SAU herbarium of macrofungi (SHMF) under the Department of Plant Pathology, Sher-E-Bangla Agricultural University.

The area of Gajni in Sherpur district was selected for conducting survey analysis on macrofungi biodiversity, distribution, habitat and morphology. A pre-designed collection procedure and data analysis procedure were used to collect information on level of knowledge on biodiversity, habitat and morphology of macrofungi in selected regions of Bangladesh.

Survey was carried out in Sherpur district of Bangladesh from June to October, 2016 and February to May, 2017 to record the morphological variability of macrofungi population. The collection was made by method given by Hailing (1996). Spotted macrofungi were inspected in their natural habitats and brought to laboratory for detailed study. Photographs were taken by means of a Sony Camera with power of 16 megapixels. The collected fleshy and woody macrofungi were studied for their macroscopic detail partnering the habit, habitat, morphology and other phenotypic parameter noted in fresh form. Standard methods of collection, preservation, macroscopic and microscopic preservations were recorded.

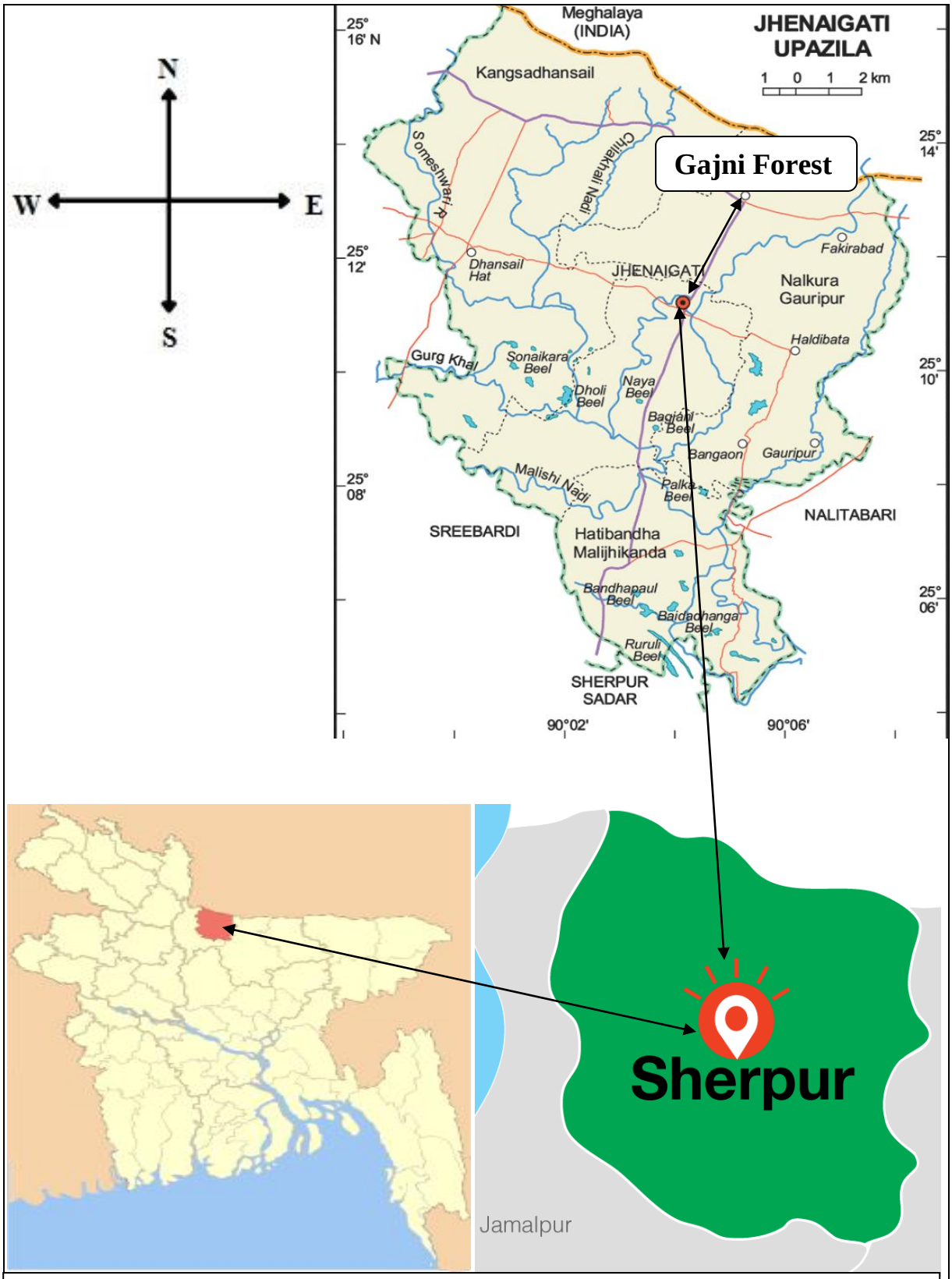

Figure 1. Survey areas of Gajni forest in Sherpur district of Bangladesh.

Macrofungi was washed by water for removing debris. During the analysis period some precautions were followed before processing of macrofungi (Kim, 2004). Mainly two types of preservation process-one is short term preservation and another is long term preservation were followed on the basis of study purpose and structure of the mushroom.

Macrofungi samples were dried by using electrical air flow drier. The power supply capacity of this drier was 1000 voltage, which easily remove moisture from collected macrofungi within three to seven hours with regular interval basis power supply (15 minutes switch off and 30 minutes switching) depending on the structure and texture of the species (Kim, 2004). The collected and processed and dried macrofungiwere stored in Zip lock poly bag during research period. Silica gel was used at the rate of 10% of dry basis during the storage period. Collecting specimens dried with the help of electric dryer dried specimens are preserved with 10% silica gel (Kim, 2004).

The following parameters were recorded for identification of macrofungi specimens 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 vail, annuls (position), volva, (Srivastava and Bano, 2010). Cap color, cap surface, cap margin, cap diameter, stipe length, gill attachment, gill spacing and spore print. Individual spore characteristics like shape, size and color were recorded. For this purpose, motic microscope was used and measuring shape, size and color with the help of Motic Images Plus 2.0 software. Final identification and classification were done by comparing recorded characteristics of

macrofungi with the color dictionary of mushroom given by Dickinson and Lucus (1982), the macrofungi guide and followed by the reference of Jorden (2004) and Pegler and Spooner (1997).

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 macrofungi was in fresh form. For microscopic characters, permanent glass slides were made from rehydrated basidiocarps with the aid of a sharp surgical blade. Basidiocarps were immersed in cotton blue stain and glycerin and placed on glass slides and covered with cover slips. Motic compound microscope (40x) were used to observe the slides. Spore size was measured by Motic Images plus 2.0 software.

The different mixed type forests are impregnated with decaying wood and rotting plant parts, termites nests, cow dungs, leaf litters etc. The specimens were found attached to various substrata. The surrounding environment temperature, soil pH, moisture condition, vegetation recorded for biodiversity of macrofungi. The air temperature was measured by thermometer. The collected samples were wrapped in polybag and brought to the laboratory for their further study.

The density of different species has been determined by the following formula (Zoberi, 1973).

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

CHAPTER IV

RESULTS AND DISCUSSION

CHAPTER IV

RESULTS AND DISCUSSION

A survey was conducted during June to October, 2016 and February to May, 2017 in Gajari (*Shorea robusta*) dominated in Gajni forest of Bangladesh to collect and identify macrofungi associated with the forest trees. A total 51 macrofungi samples were collected and identified to 22 genera, 16 species under 15 families (Table 1). The predominant genera were *Agaricus, Trametes, Ganoderma, Marasmius, Parasola, Coprinus, Clitocybe, Inonotus* and *Phallus*. The predominant families were Agaricaceae, Ganodermataceae, Marasmiaceae, Polyporaceae, Psathyrellaceae, Hymenochaetaceae, Tricholomataceae and Phallaceae.

Table 1. Macrofungi identified from Gajni forest with their common name, Scientific name, family and host name.

S.L. No.	Scientific Name	Common Name	Family	Host (Root zone/surface)
1	*Agaricus augustus*	The prince	Agaricaceae	Gajari (*Shorea robusta*)
2	*Agaricus bernardii*	Salt-loving mushroom	Agaricaceae	Gajari (*Shorea robusta*)
3	*Agaricus campestris*	Field mushroom, meadow mushroom	Agaricaceae	Gajari (*Shorea robusta*)
4	*Agaricus* sp.		Agaricaceae	Shimul (*Bombax ceiba*)
5	*Agaricus* sp.		Agaricaceae	Sissoo (*Dalbergia sissoo*)

S.L. No.	Scientific Name	Common Name	Family	Host (Root zone/surface)
6	*Coprinus* sp.		Agaricaceae	Koroi (*Albizzia procera*)
7	*Coprinus* sp.		Agaricaceae	Sissoo (*Dalbergia sissoo*)
8	*Lepiota* sp.		Agaricaceae	Mahogany (*Swietenia macrophylla*)
9	*Lycoperdon perlatum*	Puffball, warted puffball, gem-studded puffball, or the devil's snuff-box	Agaricaceae	Kurchi (*Holarrhena antidysentrica*)
10	*Calvatia* sp.	Puffball mushrooms	Agaricaceae	Neem (*Azadirachta indica*)
11	*Ganoderma zonatum*	Lingzhi or Reishi mushroom	Ganodermataceae	Koroi (*Albizzia procera*)
12	*Ganoderma tsugae*	Hemlock varnish shelf	Ganodermataceae	Haldina (*Haldina cordifolia*)
13	*Ganoderma* sp.		Ganodermataceae	Kurchi (*Holarrhena antidysentrica*)
14	*Ganoderma* sp.		Ganodermataceae	Koroi (*Albizzia procera*)
15	*Ganoderma* sp.		Ganodermataceae	Neem (*Azadirachta indica*)
16	*Dacryopinax spatularia*		Dacrymycetaceae	Gajari (*Shorea robusta*)

S.L. No.	Scientific Name	Common Name	Family	Host (Root zone/surface)
17	*Crepidotus sp.*		Crepidotaceae	Gajari (*Shorea robusta*)
18	*Marasmius nigrodiscus*		Marasmiaceae	Kadam (*Neolamarckia cadamba*)
19	*Marasmius rotula*	The pinwheel mushroom, the pinwheel marasmius	Marasmiaceae	Bohera (*Terminalia bellirica*)
20	*Marasmius* sp.		Marasmiaceae	Haldina (*Haldina cordifolia*)
21	*Parasola lactea*		Psathyrellaceae	Koroi (*Albizzia procera*)
22	*Parasola* sp.		Psathyrellaceae	Gajari (*Shorea robusta*)
23	*Psathyrella candolleana*	Common Psathyrella; Suburban Psathyrella	Psathyrellaceae	Kurchi (*Holarrhena antidysentrica*)
24	*Clitocybe dealbata*	Sweating mushroom, Ivory funnel	Tricholomataceae	Gajari (*Shorea robusta*)
25	*Clitocybe* sp.		Tricholomataceae	Kadam (*Neolamarckia cadamba*)
26	*Mycena epipterygia*		Mycenaceae	Gajari (*Shorea robusta*)
27	*Amanita* sp.		Amanitaceae	Sissoo (*Dalbergia sissoo*)
28	*Cortinarius semisanguineus*	Surprise webcap or red-gilled webcap	Cortinariaceae	Hartaki (*Terminalia chebula*)

S.L. No.	Scientific Name	Common Name	Family	Host (Root zone/surface)
29	*Daedalea* sp.		Fomitopsidaceae	Mango (*Mangifera indica*)
30	*Auricularia* sp.		Auriculariaceae	Kadam (*Tibetan buddhism*)
31	*Trametes hirsuta*	Hairy bracket	Polyporaceae	Gajari (*Shorea robusta*)
32	*Trametes gibbosa*	Lumpy bracket	Polyporaceae	Gajari (*Shorea robusta*)
33	*Trametes* sp.		Polyporaceae	Sissoo (*Dalbergia sissoo*)
34	*Trametes* sp.		Polyporaceae	Gajari (*Shorea robusta*)
35	*Trametes* sp.		Polyporaceae	Hartaki (*Terminalia chebula*)
36	*Trametes* sp.		Polyporaceae	Kadam (*Neolamarckia cadamba*)
37	*Cerrena* sp.		Polyporaceae	Gajari (*Shorea robusta*)
38	*Pycnoporus* sp.		Polyporaceae	Gajari (*Shorea robusta*)
39	*Polyporus* sp.		Polyporaceae	Bamboo (*Bambusa vulgaris*)
40	*Inonotus* sp.		Hymenochaetaceae	Sissoo (*Dalbergia sissoo*)

S.L. No.	Scientific Name	Common Name	Family	Host (Root zone/surface)
41	*Inonotus* sp.		Hymenochaetaceae	Arjun (*Terminalia arjuna*)
42	*Phallus impudicus*	Stinkhorn	Phallaceae	Gajari (*Shorea robusta*)
43	*Phallus* sp.		Phallaceae	Bohera (*Terminalia bellirica*)
44	*Steccherinum ochraceum*	Ochre spreading tooth	Stecchierinaceae	Sissoo (*Dalbergia sissoo*)

Table 2. Macrofungi identified from Gajni forest with their, Scientific name, spores characteristics, Habitat, density, Temperature and soil type.

S.L. No.	Scientific Name	Spores characteristics	Habitat	Density (%)	Temp. (^{0}c)	Soil Type
1	*Agaricus aungustus*	Light brown and hyaline, thick walled, rough, 8.2 × 8.1µm	Un-abundant	2.27	31	Sandy to sandy loam
2	*Agaricus bernardii*	Dark yellow, thick walled, smooth, ellipsoidal, 11.2 × 7.8µm	Un-abundant	4.55	32	Sandy to clay loam
3	*Agaricus campestris*	Light brown, moderately thick walled, rough,oval, 7.6 × 7.1µm	Un-abundant	2.28	32	Sandy to sandy loam
4	*Agaricus* sp.	Dark yellow,thick walled, smooth, ellipsoidal, 12.1 × 8.3µm	Un-abundant	2.28	30	Sandy soil
5	*Agaricus* sp.	Light brown, moderately thick walled, rough, regular, oval and 7.6 × 7.1µm	Un-abundant	2.27	31	Sandy to clay loam
6	*Coprinus* sp.	Brown to yellow, thin walled, smooth, round, 8.8 × 5.9µm	Un-abundant	2.27	28	Sandy to sandy loam

S.L. No.	Scientific Name	Spores characteristics	Habitat	Density (%)	Temp. (^{0}c)	Soil Type
7	*Coprinus* sp.	Light brown, thick walled, rough, round, 10.3 × 8.6µm	Un-abundant	15.91	28	Sandy soil
8	*Lepiota* sp.	Llight brown at he center, thick walled, smooth, regular, ellipsoidal, 18.1 × 10.6µm	Un-abundant	6.82	29	Sandy to sandy loam
9	*Lycoperdon perlatum*	Light brown,thin walled, smooth, clustered, round, 7.3 × 6.2µm	Un-abundant	18.18	29	Sandy soil
10	*Calvatia* sp.	Dark brown,thick walled, smooth, ellipsoidal, 15.3 × 8.9µm	Un-abundant	2.27	28	Sandy to sandy loam
11	*Ganoderma zonatum*	Dark yellow, thick walled, smooth, regular, ellipsoidal, 8.3 × 5.7µm	Un-abundant	6.82	32	Sandy to sandy loam
12	*Ganoderma tsugae*	Dark brown and black,thick walled, rough, ellipsoidal, 11.3 × 8.9µm	Un-abundant	2.27	29.5	Sandy soil
13	*Ganoderma* sp.	Light brown, moderately thick walled, rough, regular, round, 5.8 × 5.3µm	Un-abundant	4.55	32	Sandy soil
14	*Ganoderma* sp.	Light brown,thin walled, smooth, regular, round, 4.3 × 4.2µm	Un-abundant	6.82	32	Sandy to sandy loam

S.L. No.	Scientific Name	Spores characteristics	Habitat	Density (%)	Temp. (^{0}c)	Soil Type
15	*Ganoderma* sp.	Light brown, 4.3 × 4.2µm	Un-abundant	6.82	32	Sandy soil
16	*Dacryopinax spatularia*	Dark brown and black,thick walled, rough, ellipsoidal, 10.8 × 8.4µm	Un-abundant	95.45	30.5	Sandy soil
17	*Crepidotus* sp.	Dark brown and yellow,thick walled, rough, irregular and ellipsoidal, 8.9 × 7.8µm	Un-abundant	2.27	29	Sandy to sandy loam
18	*Marasmius nigrodiscus*	Dark brick, thick walled, smooth, regular and ellipsoidal, 10.3 × 7.8µm	Un-abundant	2.27	30	Sandy to clay loam
19	*Marasmius rotula*	Dark yellow, thick walled, smooth, regular, ellipsoidal, 9.8 × 5.8µm	Un-abundant	6.82	28	Sandy soil
20	*Marasmius* sp.	Light brown, moderately thick walled, clustered, smooth, regular, round, 3.7 × 3.5µm	Un-abundant	4.55	28	Sandy to sandy loam
21	*Parasola lactea*	Dark brown, thick walled, rough, ellipsoidal, 16.8 × 10.6µm	Un-abundant	2.27	28	Sandy to clay loam
22	*Parasola* sp.	Brown, thick walled, rough, ellipsoidal, 6.8 × 5.6µm	Un-abundant	4.55	28	Sandy to clay loam

S.L. No.	Scientific Name	Spores characteristics	Habitat	Density (%)	Temp. (^{0}c)	Soil Type
23	*Psathyrella candolleana*	Dark yellow, thick walled, smooth, regular, ellipsoidal, 14.6 × 8.3µm	Abundant	120.45	28	Sandy to sandy loam
24	*Clitocybe dealbata*	Light brown, thick walled, rough, regular, round, 13.3 × 12.8µm	Un-abundant	2.27	30	Sandy to clay loam
25	*Clitocybe* sp.	Light brown,thick walled, smooth, regular and oval, 11.4 × 8.3µm	Un-abundant	2.27	28	Sandy to clay loam
26	*Mycena epipterygia*	Dark brown, thick walled, rough, irregular and ellipsoidal, 13.8 × 9.6µm	Un-abundant	18.18	29	Sandy to sandy loam
27	*Amanita* sp.	Dark yellow, thick walled, smooth, regular and ellipsoidal, 14.3 × 8.6µm	Un-abundant	4.55	28	Sandy to sandy loam
28	*Cortinarius semisanguineus*	Dark brown, thick walled, smooth, irregular, ellipsoidal and 11.8 × 8.3µm	Abundant	111.36	32	Sandy to sandy loam
29	*Daedalea* sp.	Hyaline, thick walled, rough, irregular, oval and 9.2 × 7.8µm	Un-abundant	6.82	29	Sandy to sandy loam

S.L. No.	Scientific Name	Spores characteristics	Habitat	Density (%)	Temp. (^{0}c)	Soil Type
30	*Auricularia* sp.	Brown and black,thick walled, rough, irregular, ellipsoidal and 15.1×7.2µm	Un-abundant	15.91	28	Sandy to sandy loam
31	*Trametes hirsuta*	Light brown,thick walled, rough, irregular, ellipsoidal and 8.9×6.2µm	Un-abundant	9.10	32	Sandy soil
32	*Trametes gibbosa*	Brown,thick walled, rough, irregular, ellipsoidal and 15.1×7.2µm	Un-abundant	6.82	31	Sandy to sandy loam
33	*Trametes* sp.	Brown,thick walled, rough, irregular, ellipsoidal and 10.1×7.8µm	Un-abundant	36.36	29	Sandy soil
34	*Trametes* sp.	Brown,thin walled, smooth, regular, round and 7.8×6.3µm	Un-abundant	25	32	Sandy to sandy loam
35	*Trametes* sp.	Light brown,thick walled, rough, ellipsoidal and 11.2×6.2µm	Un-abundant	13.89	31	Sandy soil

S.L. No.	Scientific Name	Spores characteristics	Habitat	Density (%)	Temp. (^{0}c)	Soil Type
36	*Trametes* sp.	Brown and hyaline, rough, irregular, ellipsoidal and 10.9×8.2µm	Un-abundant	2.27	32	Sandy to sandy loam
37	*Cerrena* sp.	Brown and dark yellow,thick walled, rough, irregular, ellipsoidal and 9.2×7.8µm	Abundant	25	31	Sandy to clay loam
38	*Pycnoporus* sp.	Dark yellow,thick walled, smooth, regular, ellipsoidal and 9.8×6.4µm	Un-abundant	2.27	32	Sandy to sandy loam
39	*Polyporus* sp.	Light yellow,thick walled, rough, oval and 8.9×6.8µm	Un-abundant	22.73	30	Sandy to clay loam

S.L. No.	Scientific Name	Spores characteristics	Habitat	Density (%)	Temp. (^{0}c)	Soil Type
40	*Inonotus* sp.	Light brown,thin walled, rough, irregular,round and 8.3×6.8µm	Un-abundant	2.27	32	Sandy soil
41	*Inonotus* sp.	Light brown,thin walled, round, irregular and 7.8×6.3µm	Un-abundant	2.27	29	Sandy soil
42	*Phallus impudicus*	Light brown,thin walled, rough, irregular, round and 7.9×5.8µm	Un-abundant	2.27	29	Sandy to sandy loam
43	*Phallus* sp.	Brown,thin walled, rough, irregular, ellipsoidal and 8.2×6.3µm	Un-abundant	2.27	29	Sandy soil
44	*Steccherinum ochraceum*	Light brown and hyaline,thin walled, ellipsoidal and 8.9×5.8µm	Un-abundant	13.63	32	Sandy to sandy loam

4.1 Morphology and ecology of *Agaricus aungustus*

Morphology: The color of pileus (cap) was whitish brown. The average size of the basidiocarp was 4.6×3.1cm. The shape of cap was convex and flat with the cap edge was round. Beneath the cap hymenophores were absent. Regular shaped black gills (lamellae) were present underside of the cap. Color of stipe was brown. Ring or anal was absent on the stipe and volva was absent on the lower part of the stipe (Plate-1).

Ecology : The species was found from the root zone of Gajari (*Shorea robusta*) tree. The habit was solitary and their distribution was moderately in moist weather.

4.2 Morphology and ecology of *Agaricus bernardii*

Morphology : The color of pileus (cap) was brown and the average size of the basidiocarp was 4.4×3.3cm. The shape of cap was convex with the cap edge was round. Beneath the cap hymenophores were absent. Regular shaped brown coloerd gills (lamellae) were present underside of the cap. Color of stipe was brownish. Ring or anal was absent on the stipe and volva was absent on the lower part of the stipe (Plate-2).

Ecology : The species was collected from the root zone of Gajari (*Shorea robusta*) tree. The habit was clustered and their distribution was in dry weather.

4.3 Morphology and ecology of *Agaricus campestris*

Morphology : The color of pileus (cap) was white and brown and the average size of the basidiocarp was 4.3×2.8cm. The shape of cap was convex and flat with the cap edge was round. Beneath the cap hymenophores were absent. Regular shaped brown colored gills (lamellae) were present underside of the cap. Thick white color stipe was present. Ring or anal and volva were absent on the stipe (Plate-3).

Ecology : The species was found form the root zone of Gajari (*Shorea robusta*) tree. The habit was solitary and their distribution was in dry weather.

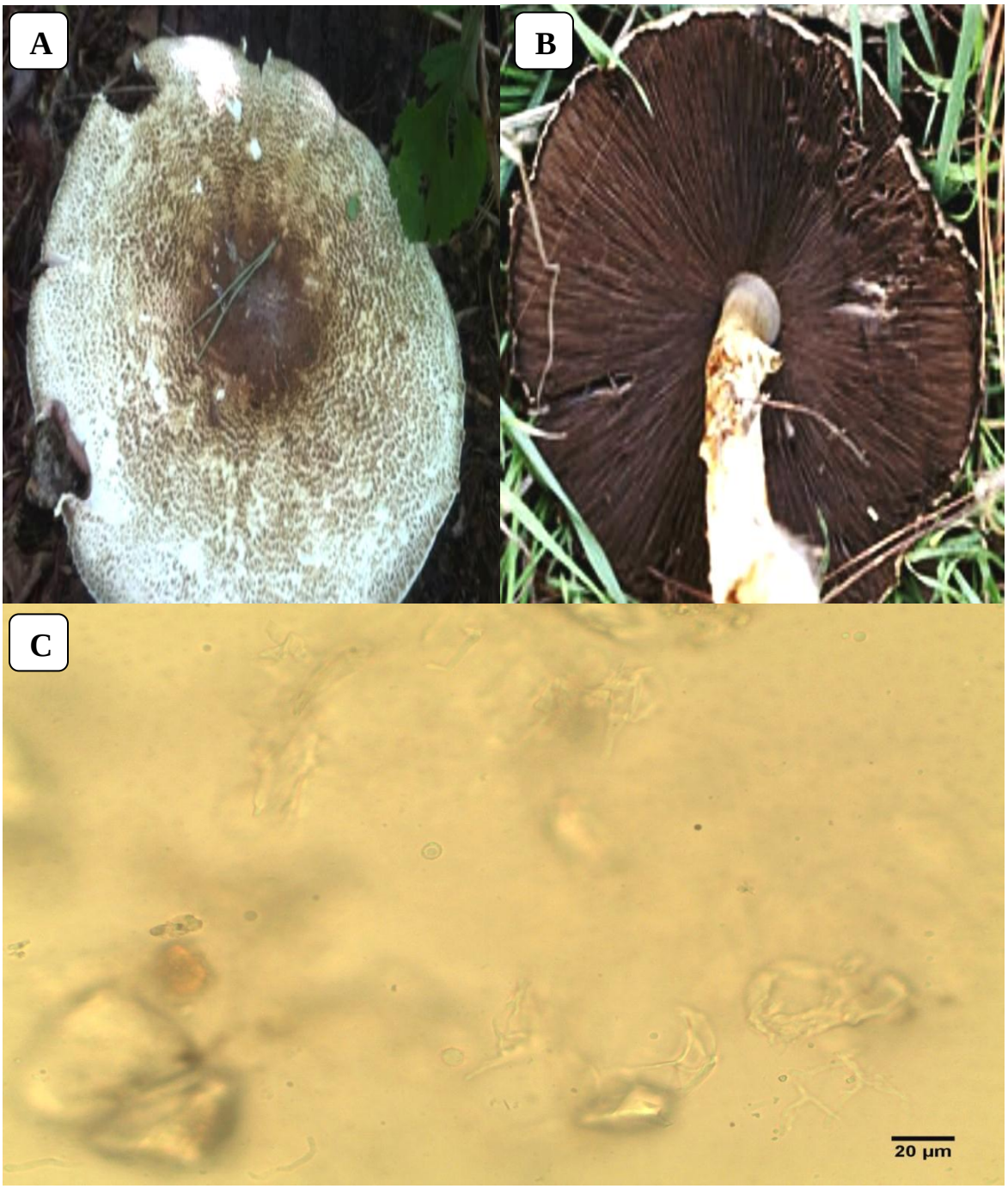

PLATE 1. ***Agaricus aungustus*****;** Mature fruiting body (A), Gills (B), Spores (C).

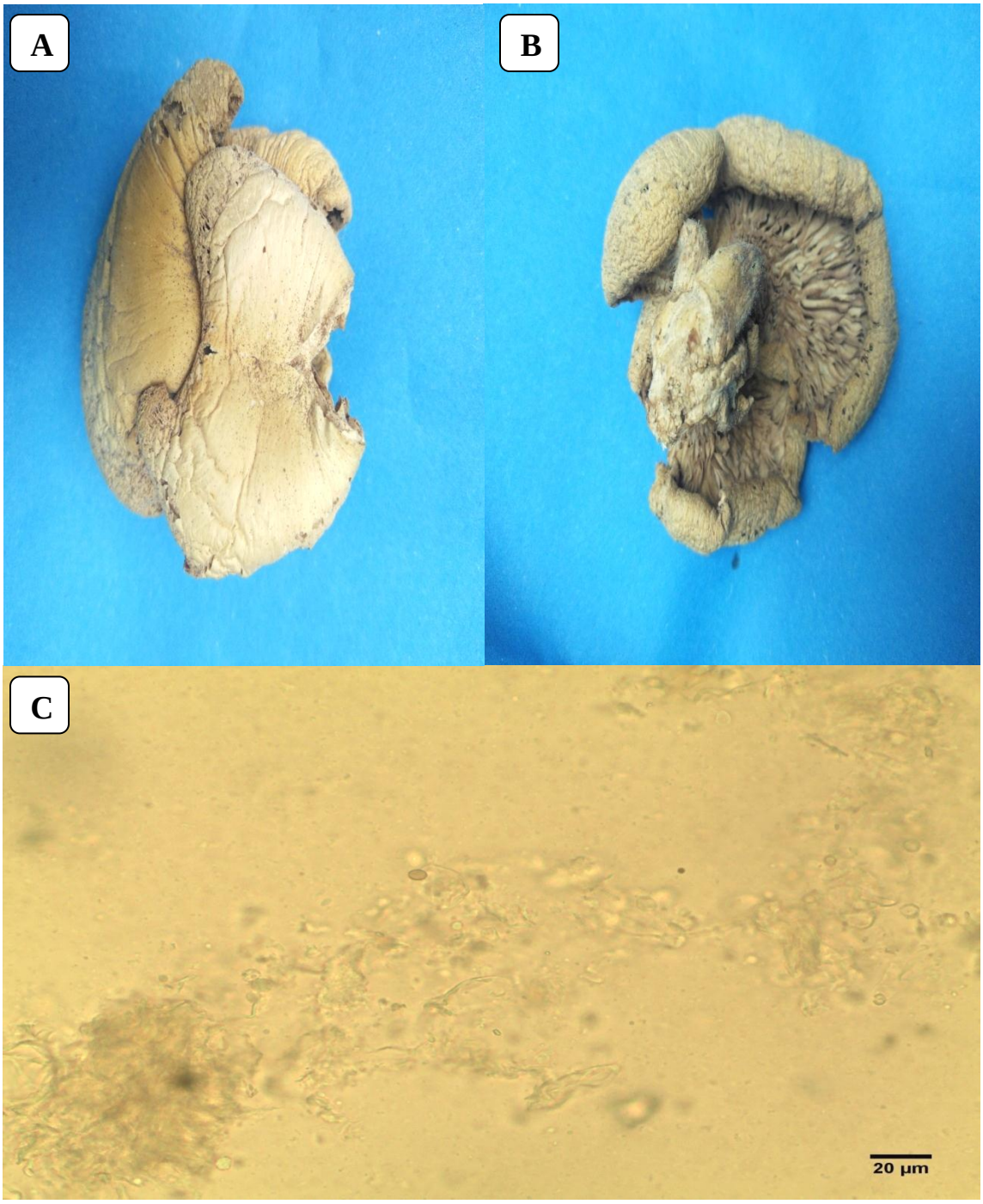

PLATE 2. ***Agaricus bernardii*;** Mature fruiting body (A), Gills (B), Spores (C).

PLATE 3. ***Agaricus campestris*;** Mature fruiting body (A), Gills (B), Spores (C).

4.4 Morphology and ecology of *Agaricus* sp.

Morphology : The color of pileus (cap) was white and the average size of the basidiocarp was 4.6×3.8cm. The shape of cap was convex and flat with the cap edge was round. Beneath the cap hymenophores were absent. Regular shaped white gills (lamellae) were present underside of the cap. The white color stipe was present. Ring or anal and volva were absent (Plate-4).

Ecology : The species was found from the root zone of Shimul (*Bombax ceiba*) tree. The habit was solitary and their distribution was in moderately dry weather.

4.5 Morphology and ecology of Agaricus sp.

Morphology : The average size of the basidiocarp was 4.3×2.8cm. The color of pileus (cap) was white and brown. The shape of cap was convex and flat with the cap edge was round. Beneath the cap hymenophores were absent. Regular shaped brown colored gills (lamellae) were present underside of the cap. Thick white color stipe was present. Ring or anal and volva were absent on the stipe (Plate-5).

Ecology : The species was found near the root zone of Sissoo (*Dalbergia sissoo*). The habit was solitary and the factors affecting their distribution was in dry weather.

4.6 Morphology and ecology of *Coprinus* sp.

Morphology : The pileus (cap) was dark brown and ash color with the convex shape and the round cap edge. The average size of the basidiocarp was 2.1×0.7cm. Beneath the cap hymenophores were absent. Regular shaped brown gills (lamellae) present. The light brown colored stipe was present (Plate-6).

Ecology : The species was found from root zone Sissoo (*Dalbergia sissoo*) tree. The habit was scattered and their distribution was in moderately moist weather.

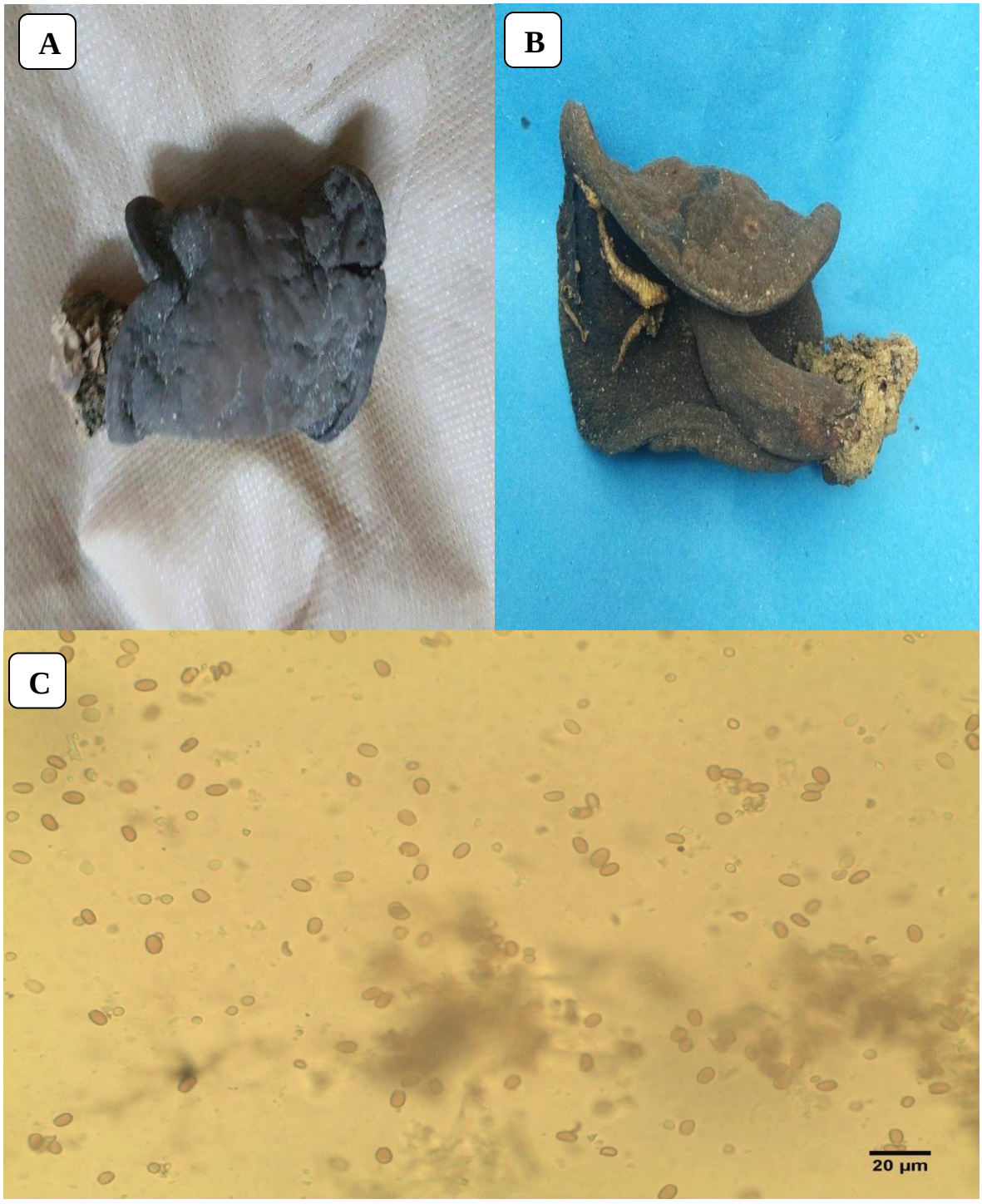

PLATE 4. ***Agaricus*** **sp.;** Mature fruiting body and Gills (A, B), Spores (C).

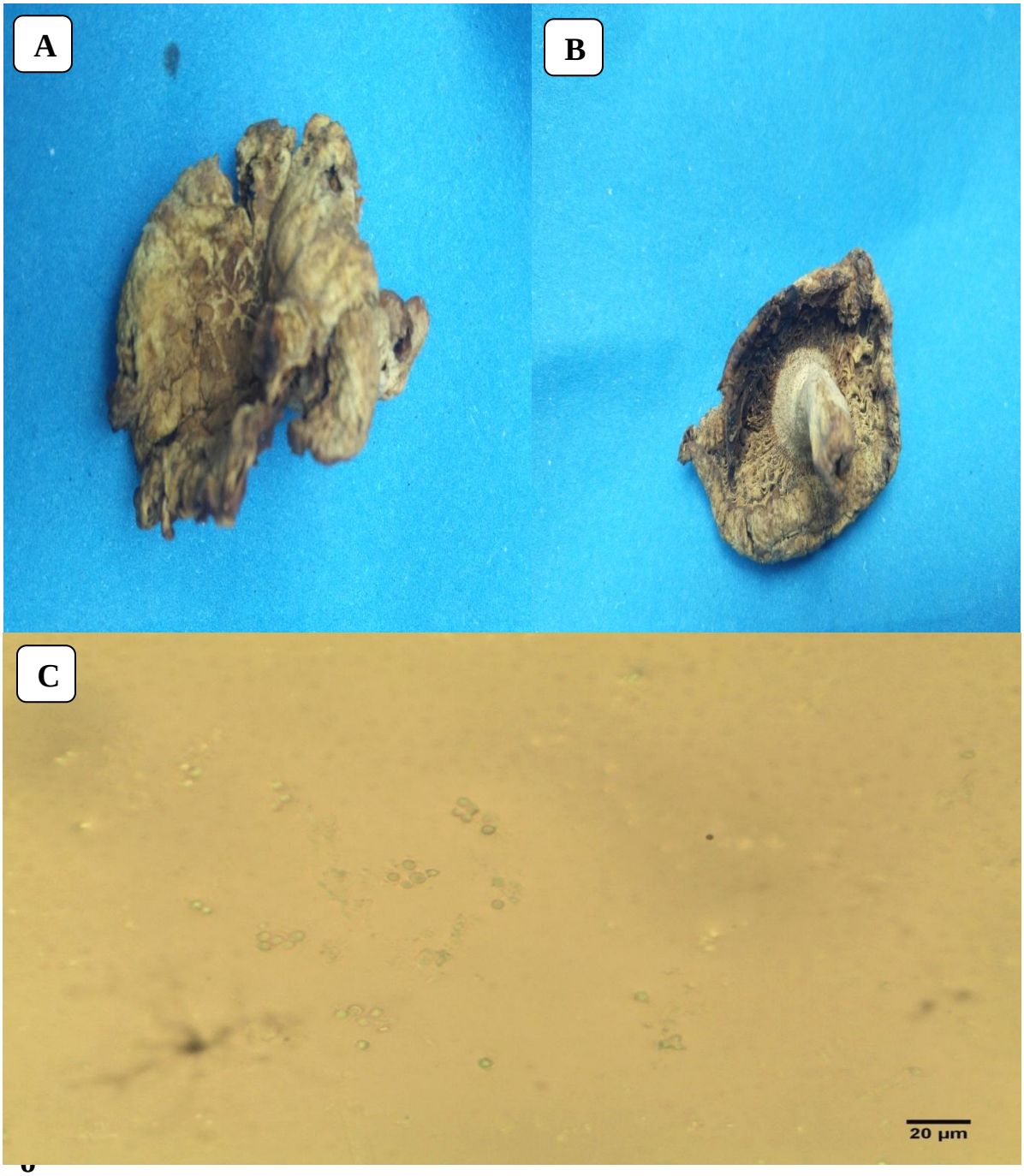

PLATE 5. *Agaricus* sp.; Mature fruiting body (A), Gills (B), Spores (C).

PLATE 6. *Coprinus* sp.; Mature fruiting body (A, B), Spores (C).

4.7 Morphology and ecology of *Coprinus* sp.

Morphology : The pileus (cap) was brown and brick red color at the center of the cap. The average size of the basidiocarp was 2.4×1.2cm. The shape of cap was conical with the cap edge was round and crenate. Beneath the cap hymenophores were absent. The brown color regular shaped gills (lamellae) were present underside of the cap.The brownish stipe was present but ring or anal and volva were absent on the lower part of the stipe (Plate-7).

Ecology: The species was found from root zone of Koroi (*Albizzia procera*) tree. The habit was scattered and their distribution was in moderately moist nature.

4.8 Morphology and ecology of *Lepiota* sp.

Morphology : The pileus (cap) was white color and dark brwon spot on the pileus (cap). The average size of the basidiocarp was 4.8×2.3cm. The shape of cap was convex and flat with the cap edge was round. Beneath the cap hymenophores were absent. White and brown distant gills (lamellae) were present underside of the cap. Long brown stipe was present but ring or anal and volva were absent on the lower part of the stipe (Plate-8).

Ecology : The species was found from the root zone of Mahogany (*Swietenia macrophylla*) tree. The habit was scattered and their distribution was in moderately moist weather.

4.9 Morphology and ecology of *Lycoperdon perlatum*

Morphology : The pileus (cap) was white color and the average size of the basidiocarp was 1.5×1.2cm. The shape of cap was ball and round with the spine like structure on the cap. Beneath the cap hymenophores were absent. Regular shaped black gills (lamellae) were absent underside of the cap. White colored pseudostipe was absent but Ring or anal and volva were absent (Plate-8).

Ecology : The species was found from the root zone of Kurchi (*Holarrhena antidysentrica*) tree. The habit was scattered and their distribution was in moderately moist weather.

PLATE 7. *Coprinus* sp.; Mature fruiting body (A), Gills (B), Spores (C).

PLATE 8. *Lepiota* sp.; Mature fruiting body (A), Gills (B), Spores (C).

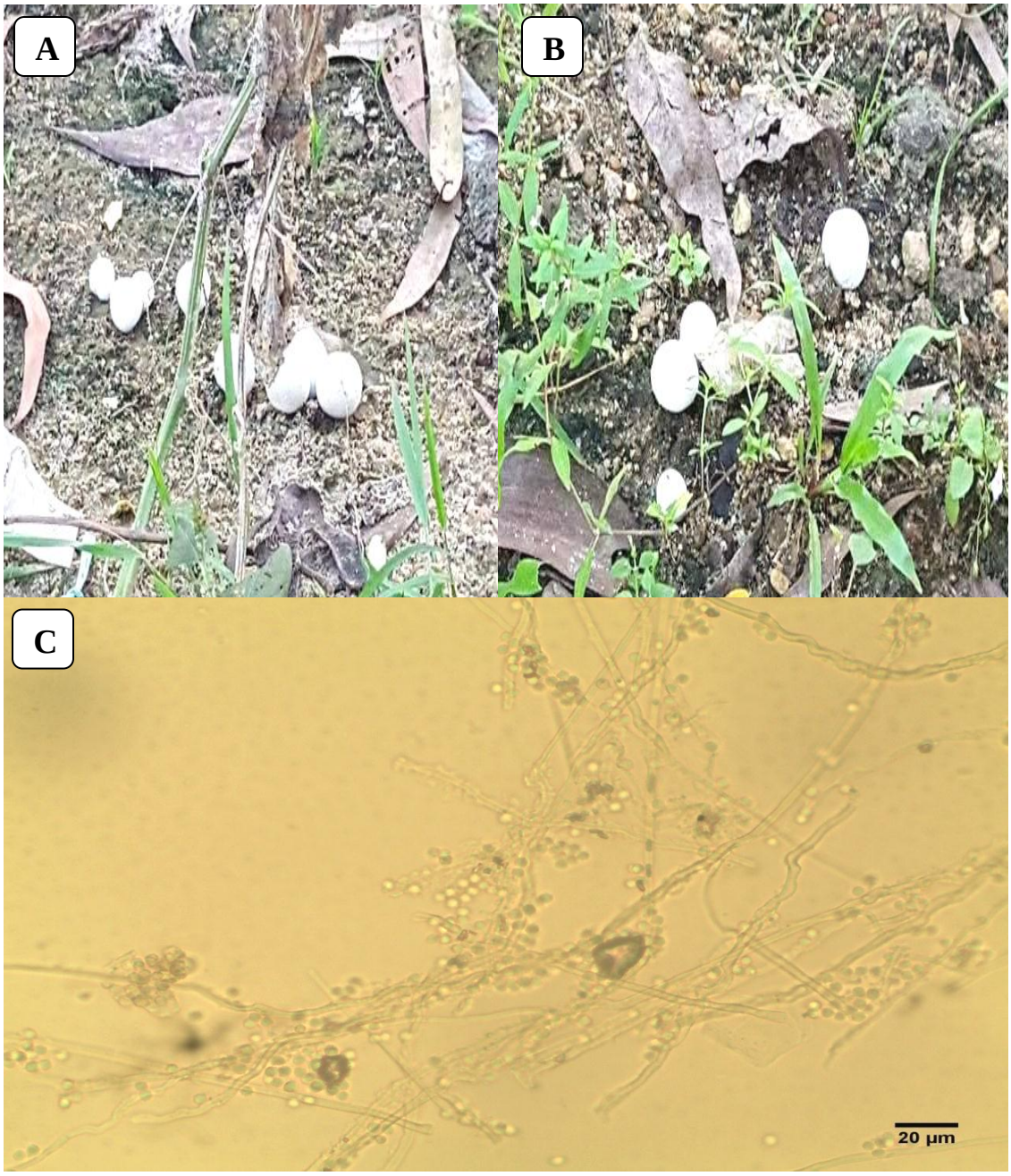

PLATE 9. ***Lycoperdon perlatum*****;** Mature fruiting body (A, B), Spores (C).

4.10 Morphology and ecology of *Calvatia* sp.

Morphology : The white color of pileus (cap) and the average size of the basidiocarp was 1.4×1.2cm with. The shape of cap was ball like with the round cap edge. Beneath the cap hymenophores were absent. Regular shaped gills (lamellae), Ring or anal and volva were absent. Spore color was dark brown at the center and hyaline at the edge (Plate-10).

Ecology : The species was found near the root zone of Neem (*Azadirachta indica*). The habit was solitary and their distribution was in moderately moist weather.

4.11 Morphology and ecology of *Ganoderma zonatum*

Morphology : The pileus (cap) was dark brown and white color at the edge and the average size of the woody basidiocarp was 3.8×5.2cm. The shape of cap was depressed and flat with the cap wavy edge. Beneath the cap hymenophores were present. White color micro pores were present underside of the cap. The pseudostipe was present and tightly attached with the host. Ring or anal and volova were absent on the lower part of the pseudostipe (Plate-11).

Ecology : The species was found on the Koroi (*Albizzia procera*). The habit was solitary and their distribution was in dry weather.

4.12 Morphology and ecology of *Ganoderma tsugae*

Morphology : The pileus (cap) was white color in of upper and brick red color in the lower part of cap. The average size of the woody basidiocarp was 2.3×1.3cm. The shape of cap was stick like with the cap wavy edge. Beneath the cap hymenophores were present. Tiny micro pores and pseudostipe were present underside of the cap. Ring or anal and volva were absent on the lower part of the stipe (Plate-12).

Ecology : The species was found on the Haldina (*Haldina cordifolia*). The habit was scattered and their distribution was in dry weather.

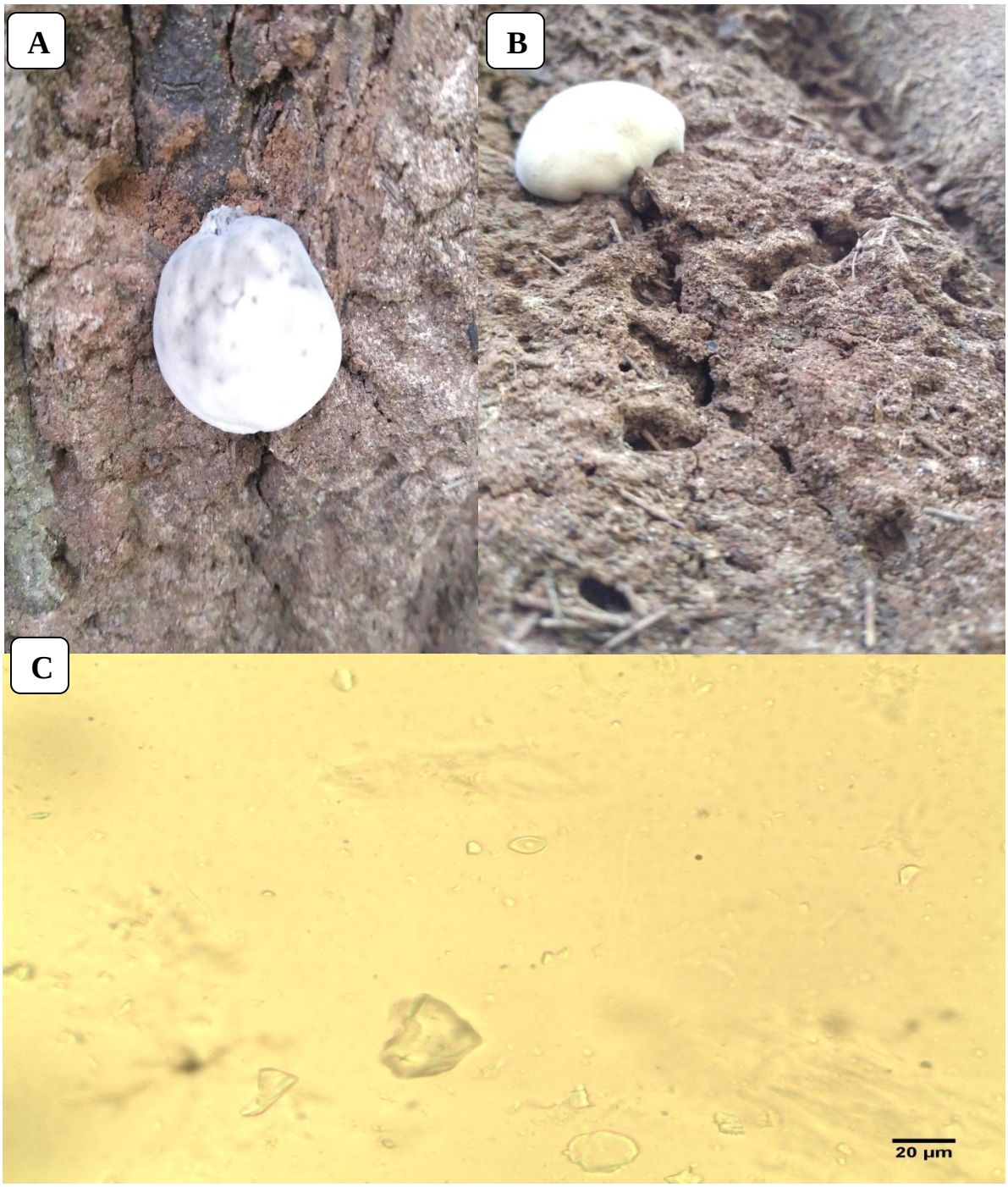

PLATE 10. *Calvatia* sp.; Mature fruiting body (A), Pores B), Spores (C).

PLATE 11. ***Ganoderma zonatum*;** Mature fruiting body (A), Pores (B), Spores (C).

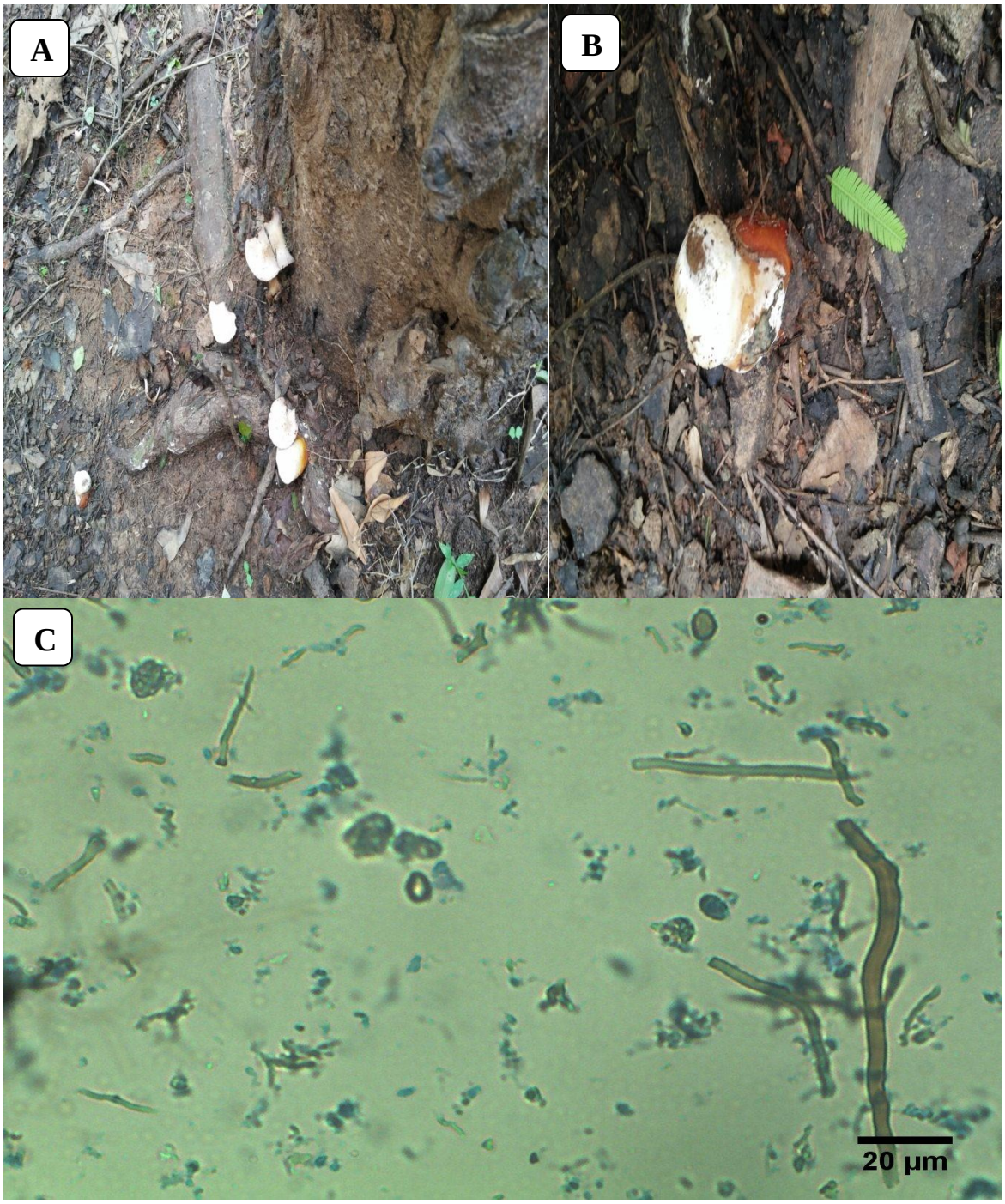

PLATE 12.*Ganoderma tsugae*; Mature fruiting body (A), Pores (B), Spores (C).

4.13 Morphology and ecology of *Ganoderma* sp.

Morphology : The pileus (cap) was dark brown and white color at the end of edge. The average size of the woody basidiocarp was 3.6×4.8cm. The shape of cap was depressed and flat with the wavy cap edge. Beneath the cap hymenophores were present. Tiny micro pores were present underside of the capbut ring or anal and volva were absent on the lower part of the cap (Plate-13).

Ecology : The species was found near the root of Kurchi (*Holarrhena antidysentrica*). The habit was clustered and their distribution was in dry weather.

4.14 Morphology and ecology of *Ganoderma* sp.

Morphology : The pileus (cap) was white and brown and green color margin at the edge. The average size of the woody basidiocarp was 2.9×4.6cm. The shape of cap was depressed and flat with the cap wavy edge. Beneath the cap hymenophores were present. White color micro pores were present underside of the cap. The pseudostipe was present and tightly attached with the host. Ring or anal and volova were absent on the lower part of the pseudostipe (Plate-14).

Ecology : The species was found on the root zone of Koroi (*Albizzia procera*) from the mixed forest. The habit was solitary and their distribution was in dry weather.

4.15 Morphology and ecology of *Ganoderma* sp.

Morphology : The pileus (cap) was dark brownish white and the average size of the woody basidiocarp was 2.1×3.2cm. The shape of cap was depressed and flat with the cap wavy edge. Beneath the cap hymenophores were present. Brown color micro pores were present underside of the cap (Plate-15).

Ecology : The species was found on the root zone of Neem (*Azadirachta indica*). The habit was solitary and their distribution was in dry weather.

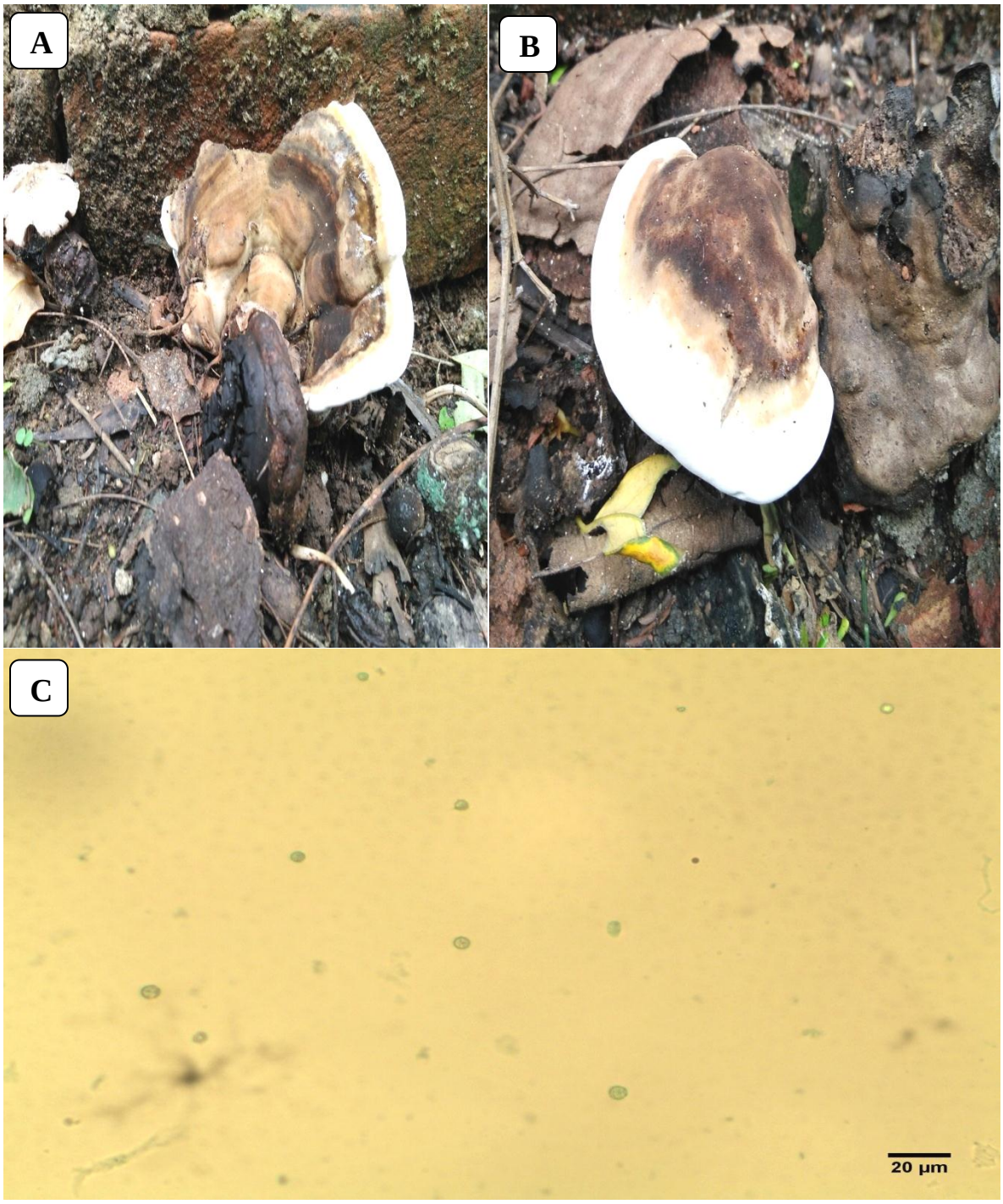

PLATE 13. *Ganoderma* sp.; Mature fruiting body (A), Pores (B), Spores (C).

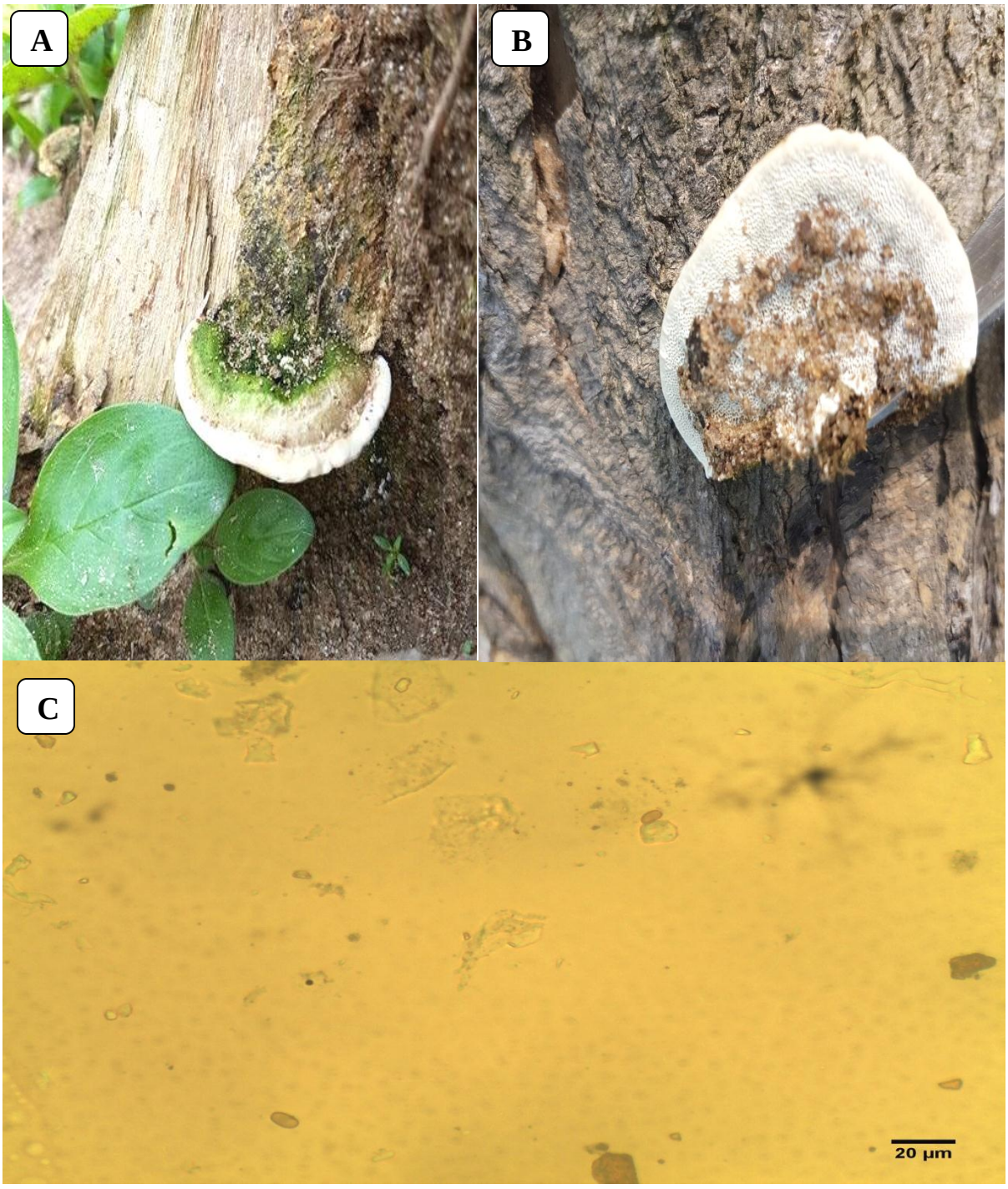

PLATE 14. *Ganoderma* sp.; Mature fruiting body (A), Pores (B), Spores (C).

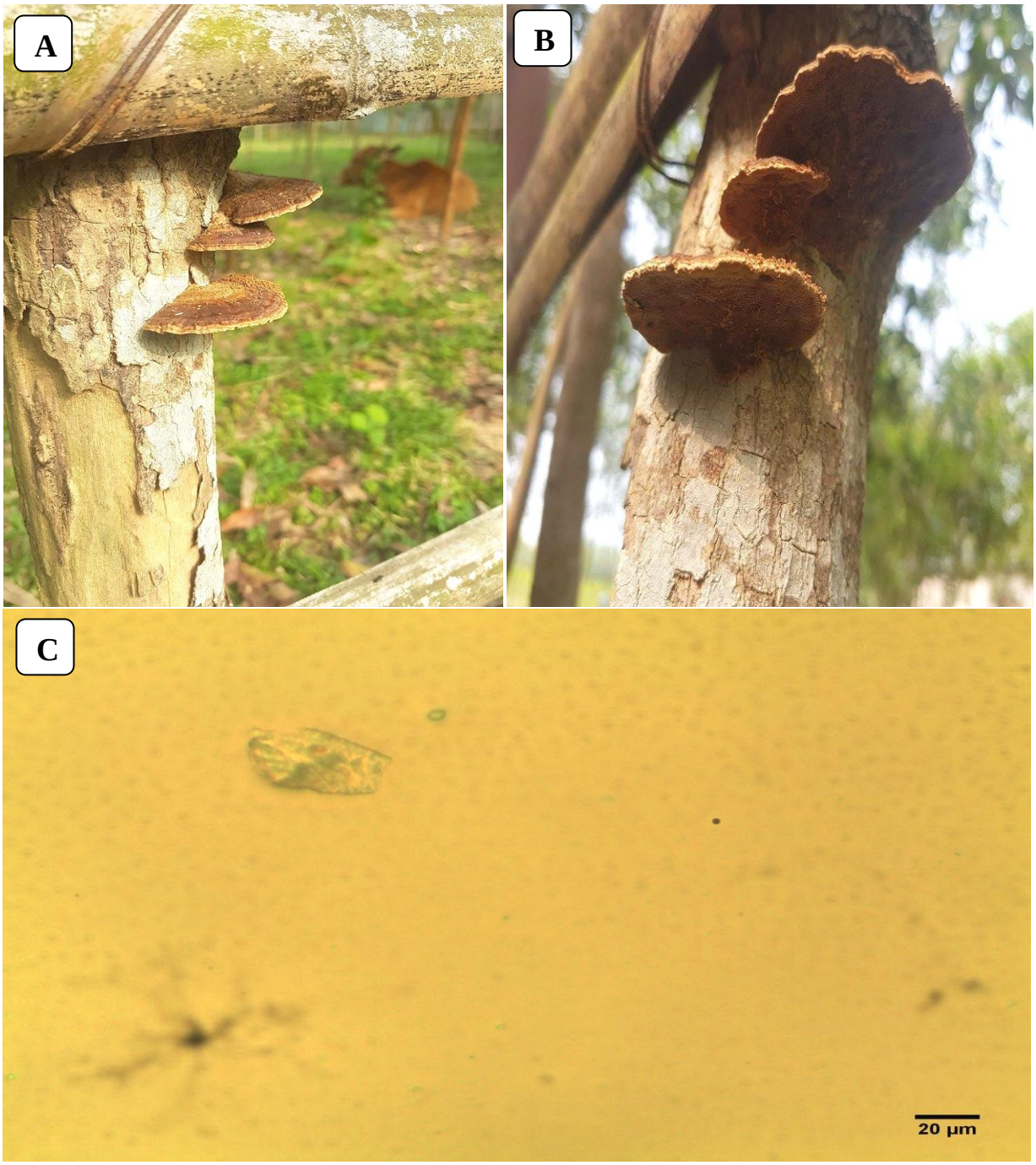

PLATE 15. *Ganoderma* sp.; Mature fruiting body (A), Pores (B), Spores (C).

4.16 Morphology and ecology of *Dacryopinax spatularia*

Morphology : The pileus (cap) was yellow and golden and the average size of the woody basidiocarp was 0.1×1.5cm with. The shape of cap was thin finger like and beneath the cap hymenophores were present. Tiny micro pores and pseudostipe were present underside of the cap (Plate-16).

Ecology : The species was found on the root zone of Gajari (*Shorea robusta*) tree from the mixed forest. The habit was clustered and their distribution was in moderately moist weather.

4.17 Morphology and ecology of *Crepidotus* sp.

Morphology : The pileus (cap) was dark brown in color and average size of the basidiocarp was 1.7×1.3cm. The shape of cap was flat with the wavy cap surface and edge. Beneath the cap hymenophores were absent. Dark brown gills were present underside of the cap. Ring or anal and volva were absent on the lower part of the stipe (Plate-17).

Ecology : The speceis was found on Gajari (*Shorea robusta*) from the mixed forest. The habit was solitary and their distribution was in moderately moist weather.

4.18 Morphology and ecology of *Marasmius nigrodiscus*

Morphology : The color of pileus (cap) was brown and dark brown at the center. The average size of the fleshy basidiocarp was 3.9×1.8cm. The shape of cap was convex and flat with the crenate cap edge. Beneath the cap hymenophores were absent. Regular shaped brown and creamy colored gills (lamellae) were present underside of the cap (Plate-18).

Ecology : The species was found near the root zone of Kadam (*Neolamarckia cadamba*) tree. The habit was solitary and their distribution was in moderately moist weather.

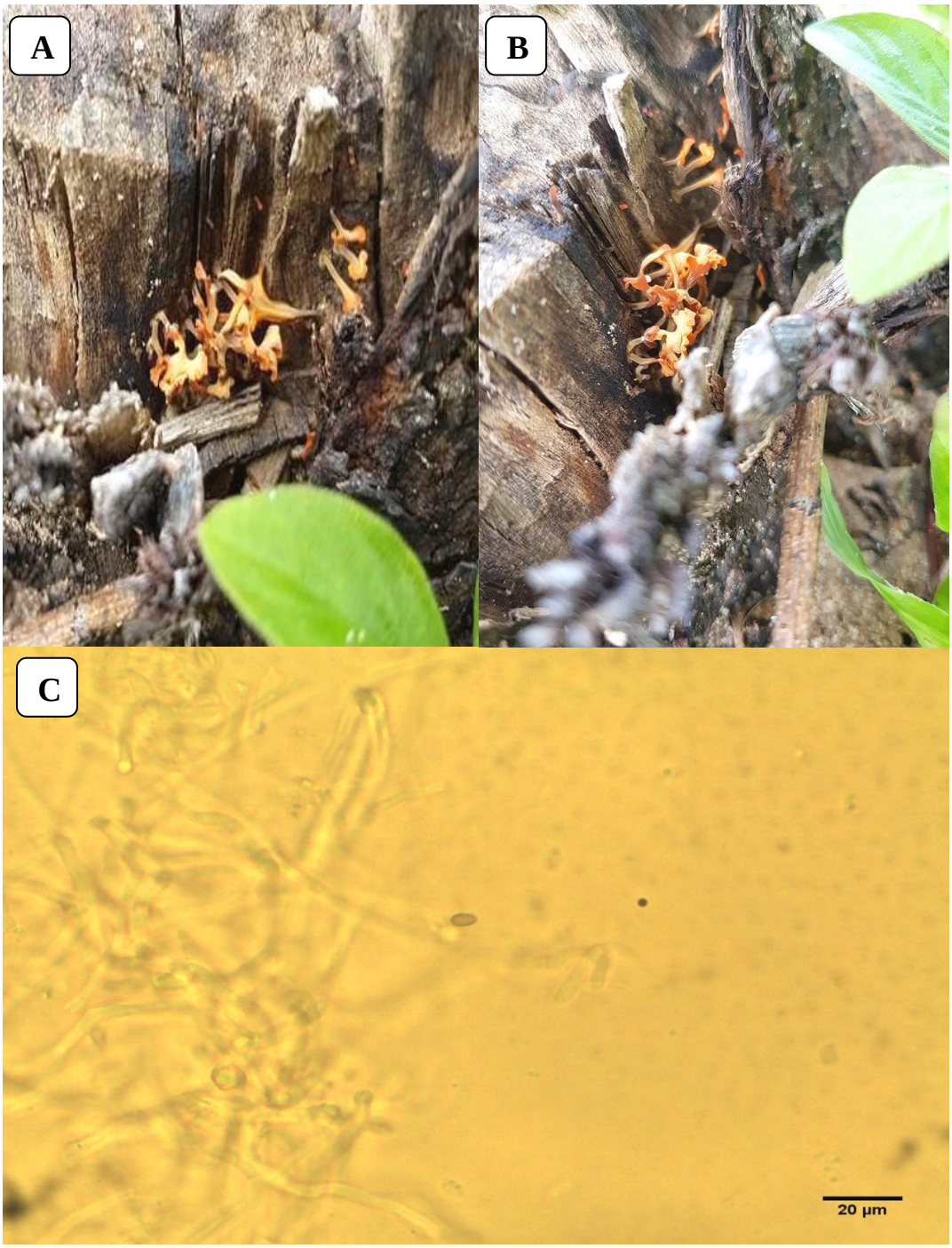

PLATE 16. ***Dacryopinax spatularia*;** Mature fruiting body (A,B), Spores (C).

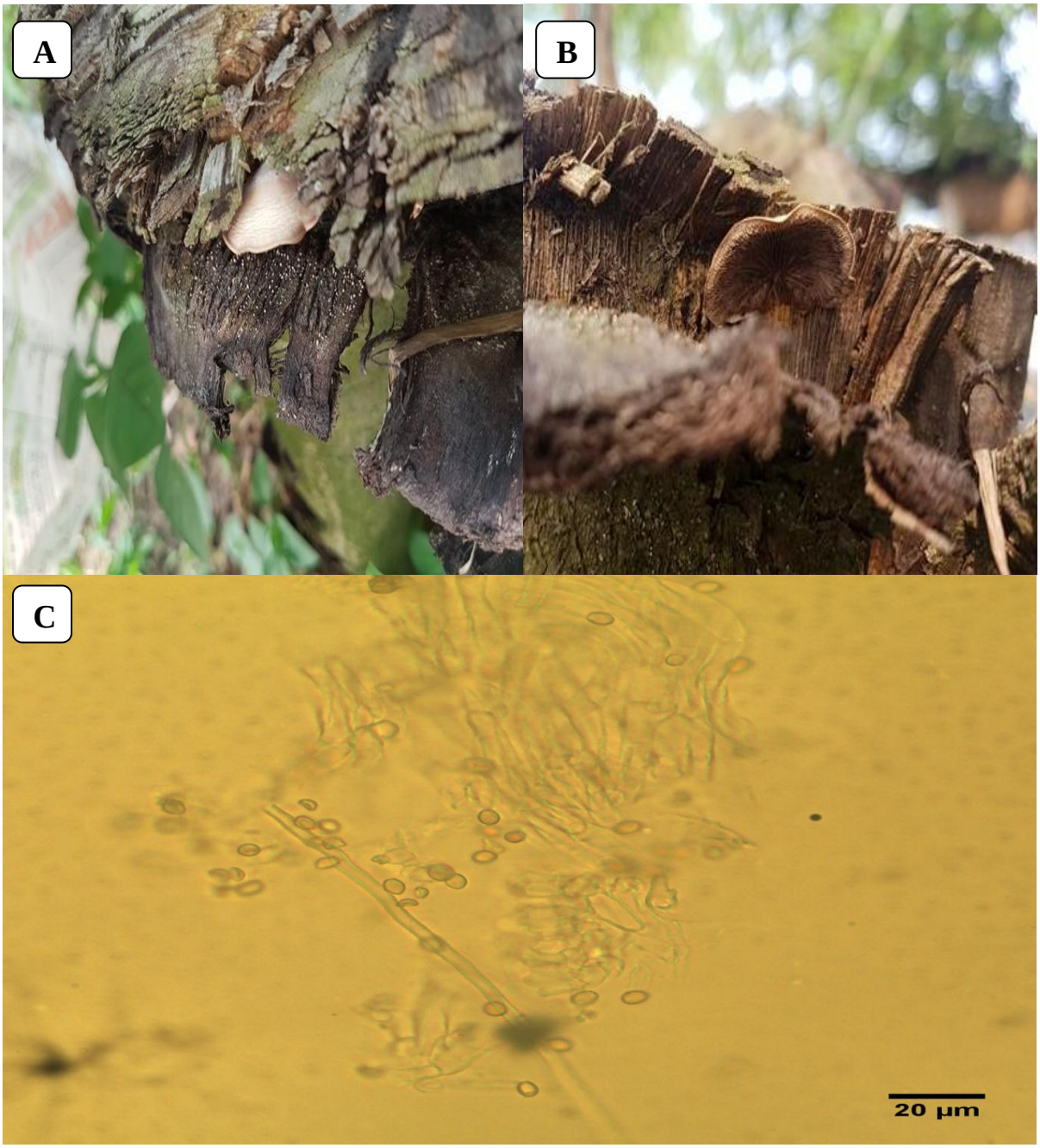

PLATE 17. *Crepidotus* sp.; Mature fruiting body (A), Gills (B), Spores (C).

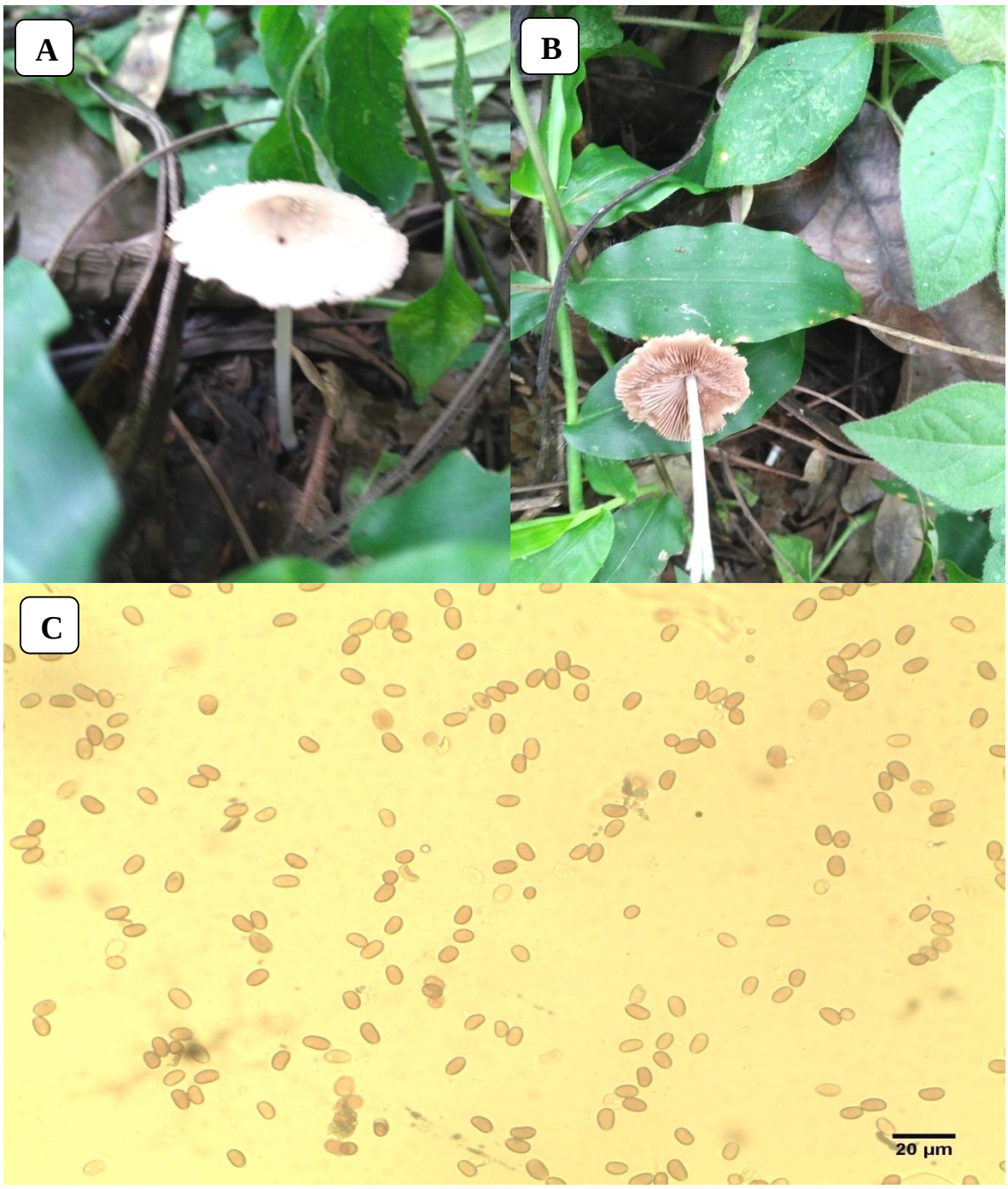

PLATE 18. ***Marasmius nigrodiscus*;** Mature fruiting body (A), Gills (B), Spores (C).

4.19 Morphology and ecology of *Marasmius rotula*

Morphology : The pileus (cap) was light brown color and average size of the fleshy basidiocarp was 6.3×1.6cm with. The shape of cap was convex and flat with the round cap edge. Beneath the cap hymenophores were absent. Regular shaped white gills (lamellae) were present underside of the cap. Color of stipe was greenish nad brown ring or anal were presnt but volva was absent on the lower part of the stipe (Plate-19).

Ecology : The species was found near the Bohera (*Terminalia bellirica*) tree. The habit was scattered and their distribution was in moist weather.

4.20 Morphology and ecology of *Marasmius* sp.

Morphology : The pileus (cap) was brown in color and average size of the fleshy basidiocarp was 3.8×1.2cm with. The shape of cap was convex and flat with the round cap edge. Beneath the cap hymenophores were absent. Regular shaped black gills (lamellae) were present underside of the cap. The dark brown colored stipe was present but ring or anal and volva were absent on the lower part of the stipe (Plate-20).

Ecology : The species was found on Bohera (*Terminalia bellirica*) tree. The habit was scattered and their distribution was in moist weather.

4.21 Morphology and ecology of *Parasola lactea*

Morphology : The pileus (cap) was white in colorand average size of the basidiocarp was 6.2×1.2cm with. The shape of cap was convex and flat with the round and crenate cap edge. Beneath the cap hymenophores were absent. Regular shaped white gills (lamellae) and greenish stipe were present underside of the cap. Ring or anal was absent on the stipe and volva was absent on the lower part of the stipe (Plate-21).

Ecology : The speceis was found near the root zone of Koroi (*Albizzia procera*) tree. The habit was solitary and their distribution was in moderately moist weather.

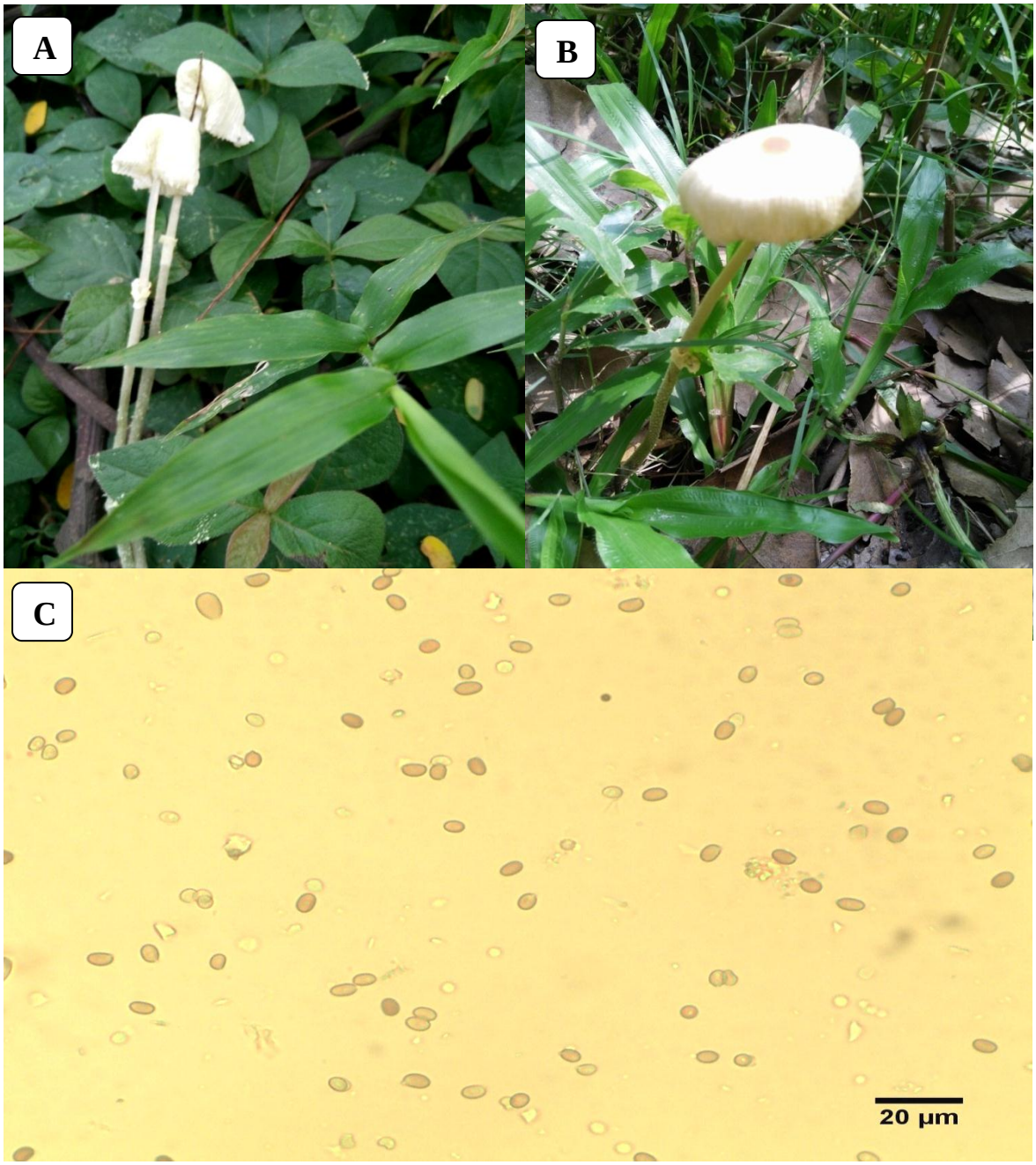

PLATE 19. *Marasmius rotula*; Mature fruiting body (A,B), Spores (C).

PLATE 20. *Marasmius* sp.; Mature fruiting body (A), Gills (B), Spores (C).

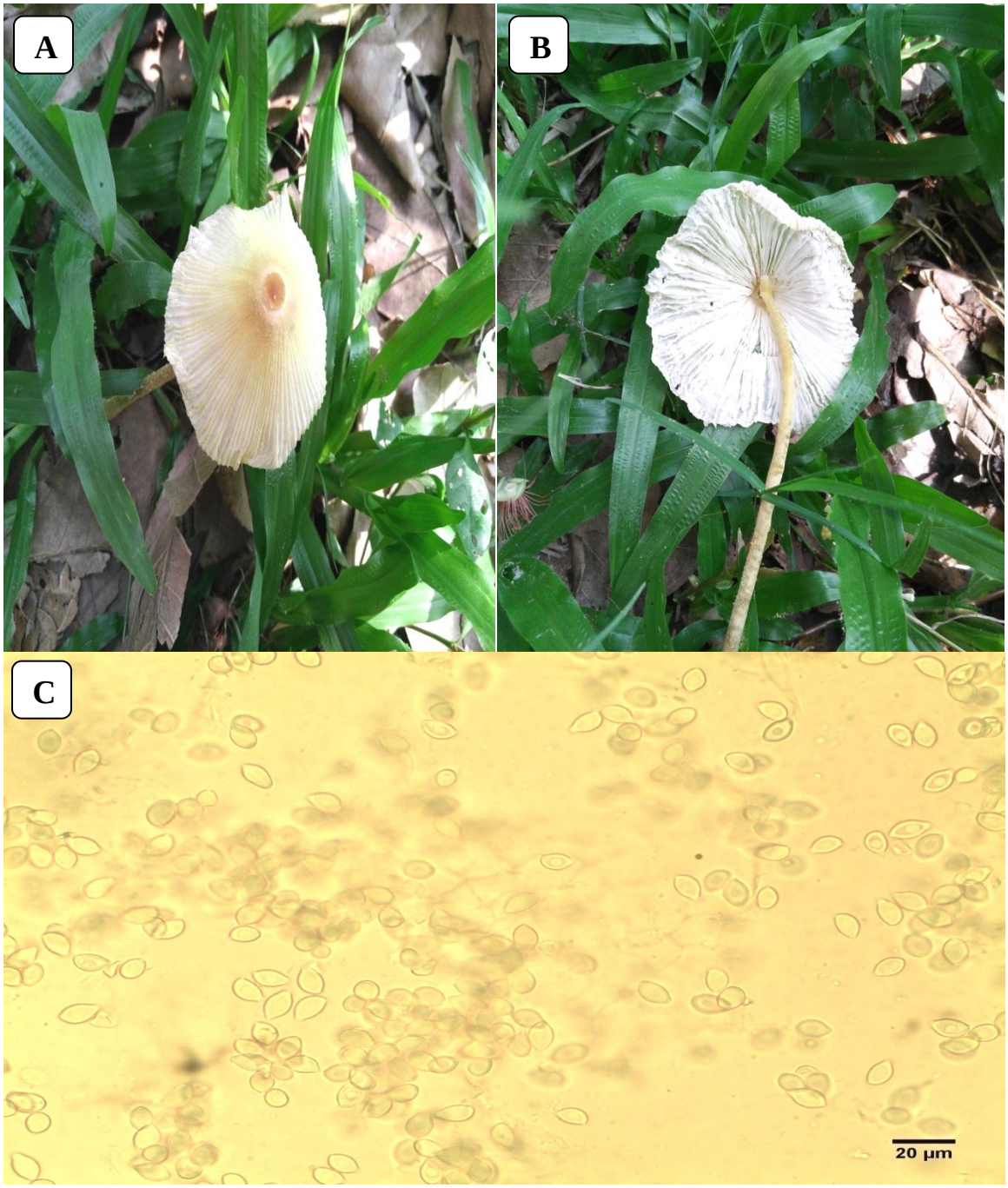

PLATE 21. ***Parasola lactea*;** Mature fruiting body (A), Gills (B), Spores (C).

4.22 Morphology and ecology of *Parasola* sp.

Morphology : The pileus (cap) was creamy color and average size of the basidiocarp was 5.2×2.6cm with. The shape of cap was convex and flat with the round and crenate cap edge. Beneath the cap hymenophores were absent. Regular shaped black colored gills (lamellae) and brownish stipe were present underside of the cap. Ring or anal was absent on the stipe and volva was absent on the lower part of the stipe (Plate-22).

Ecology : The species was found near the root of Gajari (*Shorea robusta*) tree. The habit was solitary and their distribution was moderately in moist weather.

4.23 Morphology and ecology of *Psathyrella candolleana*

Morphology : The pileus (cap) was creamy and brown color and average size of the basidiocarp was 3.6×1.5cm. The shape of cap was convex and flat with the round cap edge. Beneath the cap hymenophores were absent. Regular shaped brown gills (lamellae) and stipe were present underside of the cap. Ring or anal was absent on the stipe and volva was absent on the lower part of the stipe (Plate-23).

Ecology : The species was found on the root zone of Kurchi (*Holarrhena antidysentrica*) tree of mixed forest. The habit was clustered and their distribution was in moist weather.

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4.24 Morphology and ecology of *Clitocybe dealbata*

Morphology : The milky white color of pileus (cap) and average size of the basidiocarp was 5.8×3.2cm. The shape of cap was convex and flat with the round cap edge. Beneath the cap hymenophores were absent. Regular shaped brown gills (lamellae) and stipe were present underside of the cap. Ring or anal and volva were absent on the lower part of the stipe (Plate-24).

Ecology : The species was found near the Gajari (*Shorea robusta*) tree. The habit was solitary and their distribution was in moderately moist weather.

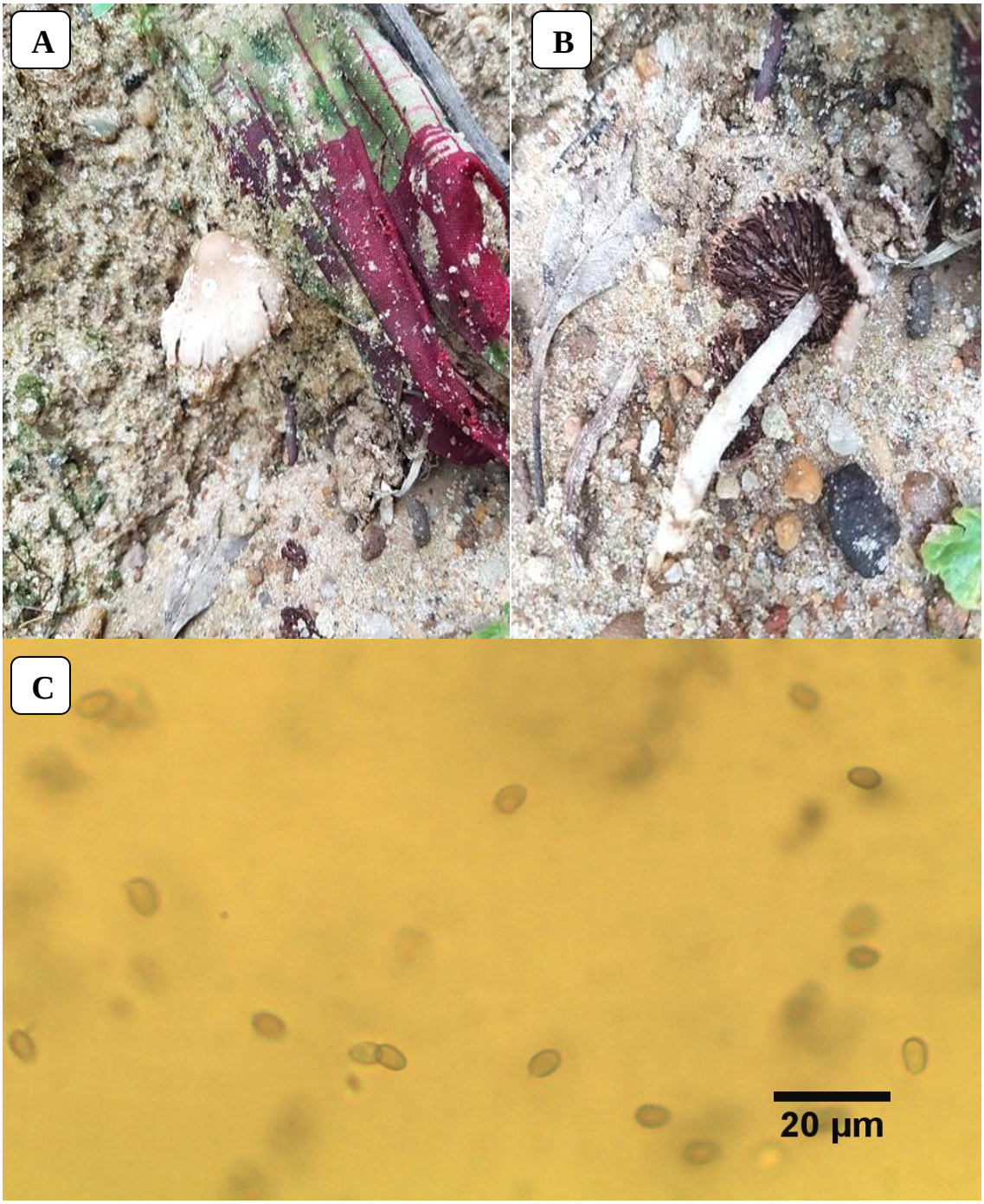


PLATE 22. *Parasola* sp.; Mature fruiting body (A), Gills (B), Spores (C).

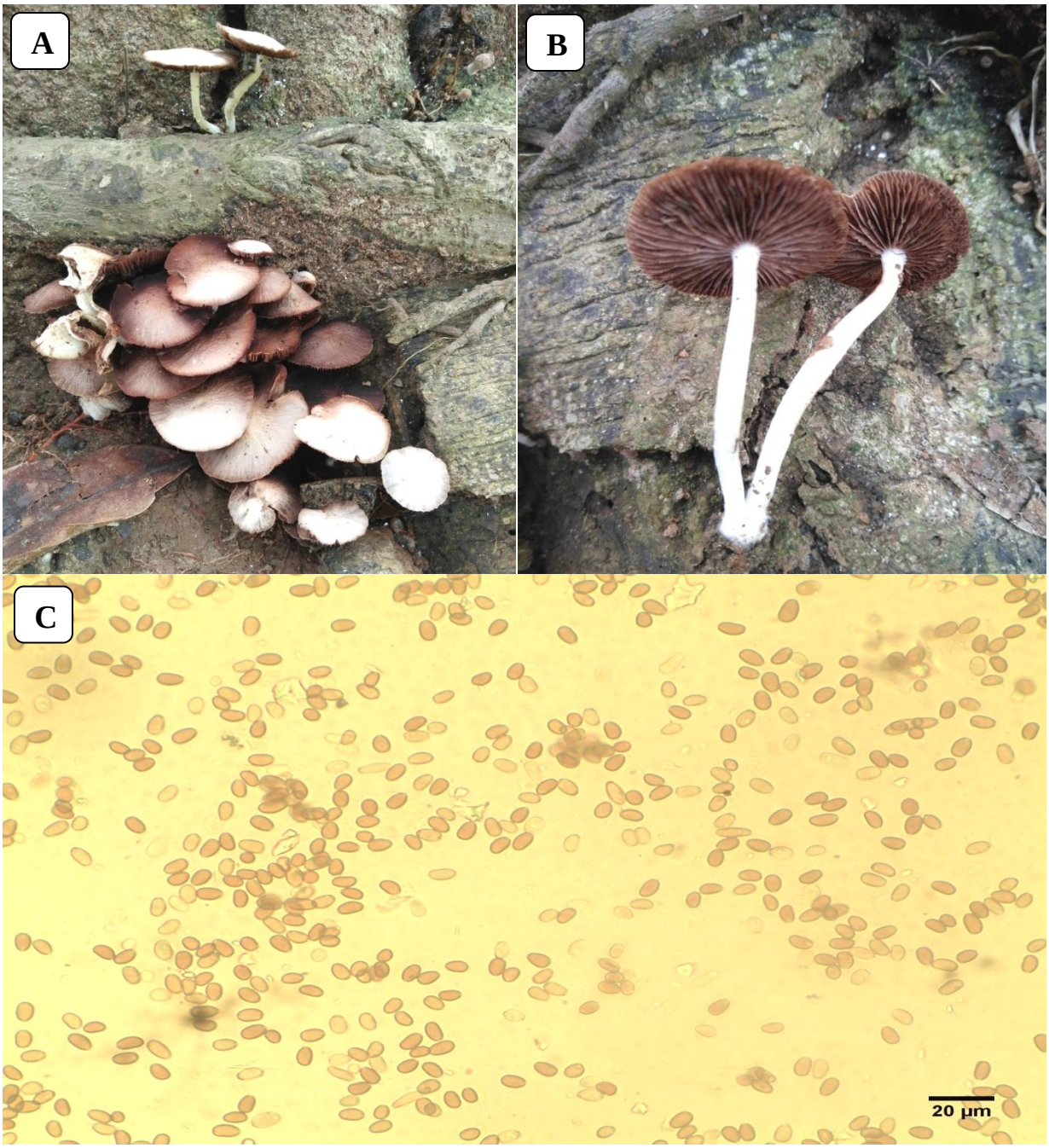


PLATE 23. ***Psathyrella candolleana*;** Mature fruiting body (A), Gills (B), Spores (C).

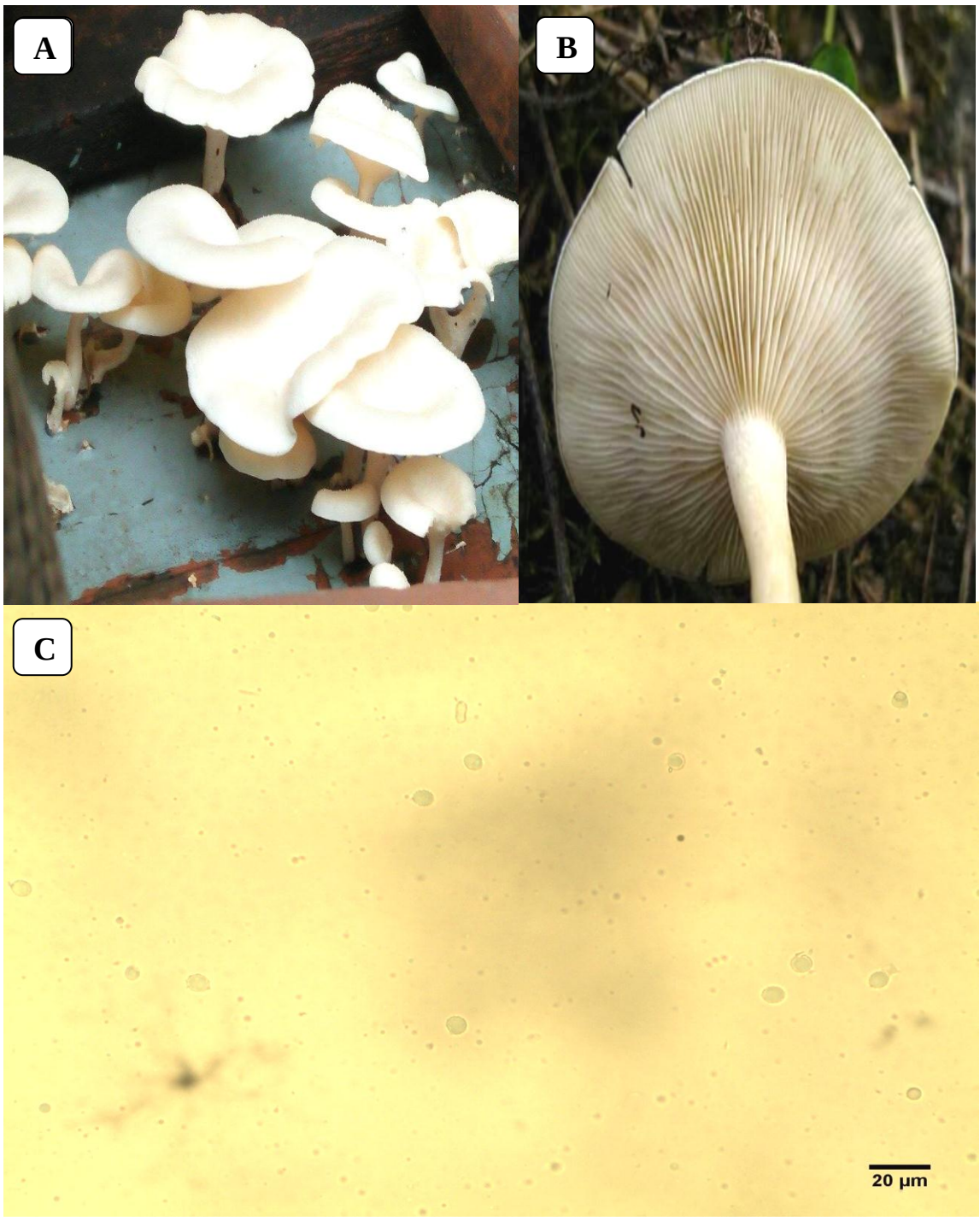


PLATE 24. ***Clitocybe dealbata*****;** Mature fruiting body (A), Gills (B), Spores (C).

4.25 Morphology and ecology of *Clitocybe* sp.

Morphology : The pink color of pileus (cap) and average size of the basidiocarp was 3.6×2.6cm. The shape of cap was convex and flat with the wavy cap edge. Beneath the cap hymenophores were absent. Regular shaped brown gills (lamellae) and stipe were present underside of the cap. Ring or anal and volva were absent on the lower part of the stipe (Plate-25).

Ecology : The species was found near the Kadam (*Neolamarckia cadamba*) tree. The habit was solitary and their distribution was in moist weather.

4.26 Morphology and ecology of *Mycena epipterygia*

Morphology : The brown and creamy color of pileus (cap) and average size of the basidiocarp was 3.3×1.2cm. The shape of cap was conical with round cap edge. Regular shaped brown gills (lamellae) and stipe were present underside of the cap. Ring or anal and volva were absent on the lower part of the stipe (Plate-26).

Ecology : The species was found on bark of Dewa (*Phaleria macrocarpa*) from the mixed forest. The habit was scattered and the factors affecting their distribution was in moderately moist weather.

4.27 Morphology and ecology of *Amanita* sp.

Morphology : The brown and powdery substance of pileus (cap) and the average size of the basidiocarp was 2.4×1.1cm. The shape of cap was ovate with the wavy cap edge. Beneath the cap hymenophores were absent. Regular shaped dark brown gills (lamellae) and stipe were present underside of the cap. Ring or anal and volva were absent on the lower part of the stipe (Plate-27).

Ecology : The species was found on bark of Bohera (*Terminalia belerica*) from the mixed forest. The habit was clustered and the factors affecting their distribution was in moist weather.

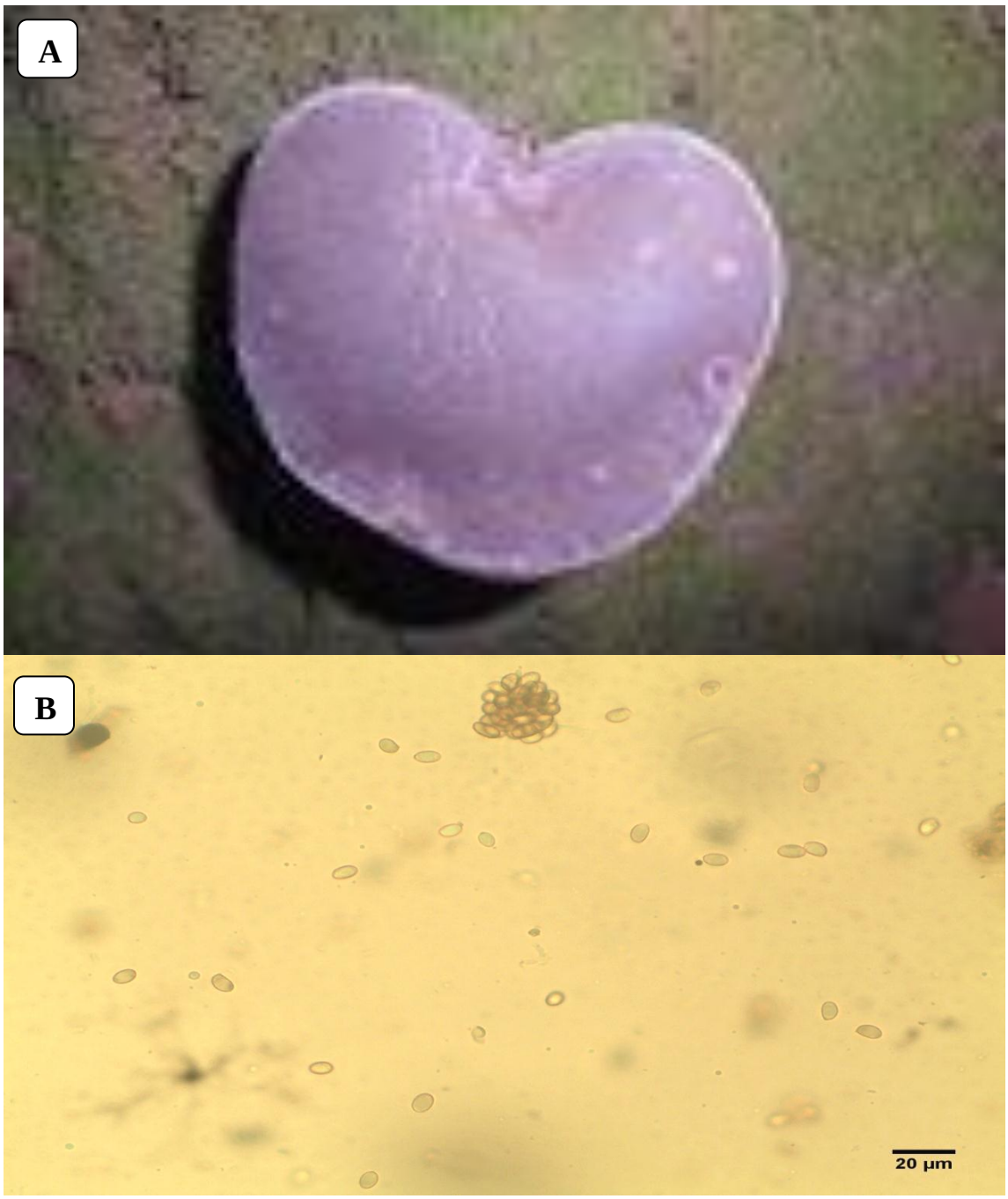


PLATE 25. *Clitocybe* sp.; Mature fruiting body (A), Spores (B).

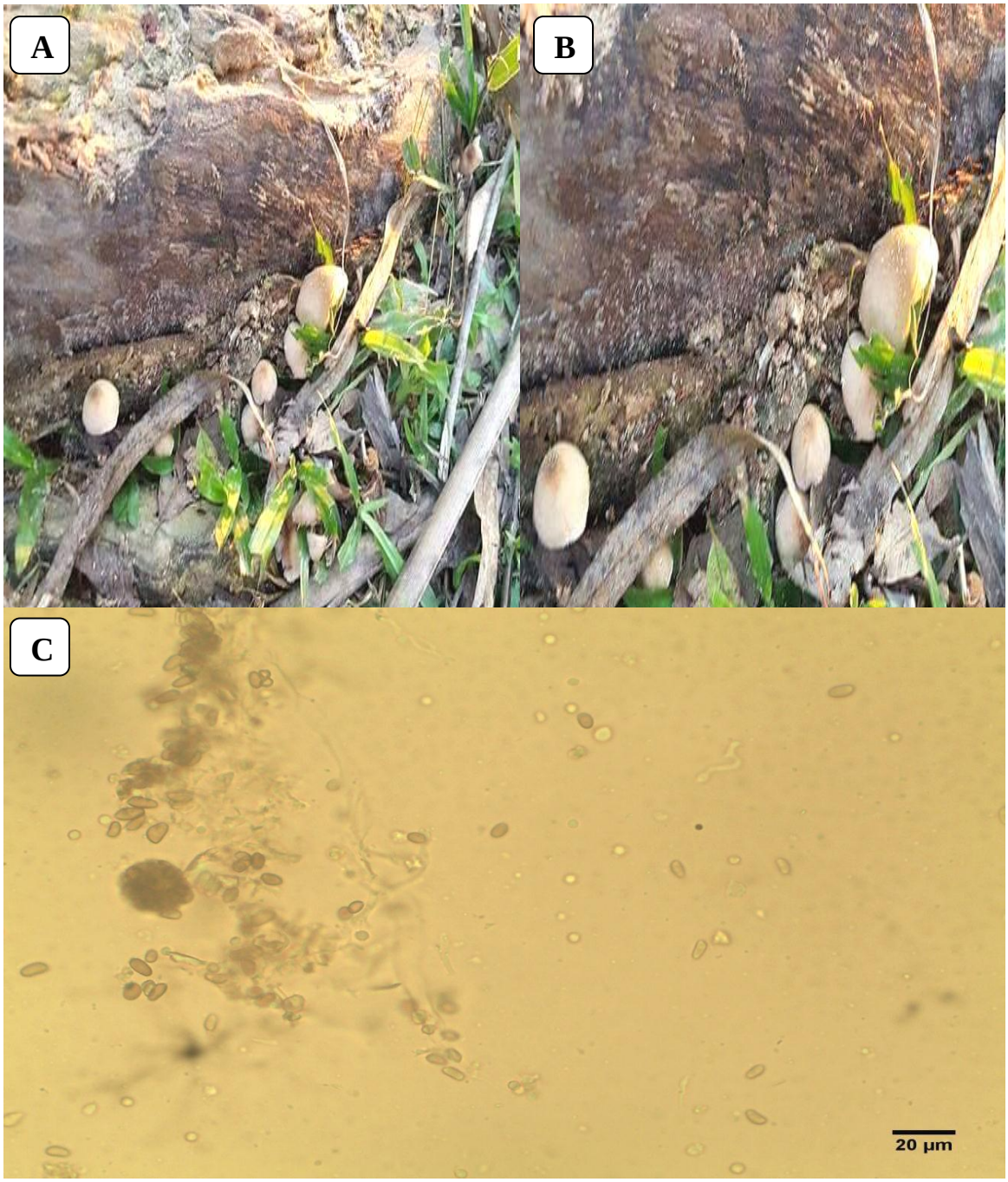


PLATE 26. ***Mycena epipterygia*****;** Mature fruiting body (A, B), Spores (C).

PLATE 27. *Amanita* sp.; Mature fruiting body (A), Spores (B).

4.28 Morphology and ecology of *Cortinarius semisanguineus*

Morphology : The dark brown color of pileus (cap) and average size of the basidiocarp was 2.8×1.3cm. The shape of cap was convex and flat with the crenate cap edge. Beneath the cap hymenophores were absent. Regular shaped brown gills (lamellae) and stipe were present underside of the cap. Ring or anal and volva were absent on the lower part of the stipe (Plate-28).

Ecology : The species was found on bark of Hartaki (*Terminalia chebula*) from the mixed forest. The habit was scattered and the factors affecting their distribution was in dry weather.

4.29 Morphology and ecology of *Daedalea* sp.

Morphology : The pileus (cap) color was brown and whitish at the end. The average size of the basidiocarp was 1.8×2.4cm. The shape of cap was flat with regular margin and wavy cap edge. Beneath the cap hymenophores were present. Macro pores and pesudostipe were present underside of the cap. Ring or anal and volva were absent on the lower part of the stipe (Plate-29).

Ecology : The species was found on the stick of Mango (*Mangifera indica*) tree. The habit was clustered and the factors affecting their distribution was in moderately moist weather.

4.30 Morphology and ecology of *Auricularia* sp.

Morphology : The brown hyaline color of pileus (cap) and the average size of the basidiocarp was 1.8×2.1cm with. The shape of cap was flat with the wavy cap edge. Beneath the cap hymenophores were present. Micro pores and pseudostipe were present underside of the cap. Ring or anal and volva were absent on the lower part of the stipe (Plate-30).

Ecology : The species was found around the root zone of Kadam (*Tibetan buddhism*). The habit was scattered and the factors affecting their distribution was moist weather.

PLATE 28. *Cortinarius semisanguineus*; Mature fruiting body (A), Gills (B), Spores (C).

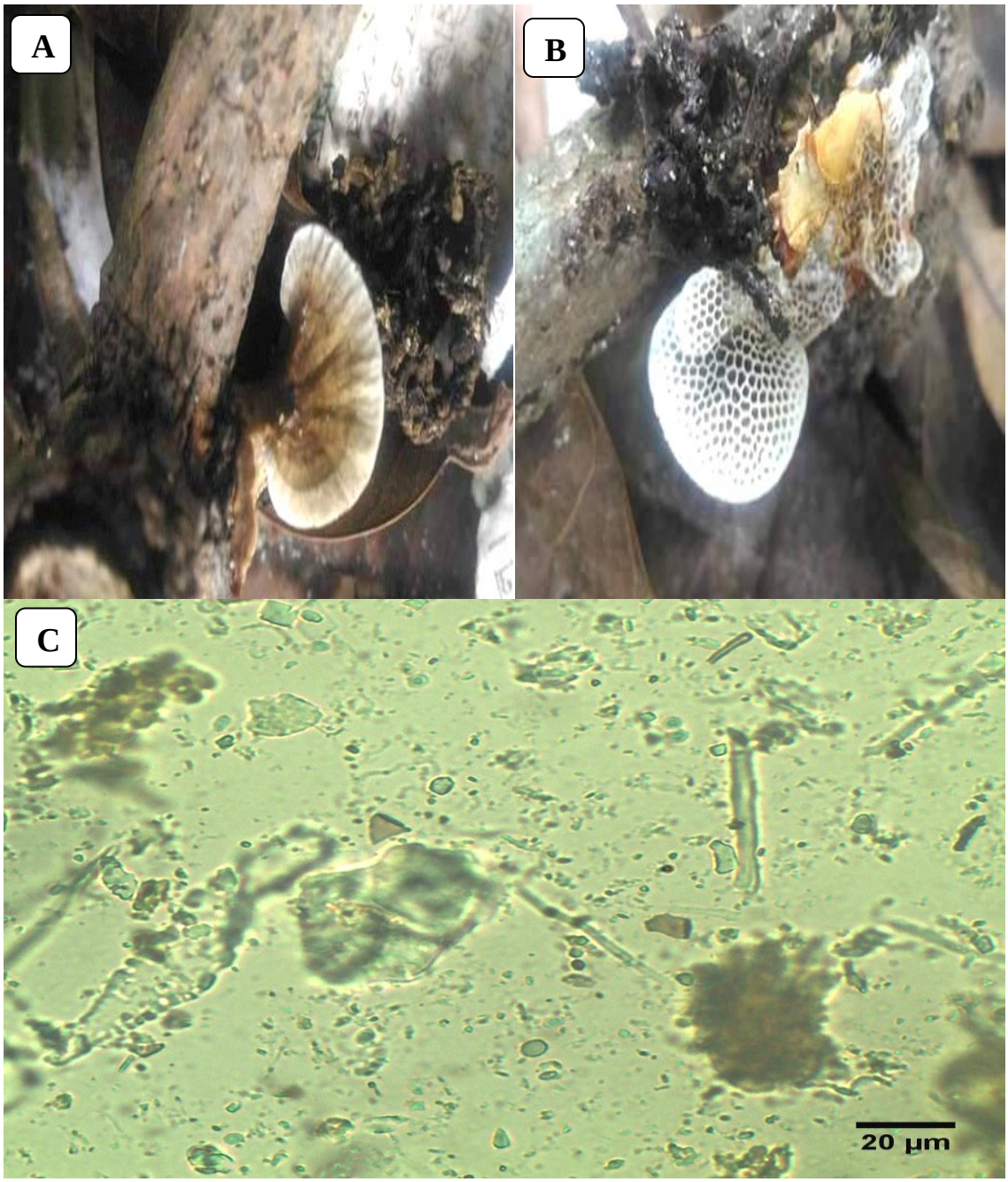


PLATE 29. *Daedalea* sp.; Mature fruiting body (A), Pores (B), Spores (C).

PLATE 30: *Auricularia* sp.; Mature fruiting body (A), Pores (B), Spores (C).

4.31 Morphology and ecology of *Trameteshirsuta*

Morphology : Thebrown color of pileus (cap) and the average size of the basidiocarp was 2.6×3.4cm. The shape of cap was flat with the wavy cap surface and edge. Beneath the cap hymenophores were present. Micro pores and pseudostipe were present underside of the cap (Plate-31).

Ecology : The species was found on Gajari (*Shorea robusta*) tree. The habit was scattered and the factors affecting their distribution was in dry weather.

4.32 Morphology and ecology of *Trametesgibbosa*

Morphology : The pileus (cap) was greenish brown and the average size of the basidiocarp was 2.8×4.3cm. The shape of cap was flat with the wavy cap edge. Beneath the cap hymenophores were present. Micro pores and pseudostipe were present underside of the cap (Plate-32).

Ecology : The species was found near the root zone of Gajari (*Shorea robusta*) tree. The habit was clustered and the factors affecting their distribution was in dry weather.

4.33 Morphology and ecology of *Trametes* sp.

Morphology : The brown and whitish color of pileus (cap) and the average size of the basidiocarp was 3.4×6.3cm. The shape of cap was flat with the wavy cap surface and edge. Beneath the cap hymenophores were present. Micro pores and pseudostipe were present underside of the cap. Ring or anal and volva were absent on the lower part of the stipe (Plate-33).

Ecology : The species was found on the Sissoo (*Dalbergia sissoo*) tree. The habit was clustered and the factors affecting their distribution was in moderately dry weather.

PLATE 31. *Trametes hirsuta*; Mature fruiting body (A), Pores (B), Spores (C).

PLATE 32. *Trametes gibbosa*; Mature fruiting body (A), Pores (B), Spores (C).

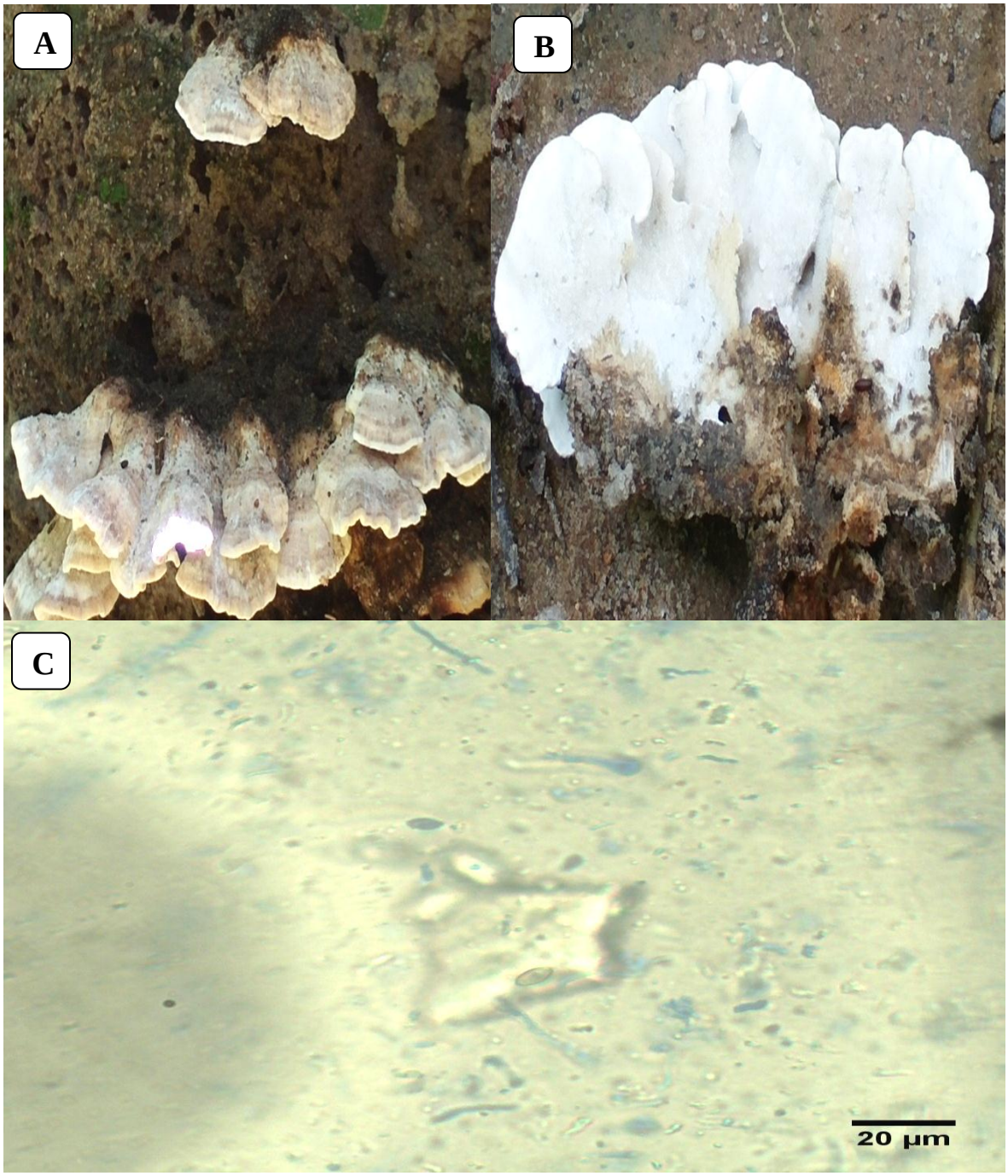


PLATE 33. *Trametes* sp.; Mature fruiting body (A), Pores (B), Spores (C).

4.34 Morphology and ecology of *Trametes* sp.

Morphology : The brown and whitish color of pileus (cap) and the average size of the basidiocarp was 3.4×6.3cm. The shape of cap was flat with the wavy cap surface and edge. Beneath the cap hymenophores were present. Micro pores and pseudostipe were present underside of the cap. Ring or anal and volva were absent on the lower part of the stipe (Plate-34).

Ecology : The species was found on the Gajari (*Shorea robusta*) tree. The habit was clustered and the factors affecting their distribution was in moderately moist weather.

4.35 Morphology and ecology of *Trametes*sp.

Morphology : The pileus (cap) was brownish white color and the average size of the basidiocarp was 1.8×2.6cm. The shape of cap was flat with the wavy white cap edge. Beneath the cap hymenophores were present. Micro pores and pseudostipe were present underside of the cap (Plate-35).

Ecology : The species was found on the bark of Mango (*Mangifera indica*) tree. The habit was solitary and the factors affecting their distribution were dry weather.

4.36 Morphology and ecology of *Trametes* sp.

Morphology : The pileus (cap) was dark brown and the average size of the basidiocarp was 2.2×3.1cm. The shape of cap was flat with the wavy margin near the cap edge. Beneath the cap hymenophores were present. Micropores and pseudostipe were present underside of the cap (Plate-36).

Ecology : The species was found on the root zone of Gajari (*Shorea robusta*) tree. The habit was solitary and the factors affecting their distribution was in dry weather.

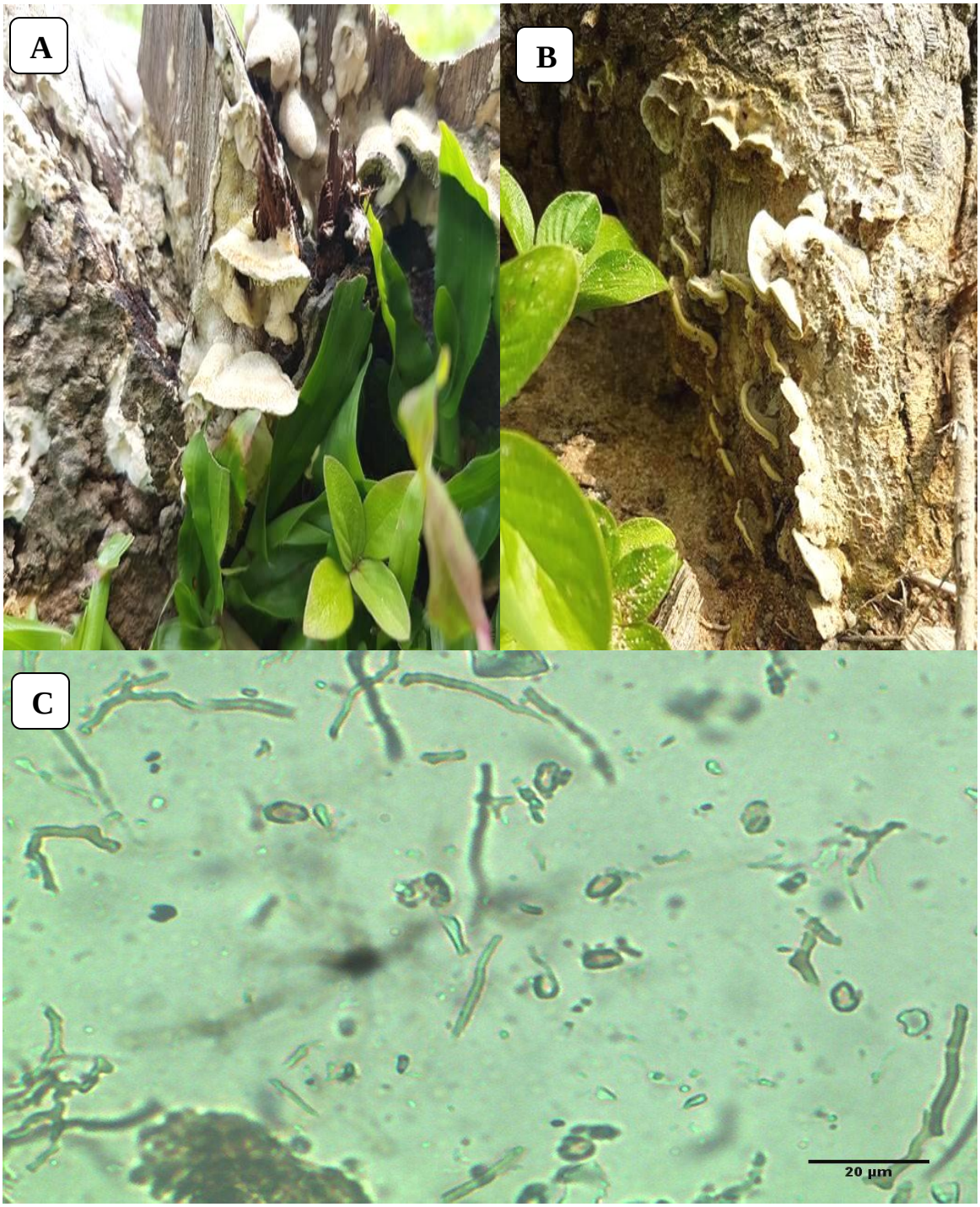


PLATE 34. *Trametes* sp.; Mature fruiting body (A), Pores (B), Spores (C).

PLATE 35. *Trametes* sp.; Mature fruiting body (A), Pores (B), Spores (C).

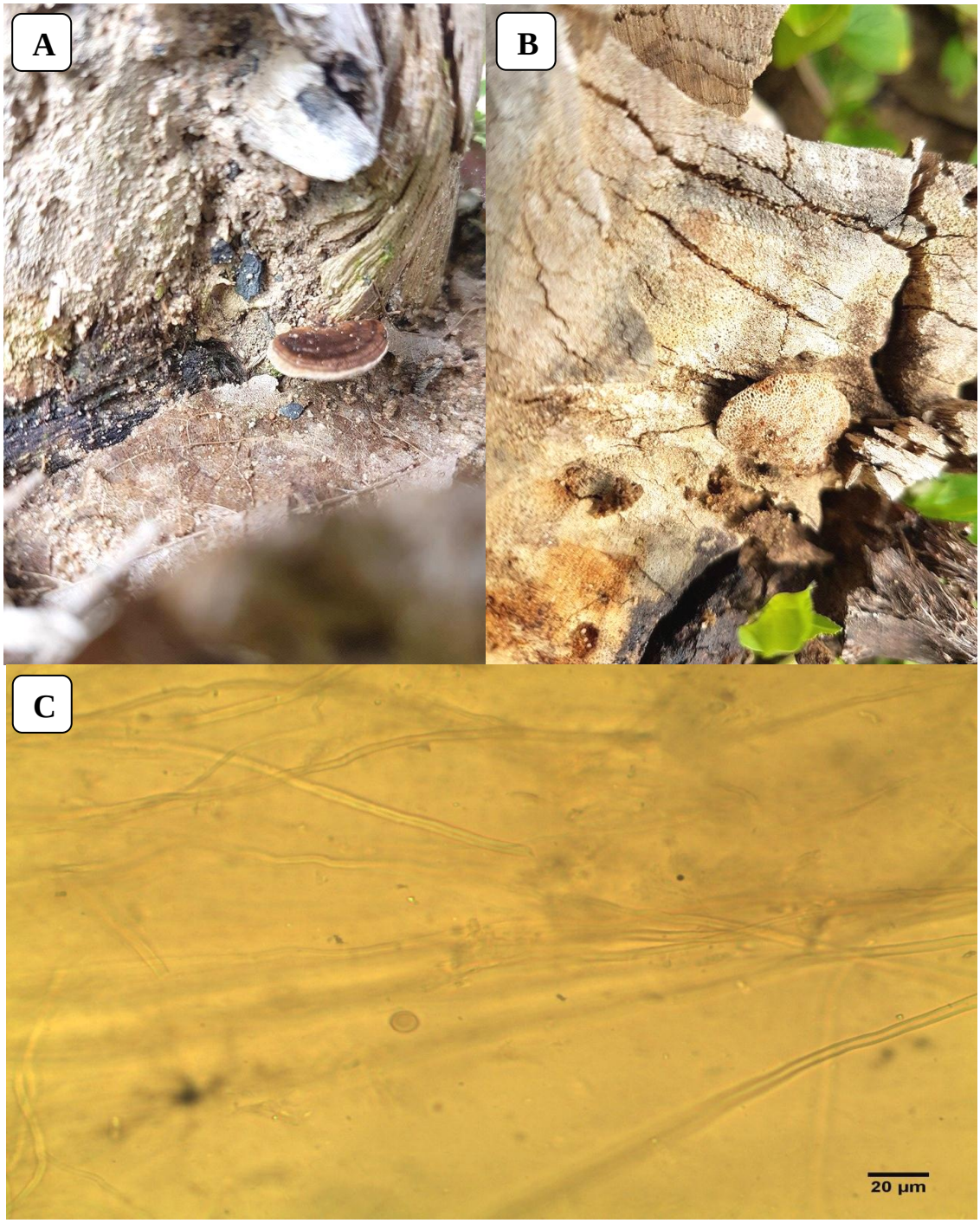


PLATE 36. *Trametes* sp.; Mature fruiting body (A), Pores (B), Spores (C).

4.37 Morphology and ecology of *Cerrena* sp.

Morphology : The pileus (cap) color was brown and green wavy margin. The average size of the basidiocarp was 3.8×5.6cm. The shape of cap was flat and hymenophores were present. Micro pores and pseudostipe were present underside of the cap. Ring or anal and volva were absent on the lower part of the stipe (Plate-37).

Ecology : The species was found on Gajari (*Shorea robusta*) tree from the mixed forest. The habit was clustered and the factors affecting their distribution was in moderately dry weather.

4.38 Morphology and ecology of *Pycnoporous* sp.

Morphology : The pileus (cap) was brick red and dark orange color. The average size of the basidiocarp was 3.2×5.1cm. The shape of cap was flat with the wavy cap edge. Beneath the cap hymenophores were present. Micro pores and pseudostipe were present underside of the cap (Plate-38).

Ecology : The species was found on Gajari (*Shorea robusta*) tree from the mixed forest. The habit was scattered and the factors affecting their distribution was in dry weather.

4.49 Morphology and ecology of *Polyporus* sp.

Morphology : The average size of the basidiocarp was 2.1×1.2cm with light browncolor of pileus (cap). The shape of cap wasfunnel shapedand micro pores and pseudostipe were present underside of the cap(Plate-39).

Ecology : The species was found on Bamboo(*Bambusa vulgaris*) tree.. The habit was clustered and the factors affecting their distribution was in moderately moist weather.

PLATE 37. *Cerrana* sp.; Mature fruiting body (A), Pores (B), Spores (C).

PLATE 38. *Pycnoporous* sp.; Mature fruiting body (A), Pores (B), Spores (C).

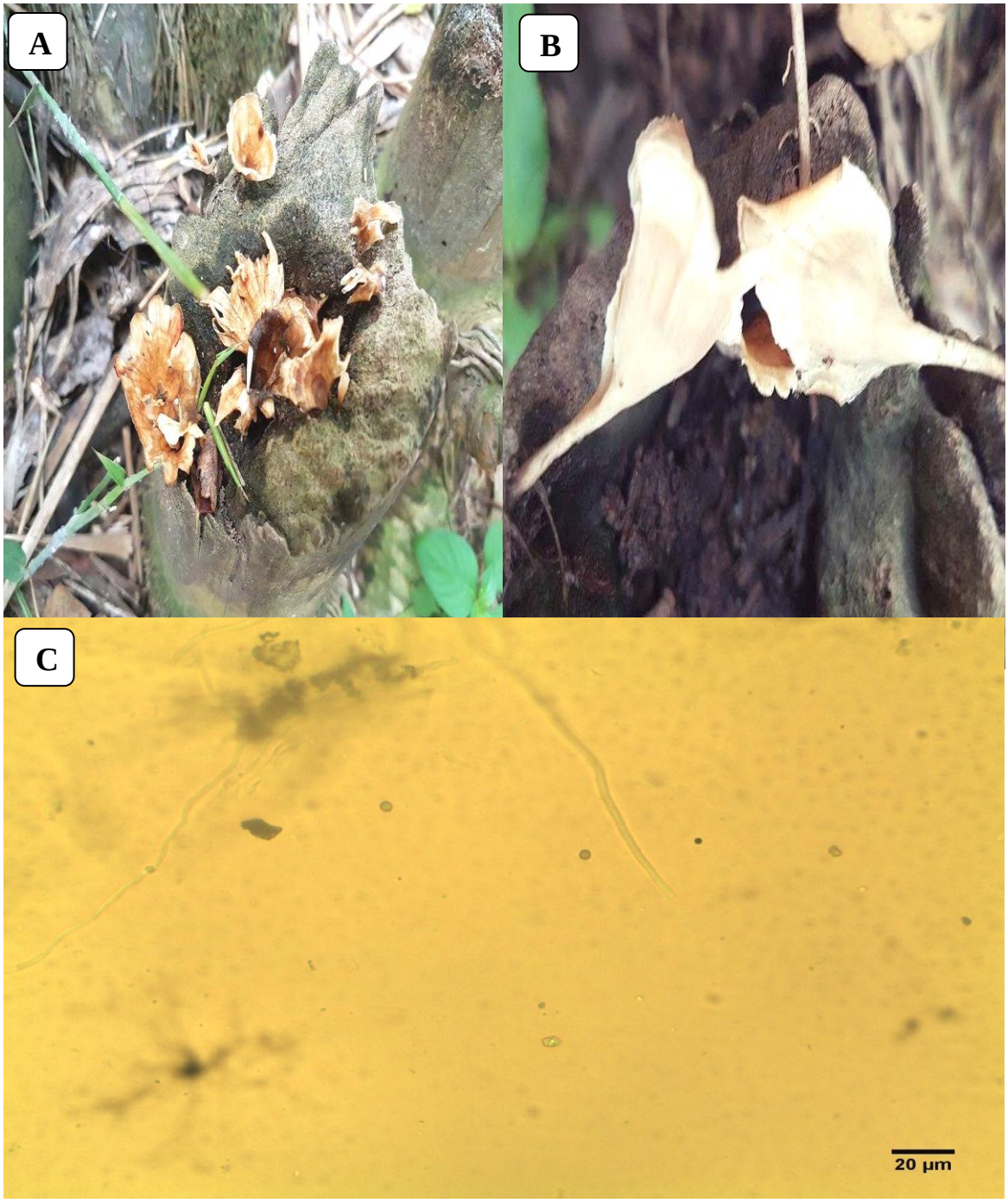


PLATE 39. *Polyporus* sp.;Mature fruiting body (A), Pores (B), Spores (C).

4.40 Morphology and ecology of *Inonotus* sp.

Morphology : The pileus (cap) was dark brown and whitish color. The average size of the basidiocarp was 2.2×1.6cm. The shape of cap was flat with the round cap surface edge. Beneath the cap hymenophores were present. Micro pores and pseudostipe were present underside of the cap. Ring or anal and volva were absent on the lower part of the stipe (Plate-40).

Ecology : The species was found on Sissoo (*Dalbergia sissoo*) tree from the mixed forest. The habit was solitary and the factors affecting their distribution was in dry weather.

4.41 Morphology and ecology of *Inonotus* sp.

Morphology : The pileus (cap) was yellowis brown. The average size of the basidiocarp was 2.4×1.6cm. The shape of cap was flat with the round cap surface edge. Beneath the cap hymenophores were present. Micropores and pseudostipe were present underside of the cap (Plate-41).

Ecology : The species was found on Arjun (*Terminalia arjuna*) tree. The habit was solitary and the factors affecting their distribution was in dry weather.

4.42 Morphology and ecology of *Phallus impudicus*

Morphology : The average size of the basidiocarp was 4.2×1.3cm with black cap and white color stipe. The shape of cap was ball shaped and round cap edge. Beneath the cap hymenophores were abesent. Micro pores presentbut ring or anal and volva were absent on the lower part of the stipe. In some cases net like structure were present bottom of the cap (Plate-42).

Ecology : The species was found near the Gajari (*Shorea robusta*) tree. The habit was solitary and the factors affecting their distribution was in moderately moist weather.

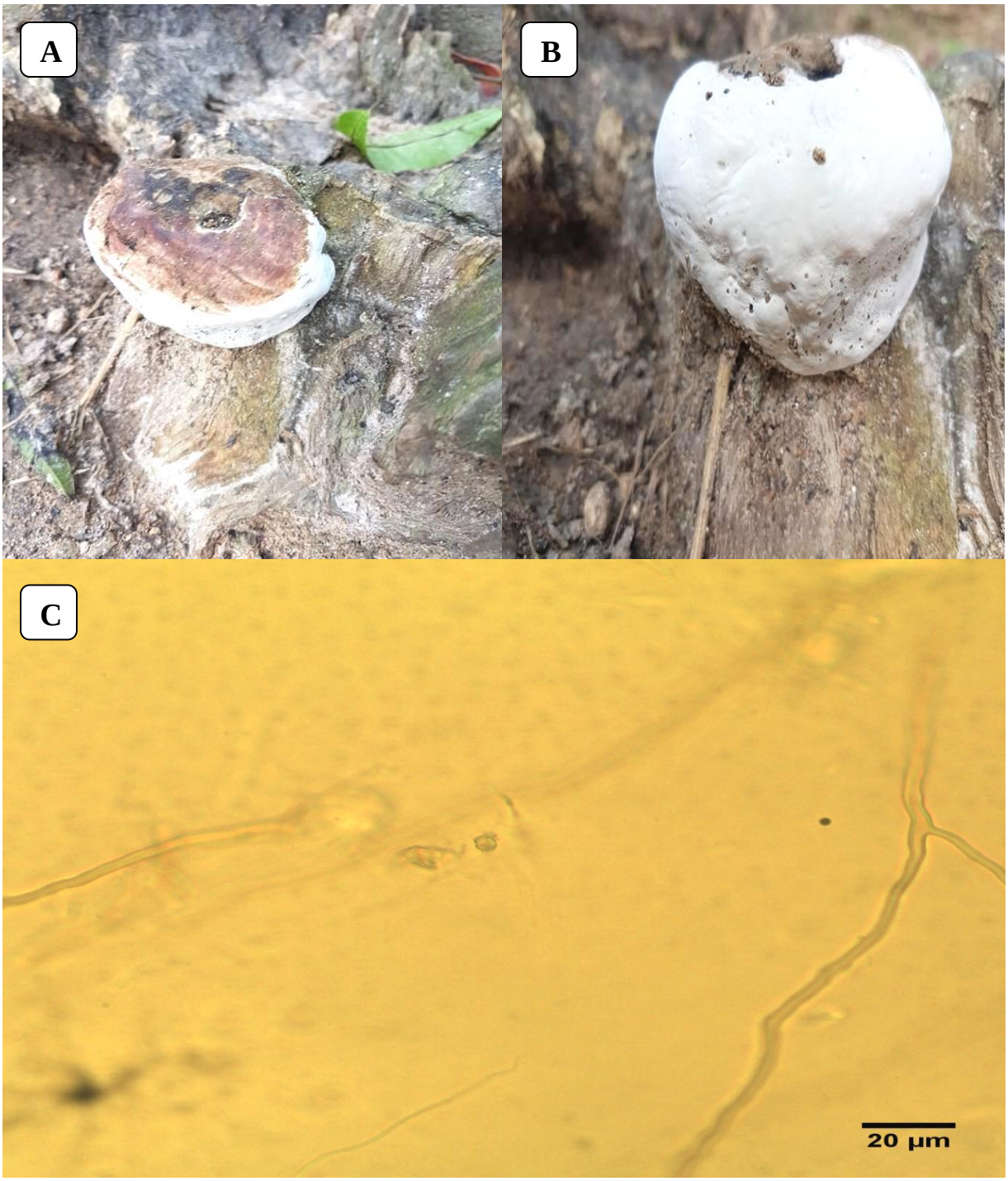


PLATE 40. *Innonotus*sp.; Mature fruiting body (A), Pores (B), Spores (C).

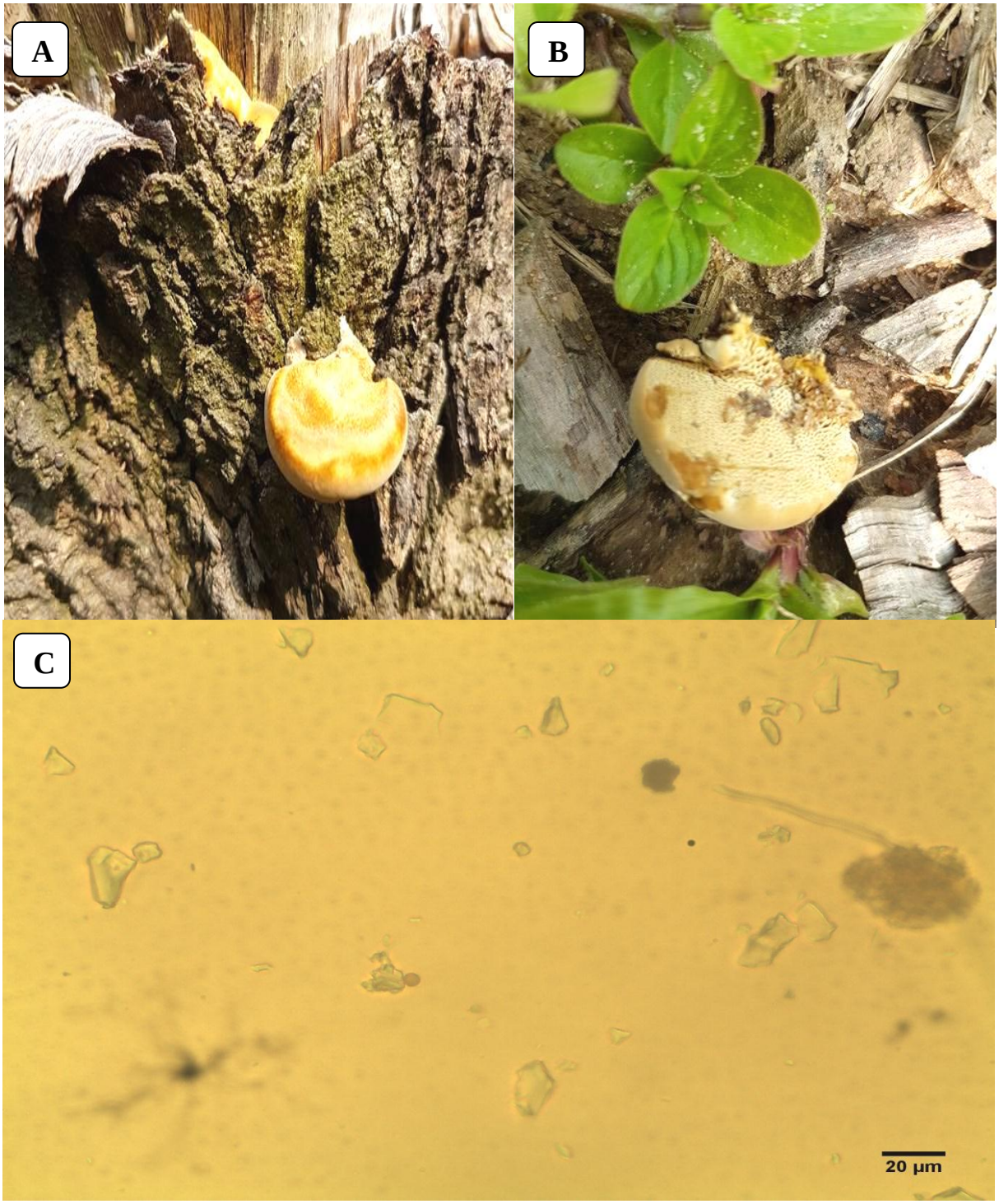


PLATE 41. *Innonotus* sp.; Mature fruiting body (A), Pores (B), Spores (C).

PLATE 42. *Phallus impudicus*; Mature fruiting body (A), Pores (B), Spores (C).

4.43 Morphology and ecology of *Phallus* sp.

Morphology : The average size of the basidiocarp was 4.1×1.3cm with whitecolor of pileus (cap). The shape of cap wasball shapedand the beneath the cap hymenophores were absent. Micro pores and pseudostipe were present underside of the cap. Ring or anal and volva were absent on the lower part of the stipe. Net like structure were present present bottom of the cap (Plate-43).

Ecology : The species was found near the root zone of Bohera (*Terminalia bellirica*) . The habit was clustered and the factors affecting their distribution was in moderately moist weather.

4.44 Morphology and ecology of *Steccherinum ochraceum*

Morphology : The average size of the basidiocarp was 2.6×5.3cm with brownish color of pileus (cap). The shape of cap wasflat and tightly attached with the host. Teeth were present under the cap (Plate-44).

Ecology : The species was found on Koroi tree (*Albizia procera*) from the mixed forest. The habit was clustered and the factors affecting their distribution was in moderately dry weather.

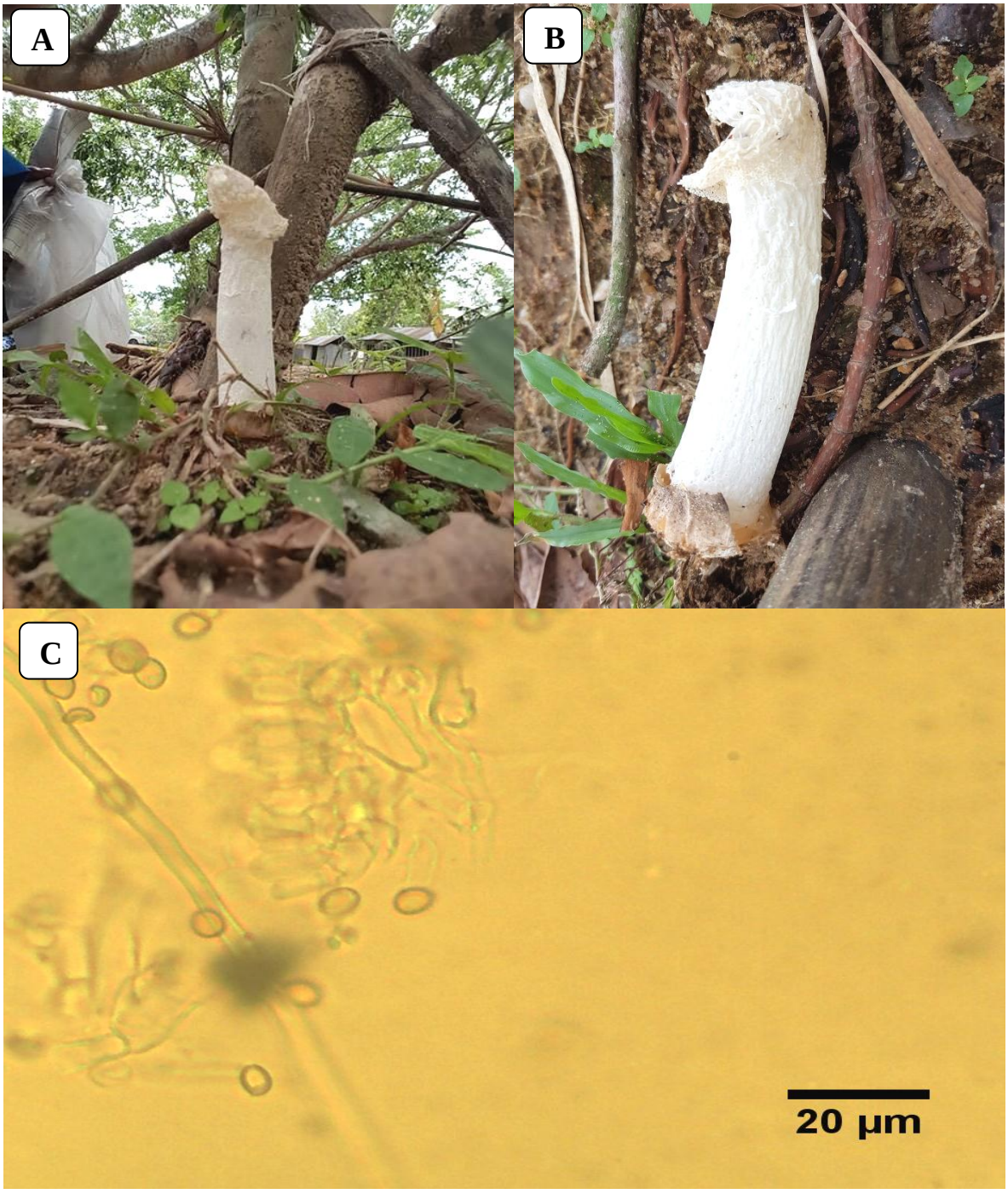


PLATE 43. *Phallus* sp.; Mature fruiting body (A), Pores (B), Spores (C).

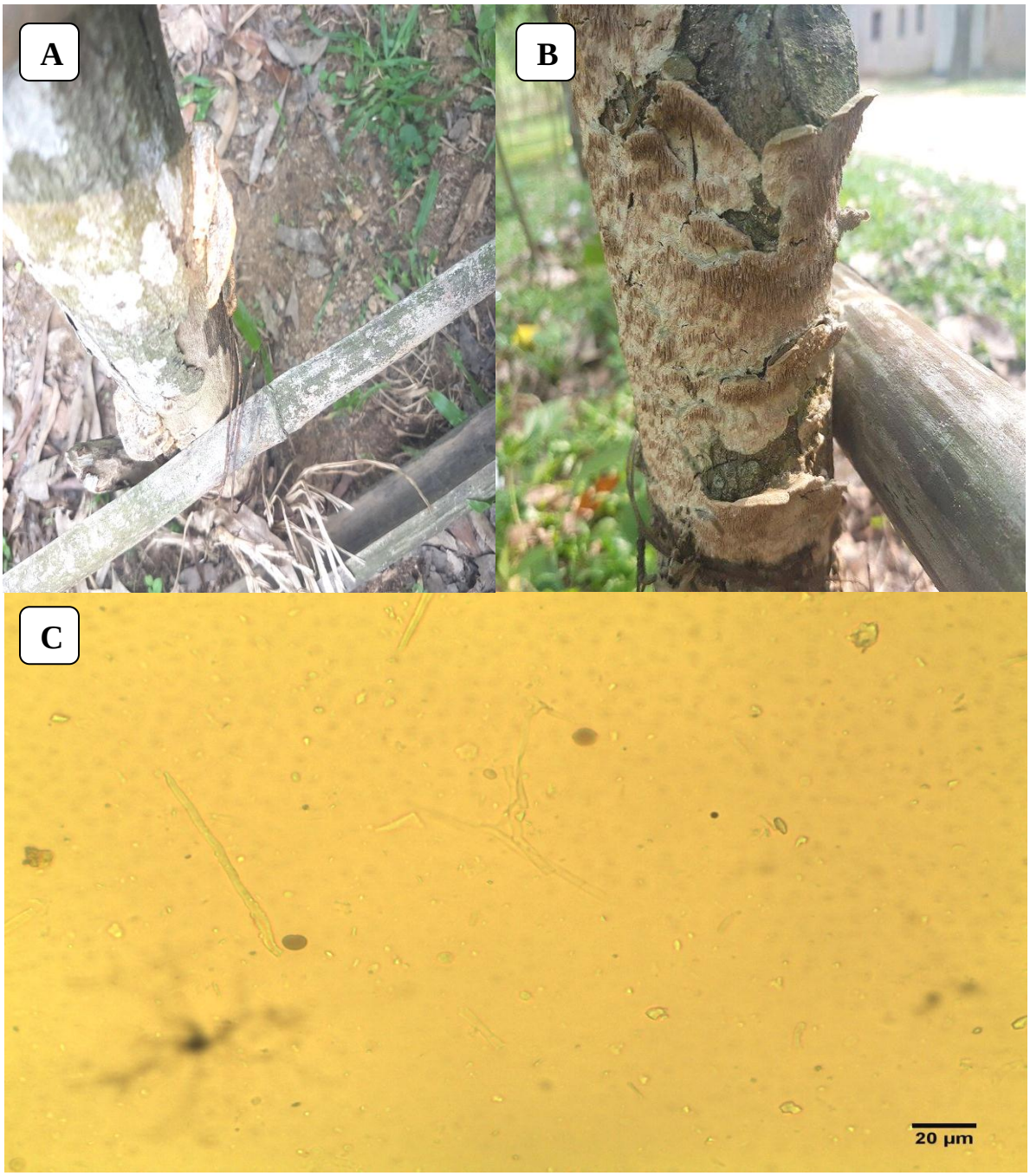


PLATE 44. ***Steccherinum ochraceum*;** Mature fruiting body and Teeth (A, B), Spores (C).

Detailed survey was carried out in Gajni forest of Sherpur in Bangladesh from June to October, 2016 and February to May, 2017 to record the morphological variability, distribution, habitat, and biodiversity of the macrofungi population.

During investigation, 51samples of macrofungi were collected and identified under 14 families. Six species of macrofungi were recorded under Agaricaceae family from the forest region. Four species of *Agaricus* viz- *Agaricus aungustus, Agaricus bernardii* and *Agaricus campestris* with the density of 2.27, 4.55 and 2.27%, respectively and two macrofungi was identified up to genus level. The spore color of *Agaricus aungustus, Agaricus bernardii* and *Agaricus campestris* were light brown and dark yellow with the spore size of 8.2×8.1µm, 11.2×7.8µm and 7.6×7.1µm, accordingly from Gajari (*Shorea robusta*) tree. Another two *Agaricus* sp. were collected from the Shimul (*Bombax ceiba*) and Sissoo (*Dalbergia sissoo*) with the density of 2.28% and their spore size were 12.1 × 8.3µm and 7.6 × 7.1µm, respectively. The result of the present study was supported by Das *et al*. (2016). They found the spore size of *Agaricus angustus* and *Agaricus campestris* were 10.3x7.22 µm and 6.4x3.8 µm, respectively. These species was also reported for Bangladesh in tropical moist deciduous forest associated with Sissoo (*Dalbergia sissoo*) tree (Rumainul *et al.,* 2015) and also from mangrove forest (Das *et al.*, 2016) and India (Mohanan, 2011; Thiribhuvanamala *et. al.*, 2011; Hansen, 1992).

Two species of *Coprinus* were identified up to genus level with the density of 2.27 and 15.91%, respectively. The spores color of *Coprinus* spp. were brown to yellow and size of spores were 8.8×5.9µm and 10.3×8.6µm. The result of the present study was supported by Das *et al.;* (2016). They found *Coprinus silvaticus* on the root zone of Burflower (*Neolamarckia cadamba*) tree in the mixed type of forest with the deep brown color spore and spore size was 9.22× 4.92µm (Das *et al.;* 2016). But in this study these two species of *Coprinus* were collected from the bark of Koroi (*Albizzia procera*) and Sissoo (*Dalbergia sissoo*) tree.

One species of *Lepiota* was found with the density of 6.82% from Mahogany (*Swietenia macrophylla*) tree. The spore color of *Lepiota* sp. was light brown and the average size of spore was 18.1×10.6µm where this species was also collected and identified with the brown color spores and size of spore was 6.28×3.4µm from the mangrove forest regions of Bangladesh (Das *et al.*, 2016).

Two species commonly known as puffball such as- *Lycoperdon perlatum* and *Calvatia* sp. were collected from the forest with the density of 20.45 and 2.27%, respectively. The color of spores of two species were light and dark brown with the spores size of 7.3 × 6.2µm and 15.3 × 8.9µm, respectively. *Lycoperdon perlatum* and *Calvatia* sp. were collected with the brown color basidiospores and supported by Murray (2013). *Calvatia* sp. was also reported from the Rangamati and Bandarban (Marzana, 2016).

Four species of *Ganoderma* were found during investigation such as- *Ganoderma zonatum, Ganoderma tsugae* with the density of 6.82, 4.55% in association with Koroi and Mehagony tree, respectively. *Ganoderma zonatum* was found on the Sissoo (*Dalbergia sissoo*) tree with the density of 18.75% and the spore size was 10.0 ×5.3µm. In the present study *Ganoderma tsugae* was found associated with Haldina (*Haldina cordifolia*) with the density of 2.28%. But in the previous study this species was found associated with the Sissoo (*Dalbergia sissoo*) tree where the average spore size was 8.5×3.2µm (Das and Aminuzzaman, 2017).

Three sample of *Ganoderma* were identified up to the genus level collected from Kurchi (*Holarrhena antidysentrica*), Koroi (*Albizzia procera*) and Neem (*Azadirachta indica*) tree with the spore color of light brown to dark brown and spore size were 5.8×5.3µm, 4.3×4.2 µm and 5.4×4.3µm, respectively. The genus *Ganoderma* was also recorded at Rajshahi, Pabna, Jaipurhat, and Dhaka districts of Bangladesh under tropical moist deciduous forest (Rumainul *et al.*, 2015). It was also reported in China (Wang *et al.*, 2012) and in India (Dwivedi *et al*., 2012; Thiribhuvanamala *et. al.*, 2011; Ram *et al.*, 2010; Cooper *et al.*, 2011; Kinge *et al.*, 2011& 2015; Bhosle *et al.*, 2010). *Ganoderma zonatum* was also found on the Sissoo (*Dalberzia*

sissoo) from the Bogra district under social forest (Aminuzzaman and Das, 2016).

One species of *Crepidotus* was collected from the log of Gajari (*Shorea robusta*) with the density of 2.27%. The spore color was dark brown to yellow and size was 8.9×7.8µm. The *Crepidotus* were identified from the mangrove forest regions of Bangladesh (Das *et al.*, 2016). *Dacryopinax spatularia* was collected and identified with the density of 95.45% from Gajari (*Shorea robusta*) tree with the spore size of 10.8×8.4µm. But this speices was collected from mangrove forest associated with betel nut (*Areca catechu*) tree with a spore size of 9.5 × 5.96 µm (Das *et al.*, 2016).

Three species of *Marasmius* were observed as- *Marasmius nigrodiscus, Marasmius rotula* and *Marasmius* sp. from the soil surface with the density 2.27, 4.55 and 4.55%, accordingly. *Marasmius nigrodiscus* was found from the log of Kadam (*Neolamarckia cadamba*) tree with the dark brick color spores and size of spore was 10.3×7.8µm. This *Marasmius nigrodiscus* was collected from the mangrove forest regions with the average spore size of 8.6 × 5.2 µm and density was 3.13% (Das *et al.*, 2016). *Marasmius* spp. were found with the dark yellow and brown color spore where size of spores were 9.8×58µm, 3.7×3.5µm, respectively. But this species was also reported for Bangladesh in tropical moist deciduous forest at Dhaka (Rumainul *et al.*, 2015; Islam, 2013) and from United Kingdom (Kirk *et al.*, 2008). The species was also reported in madagascar as well as the Mascarenes (Antonin and Buyck, 2006).

Three species under Psathyrellaceae family were identified such as- *Parasola lacteal, Psathyrella candolleana* and one unidentified species with the density of 2.27, 120.45 and 4.55%, accordingly. The spores color of *Parasola lacteal*, *Psathyrella candolleana* were dark brown to brown and size of spores were 16.8×10.6µm and 6.8×5.6µm, respectively. *Parasola lacteal* and *Parasola* sp. were collected from the Koroi (*Albizzia procera*) and Gajari (*Shorea robusta*), respectively. This *Parasola* sp. was reported in Rangamati with the brown color spores (Marzana, 2016). *Psathyrella candolleana* was found on the Kurchi (*Holarrhena antidysentrica*) tree with

the spore size of 14.6×8.3µm. A new species of *Psathyrella* (Psathyrellaceae, Agaricales) was collected and described from Punjab, India (Kaur *et al*., 2013).

Two species of *Clitocybe* under Tricholomataceae family were identified such as- *Clitocybe dealbata* and one up to genus with the same density of 2.27%. *Clitocybe dealbata* and *Clitocybe* sp. were found on the Gajari (*Shorea robusta*) and Kadam (*Neolamarckia cadamba*) tree with the light brown to brown color spores and the size of 13.3×12.8µm11.4×8.3µm, respectively. *Clitocybe dealbata* and *Clitocybe* sp. were collected and identified with the brown color spores from New York (Goldfrank, 2011; Brent and Palmer, 2007).

One species of *Mycena* was collected and identified as *Mycena epipterygia* from the Gajari (*Shorea robusta*) with the density of 18.18%. The spore color of collected macrofungi was dark brown and size of spore was 13.8×9.6µm. This species was also reported with the brown color spores with a spore size of 9.01×5.47µm from mangrove forest of Bangladesh (Das *et al.*, 2016).

One species of *Amanita* was collected and identified as- *Amanita* sp. from the root zone of Sissoo (*Dalbrrgia sissoo*) with the density of 4.55%. The spore color was dark yellow and size of spore was 14.3×8.6µm. This species was also reported with the brown color spores and spore size was 7.2×4.6µm from mangrove forest of Bangladesh (Das *et al.*, 2016). This *Amanita* sp. was also reported for Bangladesh in tropical moist deciduous forest (Rumainul *et al.*, 2015) and from the tropical Asia (Hosen *et al.*, 2015).

One species of *Cortinarius* was collected and identified as *Cortinarius semisanguineus* from the dead Sissoo (*Dalbergia sissoo*) tree surface with the second dominant density of 111.36%. The spore color was dark brown and size of spore was 11.8×8.3µm. This species was collected and identified with the light yellow and spores size was 8.2×4.8 from the mangrove forest of Bangladesh (Das *et al.*, 2016).

One species of *Daedalea* was collected and identified under the family Fomitopsidaceae with the density of 6.82% from the stick of Mango (*Mangifera indica*) tree. One species of *Auricularia* was collected and identified under the family Auriculariaceae with the density of 15.91% from the Kadam (*Tibetan buddhism*).

The spore color of *Auricularia* sp. was brown to black and size of spore was 15.1×7.2µm. *Auricularia* sp. was found on the rain (*Albizia saman*) tree with the average spore size was 6.0×3.92µm from the mangrove forest regions of Bangladesh (Das *et al.*, 2016).

Six species of *Trametes* were collected and identified as *Trametes hirsute* and *Trametes gibbosa* under the family Polyporaceae with the density of 9.10 and 6.82%, respectively. Three species of *Trametes* were also identified up to the genus level with the density of 36.36, 25 and 13.89%, respectively from the Gajni forest. The colors of spores were light brown to brown color with the size of 10.1×7.8µm, 11.2×6.2µm, 10.9×8.2µm, respectively. The Polyporaceae family was reported by Roy *et al*., (1998) in India. One species of *Cerrana*, *Pycnoporus* and *Polyporus* were found with the both of density of 25, 2.27 and 22.73%, respectively. *Pycnoporus* sp. was collected from the mangrove forest regions of Bangladesh with the red and slight brown color spores with the size of 7.4×5.17µm from Sundari (*Heritiera fomes*) tree (Das and Aminuzzaman, 2017). But in this study, the species was found on the bark of Gajari (*Shorea robusta*) tree.

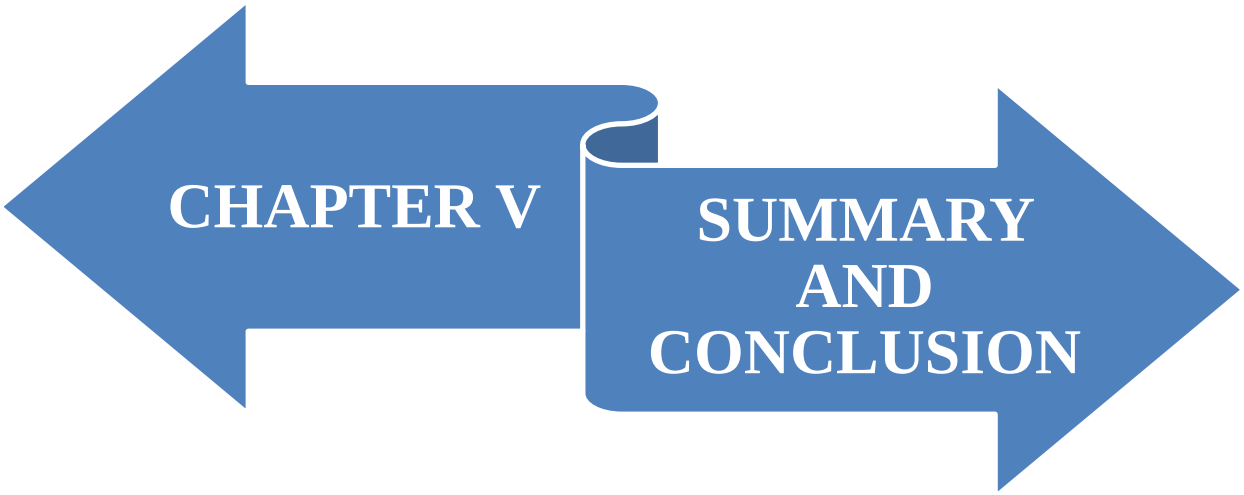
Polyporus sp. was collected from the Bamboo (*Bambusa vulgaris*) with the light yellow color spores and size of spore was 8.9×6.8µm. But this species was found with thick walled, smooth, ellipsoidal regular spore and the average spore size was 10.2µm×4.8µm which was supported by Das and Aminuzzaman (2017) and they found the species on the bark of Rain (*Albizia saman*) tree.

Two species of *Inonotus* were found on the Sissoo (*Dalbergia sissoo*) and Arjun (*Terminalia arjuna*) tree with the both of density of 2.27%. The color of spores were light brown and spore size were 8.3×6.8µm and 7.8×6.3µm,

respectively. *Inonotus hispidus* and *Inonotus dryadeus* were also identified on the Goran (*Ceriops decandra*) and Garjan (*Rhizophora apiculata*) with the density of 4.55% from the mangrove forest of Bangladesh (Das and Aminuzzaman, 2017).

Two species of *Phallus impudicus* and one unidentified *Phallus* sp. were found with the both of density of 2.27% from the Gajni forest of Bangladesh. The spore colors of collected *Phallus* was light brown to brown and size of spore was 7.9×5.8µm, 8.2×6.3µm which supports with spore color was brown (Murray, 2013).

One species of *Steccherinum ochraceum* was identified with the density of 13.63% from the bark of Koroi (*Albizia procera*) tree. The spore color of *Steccherinum ochraceum* was Light brown and hyaline and the size of spore was 8.9×5.8µm. But this species was collected from the bark of Mahagoni (*Swietenia mahagoni*) with the density of 9.10% and spore size was 13.2×7.06µm from mangrove forest regions of Bangladesh (Rashid *et al.*, 2016; Das and Aminuzzaman, 2017).


CHAPTER V
SUMMARY
AND
CONCLUSION

CHAPTER V

SUMMARY AND CONCLUSION

A detailed survey was conducted in Gajni forest of Sherpur district in Bangladesh from June, 2016 and May, 2017 to record the morphological variability, and distribution of macrofungi. A total 51 samples of macrofungi were collected and identified to 22 genera, 16 species under 15 families from the forest. The predominant genera were *Agaricus, Ganoderma*, *Marasmius, Parasola, Coprinus, Clitocybe, Trametes, Inonotus* and *Phallus*. The predominant species were *Psathyrella candolleana,Cortinarius semisanguineus,Dacryopinax spatularia*, *Trametes* sp., *Cerrena* sp., *Mycena epipterygia*, *Lycoperdon perlatum*, *Coprinus* sp..The predominant families were Agaricaceae, Ganodermataceae, Marasmiaceae, Polyporaceae, Psathyrellaceae, Hymenochaetaceae, Tricholomataceae and Phallaceae.

Four species of *Agaricus* and *Ganoderma* were collected and identified up to the genus and species level. There were 3 species and 2 species of *Agaricu s*and *Ganoderma* were identified. In case of *Maramius*, two species were identified up to the genus level and one was still unidentified. Two species of each genus such as *Parasola, Clitocybe, Trametes, Inonotus* and also *Phallus* were collected and identified from the Gajni forest. The rest of the genera were also identified with the density. The most predominant species was *Psathyrella candolleana* and found with the density of 120.45%. The second and third most predominant species were *Cortinarius semisanguineus* and *Dacryopinax spatularia* with the density of 111.36 and 95.45%, respectively. The maximum species were found to be lower in density of 2.27% during the investigation of macrofungi in Gajni forest of Bangladesh.

The present study plays an important role to explore diversity of macrofungi morphology as well as to provide the outline to the macrofungi of Bangladesh for the further utilization considering the increasing economic demand day by day. The importance of macrofungiis not only in the ecosystem dynamics but also in human diet, protein resources and health increases the need for the conservation of macrofungi from diverse location. So, conservation can also be achieved through proper identification,

cultivation, genome preservation, increase of awareness, creation national parks and forest reserve areas for the mushrooms.

So, future investigation is also needed in different seasons as well as in different forest regions to identify the new domestic and also exotic species of mushroom flora, which will represent a complete overview about the available macrofungi flora in Gajni forest regions of Bangladesh.

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