

**BIODIVERSITY, DISTRIBUTION AND MORPHOLOGICAL  
CHARACTERIZATION OF MUSHROOMS IN MANGROVE FOREST  
REGIONS OF BANGLADESH**

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**BIODIVERSITY, DISTRIBUTION AND MORPHOLOGICAL  
CHARACTERIZATION OF MUSHROOMS IN MANGROVE FOREST  
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**BY**

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## CERTIFICATE

This is to certify that the thesis entitled, “**BIODIVERSITY, DISTRIBUTION AND MORPHOLOGICAL CHARACTERIZATION OF MUSHROOMS IN MANGROVE FOREST REGIONS 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 **KALLOL DAS** bearing **Registration No. 15-06883** 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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# **BIODIVERSITY, DISTRIBUTION AND MORPHOLOGICAL CHARACTERIZATION OF MUSHROOMS IN MANGROVE FOREST REGIONS OF BANGLADESH**

**KALLOL DAS**

## **ABSTRACT**

A survey was conducted on biodiversity and distribution of mushrooms in mangrove forest regions of Bangladesh. Mangrove (Sundarban), is the largest single block of tidal halophytic mangrove forest in the world, located in the south western part of Bangladesh. It lies on the Ganges-Brahmaputra Delta at the point where it merges with the Bay of Bengal. The forest lies a little south to the Tropic of Cancer between the latitudes 21°30'N and 22°30'N, and longitudes 89°00'E and 89°55'E. A total 35 mushroom species belonging to 24 genera under 17 families were recorded during the survey. The mushroom species of *Pycnoporous sanguineus* was found on the dead logs of Sundari (*Heritiera fomes*) tree with the frequency and the density of 75% and was 22.86%, respectively. Among the collected species, the highest frequency was 75% for *Volvariella speciosa*, *Auricularia cornea*, *Marasmiellus albuscorticis*, followed by 50% for *Agaricus campestris*, *Agaricus aungustus*, *Lepiota atrodisca*, *Trametes* sp., *Daedaleopsis confragosa*, *Marasmius siccus*, *Schizophyllum* sp., *Schizophyllum commune*, *Volvariella hypopithys*, *Ganoderma* sp., *Crepidotus alabamensis*, *Heimiomyces neovelutipes* and *Irpex lacteus*. The lowest frequency was 25% for the rest of the species. Highest density was 262.86% for *Coprinus silvaticus* followed by 97.14% for *Marasmiellus albuscorticisi* and lowest density was 2.86% for *Chlorophyllum molybdites*, *Trametes versicolor*, *Gloeophyllum sepiarium*, and *Pleurotus ostreatus*.

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# CHAPTER I

## INTRODUCTION

Mushrooms are one of the most diverse groups of organisms on earth, and constitute a significant part of terrestrial ecosystem. The mushroom (or toadstool ) is the fleshy, spore-bearing fruiting body of a fungus typically produced above or below the ground on soil or its food source. They are being recognized as important food items from ancient times. Even they form a large share of the species richness and are key-players in ecosystem process.

Mushrooms are fruiting bodies of macroscopic, filamentous and epigeal fungi made up of hyphae which form interwoven web of tissue known as mycelium in the substrate upon which the fungus feeds; most often their mycelia are buried in the soil around the root of the trees, beneath leaf litters, in the tissue of tree trunk or in their nourishing substrate (Ramsbottom, 1989). Mushrooms are seasonal fungi, which occupy diverse niches in nature in the forest ecosystem. Mushrooms are mainly in the rainy season. About 80% of Bangladesh's rain falls during the monsoon season. Mushrooms are in fact the 'fruit' of the underground fungal mycelium. They are macromycetes forming macroscopic fruiting bodies such as agarics, boletes, jelly fungi, coral fungi, stinkhorns, bracket fungi, puffballs and bird's nest fungi. The number of recognized mushroom species has been reported to be 14,000, which is about 10% of the total estimated mushroom species on the earth (Cheung, 2008).



The term “Mushroom” is used mainly for the fruiting body produced by the macro-fungi and these are *Ascomycota* or *Basidiomycota*, some are edible and many are poisonous and nonedible. More than 10,000 species of mushrooms are present in and around the world and about 2000 of them are considered as edible (Rumainul *et. al*, 2015). These edible fungi are more important for a tropical/subtropical country like Bangladesh, which has a climate, most congenial for the natural growth of such fungi (Purkayastha and Chandra, 1985).

A mushroom is the fleshy spore bearing fruiting body of a fungus, typically produced above ground soil or on its food source. Some species of mushrooms are edible and some are poisonous. Mushrooms have been existing on earth even long time before man appeared on earth as it is evident from the fossil records of the lower cretaceous period. Mushroom is a general term used mainly for the fruiting body of the macro fungi (*Ascomycota* and *Basidiomycota*) and represents only a short reproductive stage in their life cycle (Das, 2010). “Mushrooms” describe a variety of gilled fungi, with or without stem, and the term is used even more generally, to describe both the fleshy bodies of some *Ascomycota* and the woody or leathery fruiting bodies of some *Basidiomycota* depending upon the context of word. Mushrooms have been found in fossilized wood that are estimated to be 300 million years old and almost certainly, prehistoric man has used mushroom collected in the wild as food. There are many edible i.e. *Volvarias*, polypore and tubers fungi that used ethno botanical food by the tribal of forest regions of India and Nepal (Alexopolous *et al.*, 1996).

Although, biologically speaking, possibly man might have used mushroom as food gatherer and hunter on the chronology of cultural evolution, but their nutritive value is untapped till now. Wild edible fungi were being collected and consumed by people for thousands of years. The geological records reveal that edible species associated with people living 13,000 years ago in Chile. Many mushrooms have been used as food and medicines. So they contribute towards diet, income and human health. Many mushrooms have been used as food and medicines. So they contribute towards diet, income and human health. Some mushrooms have been important source of revenue for rural communities in India and other developing countries (Wani *et al.*, 2010).

Mushrooms alone are represented by about 41,000 species, of which approximately 850 species are recorded from India (Deshmukh, 2004) mostly belonging to Agaricales, also known as gilled mushroom (for their distinctive gills) or euagarics. The Agaricales has 33 extant families, 413 genera and over 13000 described species (Kirk *et al.*, 2008). These are invariably high protein rich and have been considered as potential source of proteins, amino acids, vitamins and minerals. Indigenous peoples are utilizing mushroom for the treatment of different type of diseases and also as an aphrodisiac and tonic (Devkota, 2006).

Besides, they are valued for food and medicinal properties by people. However, the food value and acceptance of these edible fungi by the scientific and civilized world have not been recognized. These edible fungi are more important for a tropical/ subtropical country like Bangladesh, which has a climate, most congenial for the natural growth of such fungi (Purkayastha and Chandra, 1985).

To date, about 1,200 species of fungi belonging to the order Agaricales, Russulales and Boletales are described in comparison to about 14,000 species of mushrooms reported worldwide that contributes 10 percent of the global mushroom flora. Out of approximately 14,000 known species, 2,000 are safe for human consumption and about 650 of these possess medicinal properties (Rai *et al.*, 2005). Barros *et al.*, (2008) reported the wild mushrooms are richer sources of protein and have a lower amount of fat than commercial mushrooms.

Edible mushrooms are considered as healthy food because their mineral content is higher than that of meat or fish and most vegetables, apart from their nutritional value mushrooms have potential medicinal benefits (Chan, 1981; Chang and Miles, 1991).

The proteins of wild edible mushroom contains considerable amounts of non-essential amino acids like alanine, arginine, glycine, glutamic acid, aspartic acid, proline and serine. Mushrooms also have been used extensively in traditional medicine for curing variety of diseases including viral infection, bacterial infection, cancer, tumor, inflammation, cardiovascular diseases. About 1800 species of mushrooms with the potential of medicinal properties (Cheung, 2008).

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. Around the world, truffles are harvested primarily because of their enticing aromas. They are generally considered as a delicacy and a luxury.

All truffles (true and false) are the fruiting bodies of ectomycorrhizal fungi and therefore are associated with living host plants, usually trees or shrubs. In Europe, most commercial truffles are members of the genus *Tuber* but in dry ecosystems of Africa other genera dominate, e.g. *Telfezia* and *Tirmania* (Shannon Berch, 2013).

Biodiversity, a contraction of "biological diversity," generally refers to the variety and variability of life on Earth. Nilsson and Presson (1978) reported that, the color, shape and size of the fruiting body of mushroom can vary tremendously. It is important to properly identify the mushroom that is collected, so as to avoid a poisonous species.

One of the most widely used definitions defines it in terms of the variability within species, between species, and between ecosystems. It also refers variety and variability among the living organism and ecological complexes in which they occur. It plays a significant role in nature by enriching soil, maintaining water and climate cycle, humidity precipitation, conservation and recycling of waste material into nutrients. Determination of biodiversity of mushroom usually has done by using morphological characterization, habitat and phenotypical appearances of mushrooms in fresh form.

Ample species of wild edible and medicinal mushroom occur in all biodiversity rich region during the rainy season. They can be found on wood of living or dead trees on the leaf litters on the soil through the branching mycelia infiltration. Some mushroom are found growing in association with trees of a particular families or genus (Arora, 2008; Karwa and Rai, 2010).

Mushroom species are the indicators of the forest life support system.

The presence or absence of fungal species is also a useful indicator to assess the damage or the maturity of an ecosystem.

Recent studies confirm that they are an important source of food and income in both developing and developed countries. Indigenous peoples are utilizing mushroom for the treatment of different type of diseases and also as an aphrodisiac and tonic ( Devkota, 2006). Different types of edible mushrooms are cultivated on large scale for commercial use and many more species of mushrooms grow wildly in nature which has much nutritional and medicinal value (Alom and Bari, 2010). There is increasing interest in the mapping of macrofungal flora of many areas to obtain the distribution records similar to that already existing for flowering plants.

However, unlike plants the identification of macrofungi relies on the collection of fruiting bodies, which in turn is largely dependent up on the availability of moisture in most cases. The importance of mushrooms not only in the ecosystem dynamics but also in human diet and health increases the need for the conservation of this non-timber forest product resource. Conservation can also be achieved through cultivation, creation of national parks and forest reserve areas, and the reduction of illegal logging of timber. It is therefore necessary to include macro fungi biodiversity conservation in forest management policies in Bangladesh.

Mushroom is one of the promising concepts for crops diversification in Bangladesh as well as the whole world. Keeping this view in mind the present research work was conducted by a systematic survey in mangrove forest regions of Bangladesh with the following objectives –

1. To identify the mushrooms up to the genus and species level from mangrove forest region of Bangladesh.
2. To study the biodiversity, distribution and morphology of mushrooms in mangrove forest regions of Bangladesh.

## **CHAPTER II**

### **REVIEW OF LITERATURE**

The forest of Bangladesh can be grouped in to four broad categories depending on their location, nature and type of management. They are mangrove forest, tropical moist deciduous forests, tropical evergreen and semi evergreen forests and village forests. Among them the mushroom biodiversity of mangrove forests regions are described. The main purpose of this chapter is to review the previous studies, which are related to the present study. Therefore, an attempt has been made here to compile the research work carried out on the subject elsewhere.

Deepak K. Rahi *et. al.* (2016) reported that Mushrooms are well known for their nutritional as well as therapeutic values worldwide. Interest in mushrooms has peaked because immunity and cellular protection are important issues for health conscious consumers and for those individuals who are dealing with serious health issues. Mushrooms generally belong to Basidiomycetes which harbors numerous mushroom species with diversity of metabolites of nutraceutical and therapeutic significance. 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. Various academic and research institutes are all involved actively in research on bioactive metabolites of mushrooms.

Sharareh Rezaeian *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.

Beuy Joob and Viroj Wiwanitkit (2016) stated that Linzhi (*Ganoderma lucidum*) is a well-known medicinal mushroom. This mushroom originated from China becomes the widely used supplementation worldwide. 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. In this short manuscript, the authors discuss on evidence of Linzhi's clinical usefulness in renal diseases.

Rahaman *et al.* (2016) surveyed that at south western region of Bangladesh is known as mangrove forest region, positioning at 22°55'N latitude and 89°15'E longitudes having a wide range of ecosystem. The survey was conducted from June to October, 2014 in 5 districts namely Kushtia, Chuadanga, Jessore, Satkhira and Khulna. A total of 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%. Moreover, *Lepiota cristata* was distributed in Daulatpur of Kushtia and Koira of Khulna districts in the south western region of Bangladesh.

Vanessa Vieira *e. al.* (2016) studied that the wild mushroom *Leucopaxillus candidus* (Bres.) Singer was studied for the first time to obtain information about its chemical composition, nutritional value and bioactivity. Free 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. Other compounds detected were oxalic and fumaric acids, phydroxybenzoic and cinnamic acids. The methanolic extract revealed antioxidant activity and did not show hepatotoxicity in porcine liver primary cells. The present study provides new information about *L. candidus*.

Rumainul *et al.* (2015) reported that, mushroom flora is an important component of the ecosystem and their biodiversity study has been largely neglected and not documented for the tropical moist deciduous forest regions of Bangladesh. They 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. The entire mushroom flora and its morphological characteristics have been described and illustrated.

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. They collected 57 samples of *Ganoderma* from oil palm and other hosts for identification using comparative morphology and molecular techniques. Morphological and molecular characterization of the 57 species showed that they belonged to 17 species of *Ganoderma* of which two species, *Ganoderma tornatum* and *Ganoderma chalconeum* are new records for 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 eurhizus* 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. These regions with tribal populations, especially the Santals in the forest fringes, have traditional knowledge related to mushrooms.

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 geotrappa*, *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*. Among them some are edible like *L. nuda* and *Clitopilus prunnulus* which are used to prepare indigenous medicines using traditional techniques.

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* woodland 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. Moreover, it was found that 30% of men were involved in collecting and only 6.5% in selling. About 45 species of wild edible mushrooms were collected mainly from *Lactarius*, *Russula*, *Cantharellus* and *Amanita* species.

Andrew *et al.* (2013) reported the diversity and distribution of macrofungi in the Mount Cameroon Region. These were assessed at low and high altitudinal ranges in the four flanks of the mountain during the rainy and early dry seasons of 2010 and 2011. A total of 177 macrofungal species belonging to 83 genera and 38 families were recorded. Species richness was higher in the rainy seasons (134 species) than in the early dry seasons (89 species) and tended to decrease with altitude, with 116 and 112 species for low and high altitudes, respectively. Eighty-eight species were recorded only in the rainy seasons, 43 species in the early dry seasons only, and 46 species were common to both seasons. Sixty-five species were found only in the low altitude, 61 species only in the high altitude, and 51 species were common to both altitudes.

*Auricularia auricular* was the most abundant species during the rainy seasons, while *Coltricia cinnamomea* was rare during the rainy seasons, and the most abundant during the dry seasons. 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. Out of these maximum six genera assignable to family *Polyporaceae*, five genera to *Russulaceae*, three genera to *Agaricaceae*, two genera to *Ganodermataceae* and *Cantharellaceae* each and rest of the families were represented by single genus only. The 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 coordinates 72°00' and 72°30' E longitudes 32°25' and 32°45' N latitudes with diversified ecosystem.

The ethno- mycological study of soon valley has been strongly neglected in the past. So, the survey was conducted during 2010-11 in four villages i.e. Nowshehra, Dhaka, Sakhiabad and Knaty garden of the Soon Valley. A total of 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* (Auriscipinaceae, edible), *Galerina unicolor* (Hymenogatraceae), *Citocybe flaccid* (Trichomataceae, edible), *Oudemansiella redicata* (Physalacriaceae, edible), *Hygrophorus eburnes* (Hygrophoraceae, edible) and *Agaricus campestris* (Agaricaceae, edible). The investigation proves the existence of a distinct biodiversity in mushroom population.

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 Kurdistan region. 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.

Kumar *et al.* (2013) reported that, the macro-fungal diversity and nutrient content of some edible mushrooms of Nagaland, India. They 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. The selected species were analyzed for proximate analysis of nutritional values. The protein content varies from 22.50-44.93% and carbohydrates were recorded 32.43-52.07% in selected species.

Shannon Berch (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. The potential for the discovery and commercialization of novel native truffles is good, but only if trained dogs are used for exploration and harvesting can this potential be sustainably and ethically realized.

Pushpa and Purushothama (2012) conducted a survey on the biodiversity of mushrooms belonging to the class Basidiomycetes in Bangalore. The survey were conducted from June 2007 to November 2010 in eight different places which included scrub jungles and urban places in a around Bangalore.



A total number 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 commune* 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 there were 26 types found in both years.

Dwivedi *et al.* (2012) studied on the taxonomy and diversity of macro fungi in semi evergreen and moist deciduous forest of Amarkantak where more than 50 samples were collected which is situated in Madhya Pradesh in India.

Extensive surveys were conducted from July 2010 to September 2010, where collection, characterization, preservation and photo of macro fungal carried the genera like is *Agaricus*, *Amanita*, *Nyctalis*, *Russula*, *Boletus*, *Macrolapiota*, *Ganoderma* and *Termitomyces*. Out of 50 samples only 16 samples were identified up to species level. This preliminary study shows that the forest is very rich in mushroom diversity.

Bankole and Adekunle (2012) conducted an experiment on biodiversity of mushrooms in Lagos State, Nigeria as they collected in Lagos State for 12 months. The mushrooms collected included *Agaricus campestris*, *Coprinus comatus*, *Daldinia concentrica*, *Ganoderma adpersum*, *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.

Smith and Thiers (2011) reported that fruit bodies of the genus *Tylopilus* are encountered as large stout bolete mushrooms, which generally arise from the ground or occasionally from the wood. They have stout stipes, which do not have a ring. A keyfield character which distinguishes them from members of genus *Boletus* is the presence of their pink-tinged pores. It is a polyphyletic morphology that does not unite the *Tylopilus* species using traditional morphological characters.

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.

Karwa and Rai (2010) reported on the tapping into the edible fungi biodiversity of Melghat forest in Central India for occurrence of wild edible fungi and their prevalent favorable ecological factors in consecutive years in the months of June to February (2006-2008). A total of 153 species of mushrooms were recorded, collected, photographed and preserved.

The enormous biomass in the forest favors variety of edible and medicinal mushrooms. Dominating species belong to genera *Agaricus*, *Pleurotus*, *Termitomyces*, *Cantharellus*, *Ganoderma*, *Auricularia*, *Schizophyllum*, *Morchella*, etc.

Hanlon 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. When species records according to major taxonomic clades are examined, it is evident that under-recording of Agaricomycete species from the ROI is common throughout all of the clades.

Ram *et al.* (2010) conducted a field survey for collection of various edible fleshy fungi from different localities of the Eastern Uttar Pradesh forest. The collected edible fleshy fungi were studied for their macroscopic detail parenting the habit, habitat, morphology and other phenotypic parameter noted in fresh form.

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

Agrahar and Subbuakshmi (2005) conducted an experiment on Meghalaya mushrooms. The region in general is blessed with a rich forest growth, with about 0-50% of the geographical area covered with lush green forests. These forests abound in macro fungi which are found growing on the forest-floor, wigs and branches, rotting plat parts, in mycorrhizal association with higher plants, etc.

## **CHAPTER III**

### **MATERIALS AND METHODS**

#### **3.1 Experimental site**

Experiment was conducted at the Laboratory, Department of Plant Pathology (DPP), Sher-e-Bangla Agricultural University (SAU), Dhaka. The samples were collected from different mangrove forest regions of Bangladesh.

##### **3.1.1 Source of data and sampling procedure**

A systematic sampling procedure was used baseline survey. Four Upazilla belong to three districts of mangrove forest regions of Bangladesh were selected for conducting survey analysis on mushroom 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 mushroom in selected regions of Bangladesh.

#### **3.2 Collection of mushroom samples**

Detailed survey was carried out in 5 Upazilla of Khulna, Bagerhat and Satkhira districts of mangrove forest regions in Bangladesh from July to October, 2015, to record the morphological variability in the mushrooms population. The collection was made by method given by Hailing (1996). Spotted mushrooms were inspected in their natural habitats and brought to laboratory for detailed study. Photo-graphs were taken by means of a Sony Camera with power of 16 megapixels. The collected fleshy fungi 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. Collected mushroom was preserved as dried specimens in the Plant Pathology Laboratory of Sher-e-Bangla Agricultural University.

### **3.2.1 Collection site**

Collection site was four Upazilla of of Khulna, Bagerhat and Satkhira districts of Mangrove region of Bangladesh (Fig. :1and Table-1) located between 21°30'- 22°30'N, 89°12'-90°18'E which consists of three wildlife sanctuaries (Sundarbans West, East and South) lying on disjunct deltaic islands in the Sundarbans Forest Division of Khulna District. Collection site was mangrove forests region residential area, roadsides and nearby villages of Khulna, Bagerhat and Satkhira Districts. Minimum and maximum temperature was 27°C and 32.1°C. The average annual relative humidity was 70-84%. The dominant tree species of this area were Sundari (*Heritiera fomes*), Sisso (*Dalbergia sissoo*), Rain tree (*Samanea saman*), Mehogoni (*Swietenia macrophylla*), Coconut (*Cocos nucifera*) and Betal nut (*Areca catechu*). During rainy season, there is abundant growth of several kinds of mushroom. 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 four Upazilla in selected two districts.

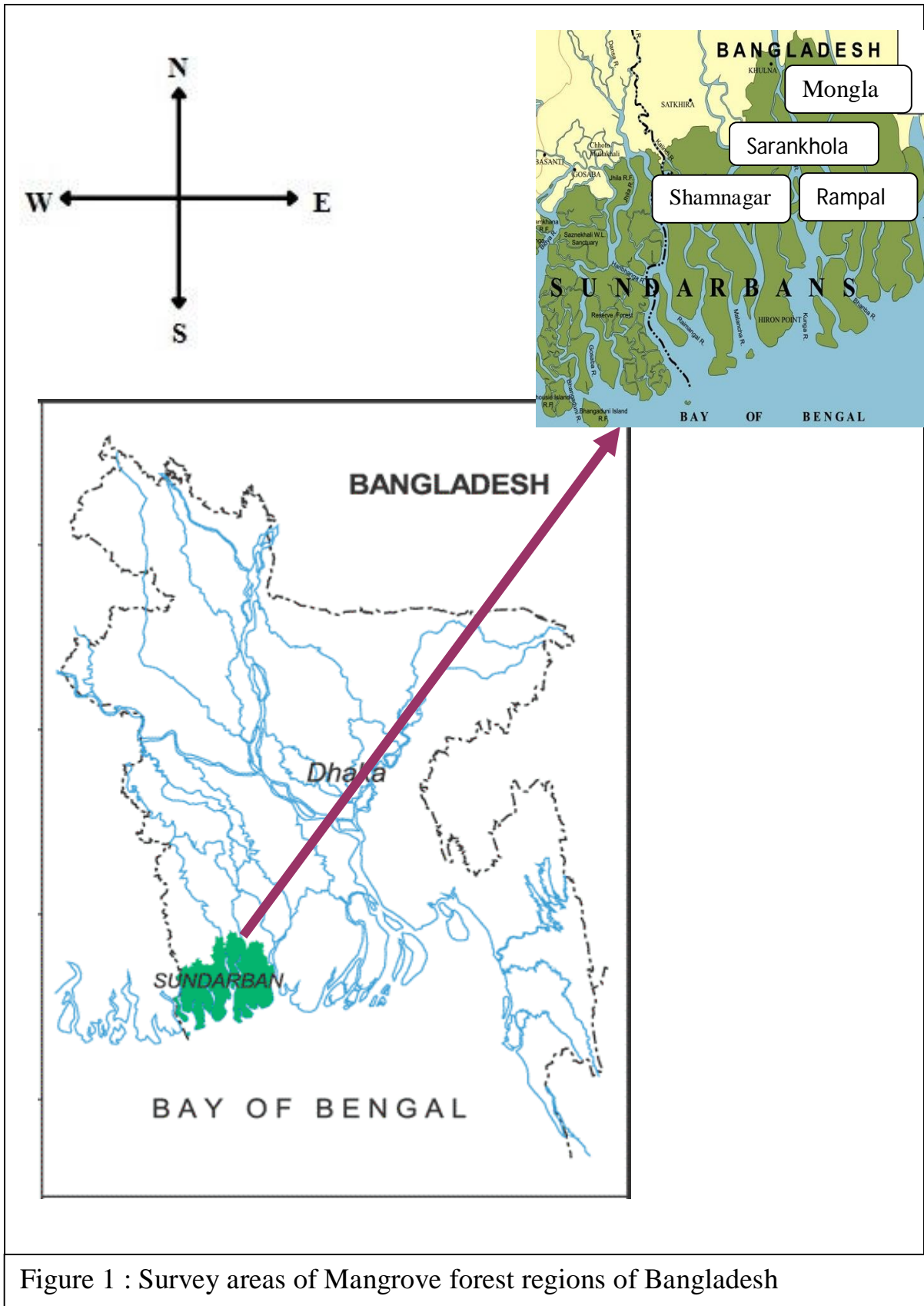


Figure 1 : Survey areas of Mangrove forest regions of Bangladesh

**Table -1 : Survey areas of Mangrove forest regions of Bangladesh**

Sl. No.	District(s)	Surveyed Upazilla(s)			
		Name of surveyed Upazilla(s)			Number of Upazilla
1.	Bagerhat	Mongla	Rampal	Sarankhola	3
2.	Satkhira	Shamnagar			1
Total	District = 2	Upazilla = 4			

### **3.3 Mushroom processing**

Freshly harvested mushroom was washed by water for removing debris. Fleshy mushroom is highly perishable as it is susceptible to deterioration by the enzyme and microorganism. It has been realized that merely fleshy collected mushroom is of no use unless these are properly preserved. During the analysis period some precautions were followed before processing of mushroom. 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 (Kim, 2004).

#### **3.3.1 Drying**

Collected 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 mushroom 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).



### **3.3.2 Storage**

Dried mushrooms were 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).

### **3.4 Morphological observation**

Data on the following parameters were recorded for identification of mushrooms 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 veil, 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 help of Motic Images Plus 2.0 software. Final identification and classification were done by comparing recorded characteristics of mushrooms with the color dictionary of mushroom given by Dickinson and Lucas (1982), the mushroom guide and followed by the reference of Jorden (2004) and Pegler and Spooner (1997).

#### **3.4.1 Morphological characterization procedures**

The basidiocarps were rehydrated by soaking in water for few minutes before analyzing their morphology. Qualitative characters such as color, shape, and presence of hymenia were evaluated by eye observation while texture was determined by feeling the back and top surfaces using fingers.

Most of the morphological data were recorded during collection period that is when the mushroom was in fresh form. 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.

### 3.5 Habitat, distribution and diversity analysis

The different forests are mixed type of 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 mushroom. Soil pH, soil moisture were measured by pH meter and air temperature by thermometer during collection period. Soil moisture is usually expressed in units termed pH. Collected samples were wrapped in polybag and brought to the *laboratory* for their further study. The frequency and density of different species has been determined by the following formulas (Zoberi, 1973).

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

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

## CHAPTER IV

### RESULTS AND DISCUSSION

#### 4.1 Morphology, habitat and biodiversity of *Agaricus* sp.

##### 4.1.1 *Agaricus campestris*

**Common name :** Field mushroom or meadow mushroom.

**Family :** Agaricaceae

##### **Morphology of *Agaricus campestris***

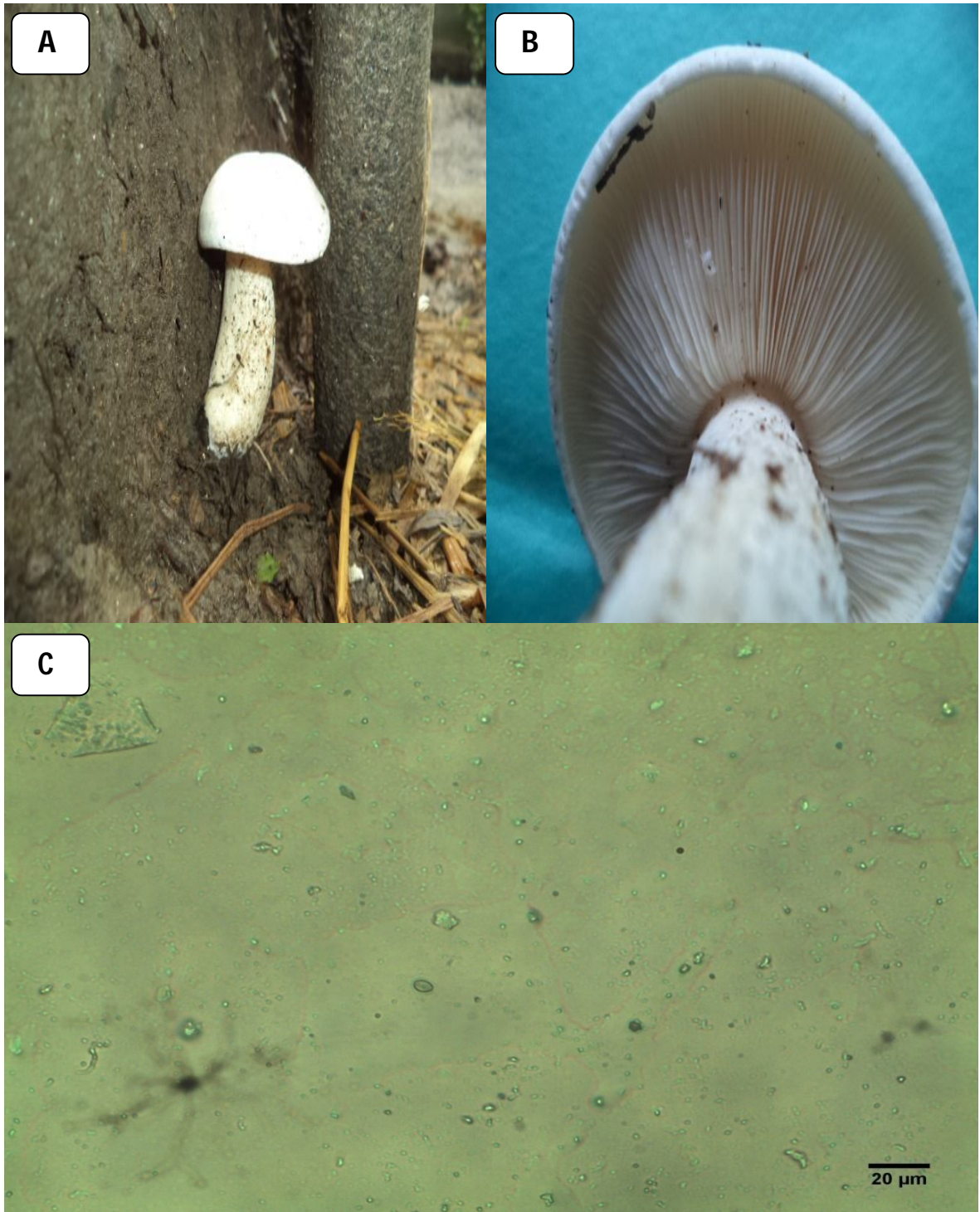
Average size of fructification was 6.7×8.5 cm. The color of pileus (cap) was white. The shape of cap was Convex. The cap edge was round smooth. Fleshy white Color scale was found on the cap. Beneath the cap hymenophores were absent. Regular shaped gills (lamellae) were present underside of the cap. The color of gills was white. Color of stipe was whitish. The average length and width of stipe was 4.6 cm and 2.6 cm respectively. Ring or anal was absent on the stipe and volva was absent on the lower part of the stipe. Spore color was brown, spore shaped were single walled, rough and irregular shaped and average spore size was 6.4 × 3.8 μm (Plate-1).

##### **Habitat of *Agaricus campestris***

The mushroom was found on the on soil and the forest type was mixed. The soil was loamy and moist in nature. Average Relative Humidity was 72%, soil pH was 6.7 and soil type was clay loam. Average recorded temperature was 31°C.

##### **Biodiversity of *Agaricus campestris***

*Agaricus campestris* was found Mongla, Rampal and Sarankhola of Bagerhat district. A total three number of mushrooms of *Agaricus campestris* were found during collection. The frequency of its presence was 50% and the density was 8.57%.



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

#### **4.1.2 *Agaricus xanthodermus***

**Common name :** Yellow-staining mushroom or simply the yellow-stainer.

**Family :** Agaricaceae

#### **Morphology of *Agaricus xanthodermus***

The average size of fructification was 11.2×5.9 cm. The color of pileus (cap) was white and creamy (Young). But mature pileus color was brown and creamy. The shape of cap was ovate and depressed shaped. The cap edge was round smooth. Fleshy white Color scale was found on the cap. Beneath the cap hymenophores were absent. Regular shaped gills (lamellae) were present underside of the cap. The color of gills was dark brown. Color of stipe was whitish and brownish. The length and width of stipe was 3.6-9.2 and 0.6-0.8cm, respectively. Ring or anal was absent on the stipe and volva was absent on the lower part of the stipe. Spore color was brown, spore shaped were single walled, smooth, regular and ellipsoidal shaped and average spore size was  $7.5 \times 3.5\mu\text{m}$  (Plate-2).

#### **Habitat of *Agaricus xanthodermus***

The mushroom was found on humus and soil surface. Average Relative Humidity was 84%, soil pH was 6.7 and soil type was sandy to clay loam. Average recorded temperature was 30°C.

#### **Biodiversity of *Agaricus xanthodermus***

*Agaricus xanthodermus* was found in Shamnagar of Satkhira district. A total 6 number of mushrooms of *Agaricus xanthodermus* were found during collection. The frequency of its presence was 25% and the density was 17.14%.



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

### **4.1.3 *Agaricus silvicola***

**Common name :** Wood mushroom

**Family :** Agaricaceae

#### **Morphology of *Agaricus silvicola***

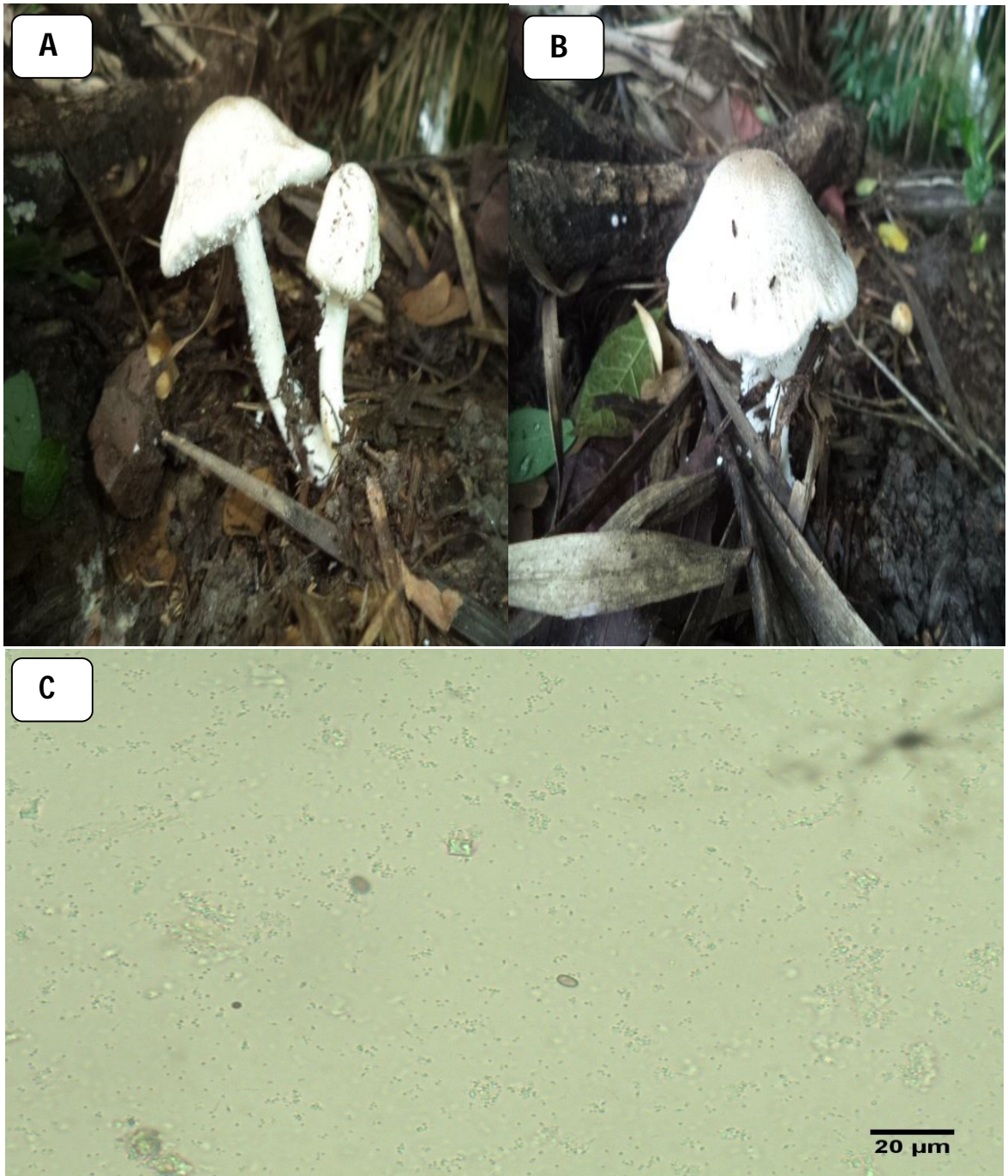
Average size of fructification was 7.3×3.2 cm. The color of pileus (cap) was white. The shape of cap was campanulate and ovate shaped. The cap edge was round smooth. Beneath the cap hymenophores were absent. Regular shaped gills (lamellae) were present underside of the cap. The color of gills was white. Color of stipe was whitish. The average length and width of stipe was 4.8 cm and 0.7cm, respectively. Ring or anal was absent on the stipe and volva was absent on the lower part of the stipe. Spore color was brown, spore shaped were single walled, smooth and oval shaped and average spore size was 7.4× 3.9 μm (Plate-3).

#### **Habitat of *Agaricus silvicola***

The mushroom was found on humus. Average Relative Humidity was 82%, soil pH was 6.7 and soil type was clay loam and sandy loam. Average recorded temperature was 31°C.

#### **Biodiversity of *Agaricus silvicola***

*Agaricus silvicola* was found in Mongla, Rampal, Sarankhola of Bagerhat district. A total four number of mushrooms of *Agaricus silvicola* were found during collection. The frequency of its presence was 25% and the density was 11.43%.



**PLATE-3:** *Agaricus silvicola* ; Mature fruiting body (A, B), Spores (C).



#### **4.1.4 *Agaricus aungustus***

**Common name :** The prince

**Family :** Agaricaceae

#### **Morphology of *Agaricus aungustus***

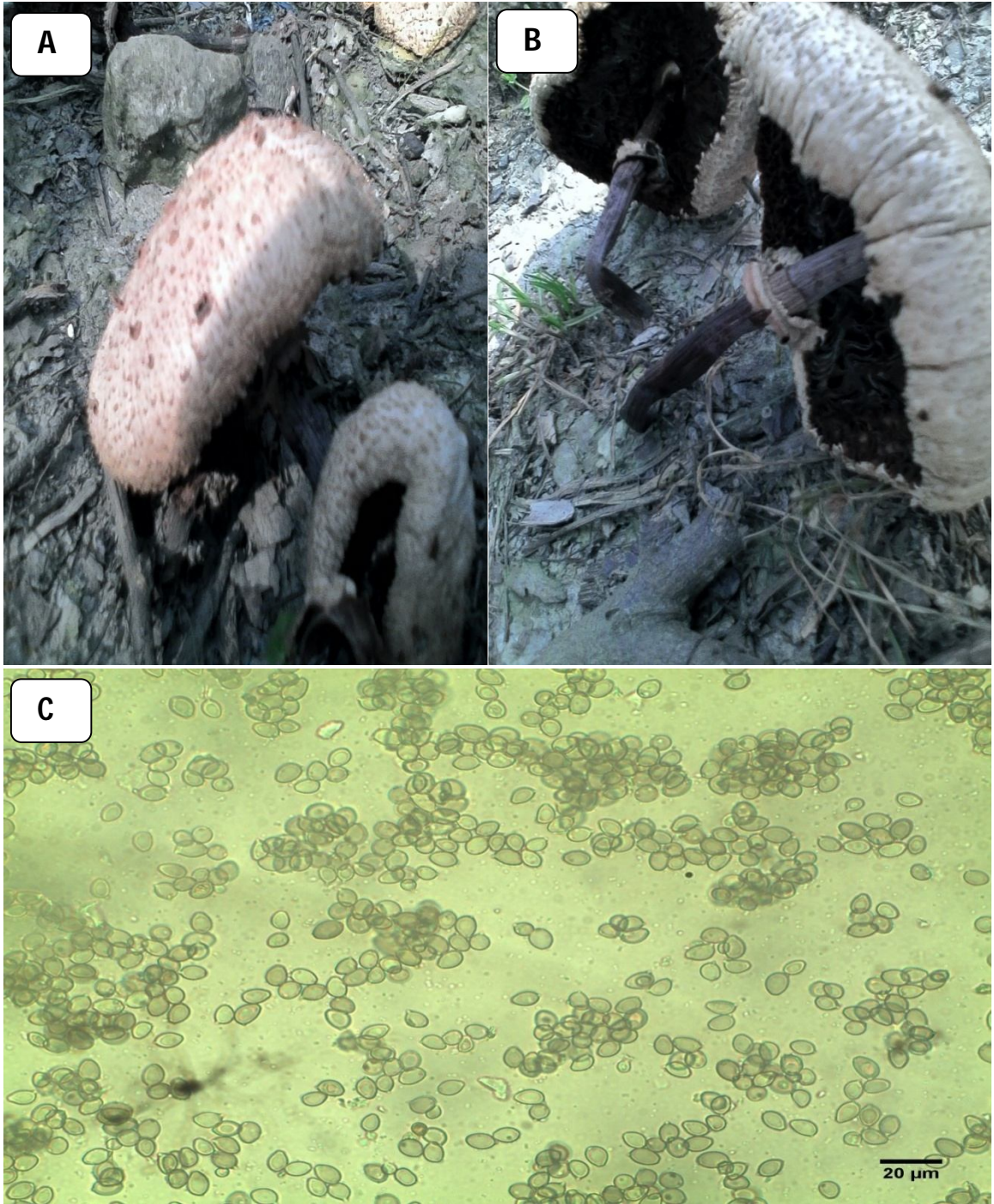
The average size of fructification was 13.2×7.1 cm. The color of pileus (cap) was brown. The shape of cap was convex. The cap edge was round appendiculate. Fleshy brown color scale was found on the cap. Beneath the cap hymenophores were absent. Regular shaped gills (lamellae) were present underside of the cap. The color of gills was black. Color of stipe was brownish. The length and width of stipe was 4 cm and 0.9 cm, respectively. Ring or anal was present on the stipe and volva was absent on the lower part of the stipe. Spore color was brown, spore shaped were single walled, smooth and irregular shaped and average spore size was  $10.3 \times 7.22 \mu\text{m}$  (Plate-4).

#### **Habitat of *Agaricus aungustus***

The mushroom was found on the soil surface. Average Relative Humidity was 80%, soil pH was 6.4 and soil type was sandy loam. Average recorded temperature was 32°C.

#### **Biodiversity of *Agaricus aungustus***

*Agaricus aungustus* was found in Mongla, Rampal, Sarankhola of Bagerhat district. A total eight number of mushrooms of *Agaricus aungustus* were found during collection. The frequency of its presence was 50% and the density was 22.86%.



**PLATE-4:** *Agaricus aungustus* ; Mature fruiting body (A), Gills (B), Spores (C).

#### **4.1.5 *Agaricus arvensis***

**Common Name :** Horse mushroom

**Family :** Agaricaceae

#### **Morphology of *Agaricus arvensis***

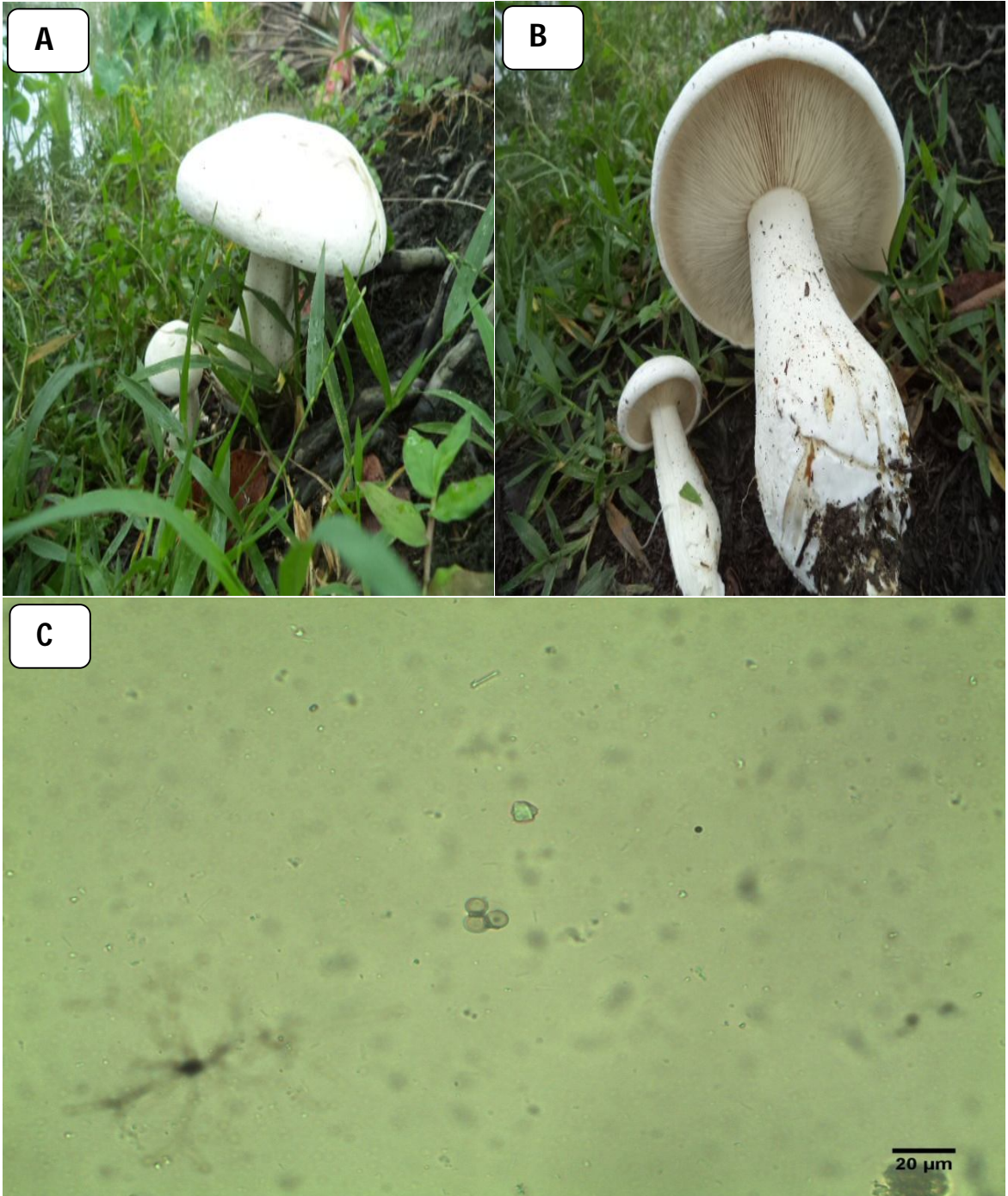
Size of fructification was 10.5 × 8.1cm. The color of pileus (cap) was white. The cap was convex shaped. The cap edge was round smooth. Beneath the cap hymenophores were absent. Regular shaped gills (lamellae) were present under the cap. The color of gills was white. Color of stipe was whitish. The average length and width of stipe was 8.2 cm and 2.1cm, respectively. Ring or anal was absent on the stipe and volva was absent on the lower part of the stipe. Spore color was brown, thick walled, rough and regular shaped and average spore size was 7.5× 7.1µm (Plate-5).

#### **Habitat of *Agaricus arvensis*.**

The mushroom was found on the on the root zone of Coconut (*Cocos nucifera*) tree. Average Relative Humidity was 84%, soil pH was 6.3 and soil type was sandy to sandy loam. Average recorded temperature was 29°C.

#### **Biodiversity of *Agaricus arvensis***

*Agaricus arvensis* was found in Shamnagar Upazilla of Satkhira district. A total two number of mushrooms of *Agaricus arvensis* were found during collection. The frequency of its presence was 25% and the density was 5.71%.



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

## **4.2 Morphology, habitat and biodiversity of *Coprinus* sp.**

### **4.2.1 *Coprinus silvaticus***

**Common name:** Erdei tintagomba

**Family:** Agaricaceae

#### **Morphology of *Coprinus silvaticus***

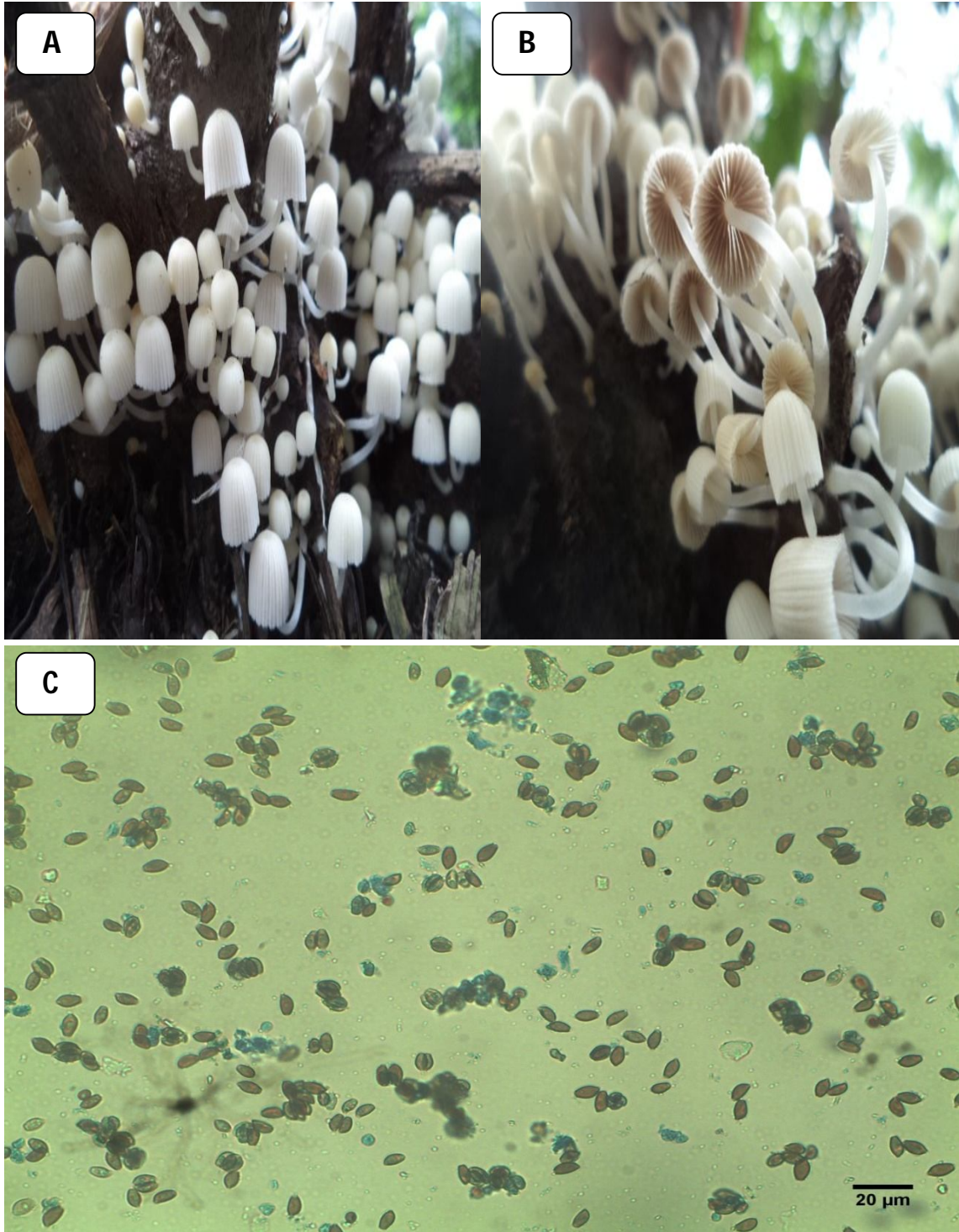
Average size of fructification was 2.4×0.8 cm. The color of pileus (cap) was white. The shape of cap was ovate. The cap edge was crenate. Surface characters and zonation of the cap was scaly. White color scale was found on the cap. Beneath the cap hymenophores were present. Regular shaped and white color gills (lamellae) were present underside of the cap. The stipe was white in color. The length and width of stipe was 2.6 cm and 0.2-0.3 cm respectively. Ring or anal was absent on the upper part of stipe and volva was absent on the lower part of stipe. Spore color was deep brown, single walled, smooth and irregular shaped. The spore size was 9.22× 4.92 μm (Plate-6).

#### **Habitat of *Coprinus silvaticus***

The mushroom was found on the on the root zone of burflower-tree (*Neolamarckia cadamba*). Average Relative Humidity was 79%, soil pH was 6.2 and soil type was clay. Average recorded temperature was 32°C.

#### **Biodiversity of *Coprinus silvaticus***

*Coprinus silvaticus* was found in Sarankhola of Bagerhat district. A total 92 number of mushrooms of *Coprinus silvaticus* were found during collection. The frequency of its presence was 50% and the density was 262.86%.



**PLATE-6:** *Coprinus silvaticus* ; Mature fruiting body (A), Gills (B), Spores (C).

### **4.3 Morphology, habitat and biodiversity of *Chlorophyllum* sp.**

#### **4.3.1 *Chlorophyllum molybdites***

**Common name :** False parasol or green-spored parasol

**Family :** Agaricaceae

#### **Morphology of *Chlorophyllum molybdites***

Size of fructification was 11.5×2.2 cm. The color of pileus (cap) was white and creamy. The shape of cap was campanulate (Bell-shaped) shaped. The cap edge was round smooth. Beneath the cap hymenophores were present. Regular shaped gills (lamellae) were present underside of the cap. The color of gills was black. Color of stipe was brownish. The length and width of stipe was 9.2 cm and 0.6 cm, respectively. Ring or anal was present on the stipe and volva was absent on the lower part of the stipe. But veil was present. Spore color was brown, spore shaped were single walled, smooth irregular and oval shaped. The average spore size was  $9.92 \times 7.26 \mu\text{m}$  (Plate-7).

#### **Habitat of *Chlorophyllum molybdites***

The mushroom was found on the on the root zone of Coconut (*Cocos nucifera*) tree. Average Relative Humidity was 83%, soil pH was 6.8 and soil type was clay loam to loam. Average recorded temperature was 31°C.

#### **Biodiversity of *Chlorophyllum molybdites***

*Chlorophyllum molybdites* was found in Shamnagar of Satkhira district. Only one number of mushroom of *Chlorophyllum molybdites* was found during collection. The frequency of its presence was 25% and the density was 2.86%.



**PLATE-7: *Chlorophyllum molybdites* ; Mature fruiting body (A,B), Spores (C).**



#### **4.4 Morphology, habitat and biodiversity of *Lepiota* sp.**

##### **4.4.1 *Lepiota* sp.**

**Family :** Agaricaceae

##### **Morphology of *Lepiota* sp.**

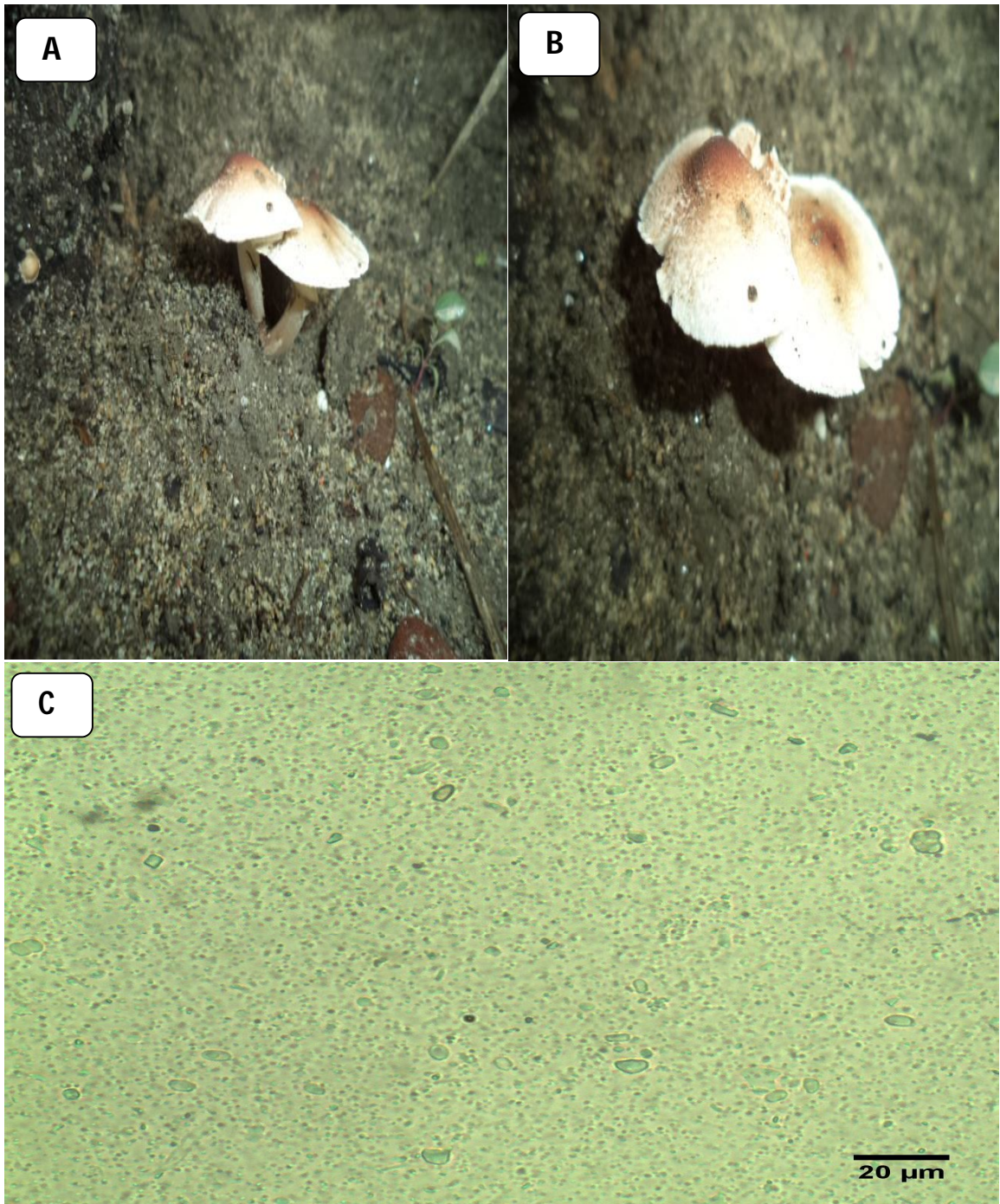
Average size of fructification was 2.6×1.4 cm. The color of pileus (cap) was white and creamy. The shape of cap was umbonate shaped. The cap edge was remose(cracked). Surface characters and zonation was glabrous. Beneath the cap hymenophores were absent. Regular shaped and tellowish white color gills (lamellae) were present underside of the cap. Color of stipe was whitish. The average length and width of stipe was 2.6 cm and 0.25 cm, respectively. Ring or anal was absent on the stipe and volva was absent on the lower part of the stipe. Spore color was brown, spore shaped were single walled, smooth and irregular shaped and average spore size was 6.28× 3.4 μm (Plate-8).

##### **Habitat of *Lepiota* sp.**

The mushroom was found on soil surface. Average Relative Humidity was 82%, soil pH was 6.8 and soil type was sandy to sandy loam. Average recorded temperature was 28°C.

##### **Biodiversity of *Lepiota* sp.**

*Lepiota* sp. was found in Mongla, Rampal and Sarankhola Upazilla of Bagerhat district. A total four number of mushrooms of *Lepiota* sp. were found during collection. The frequency of its presence was 25% and the density was 11.43%.



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

#### **4.4.2 *Lepiota atrodisca***

**Common name :** White-disc lepiota

**Family :** Agaricaceae

#### **Morphology of *Lepiota atrodisca***

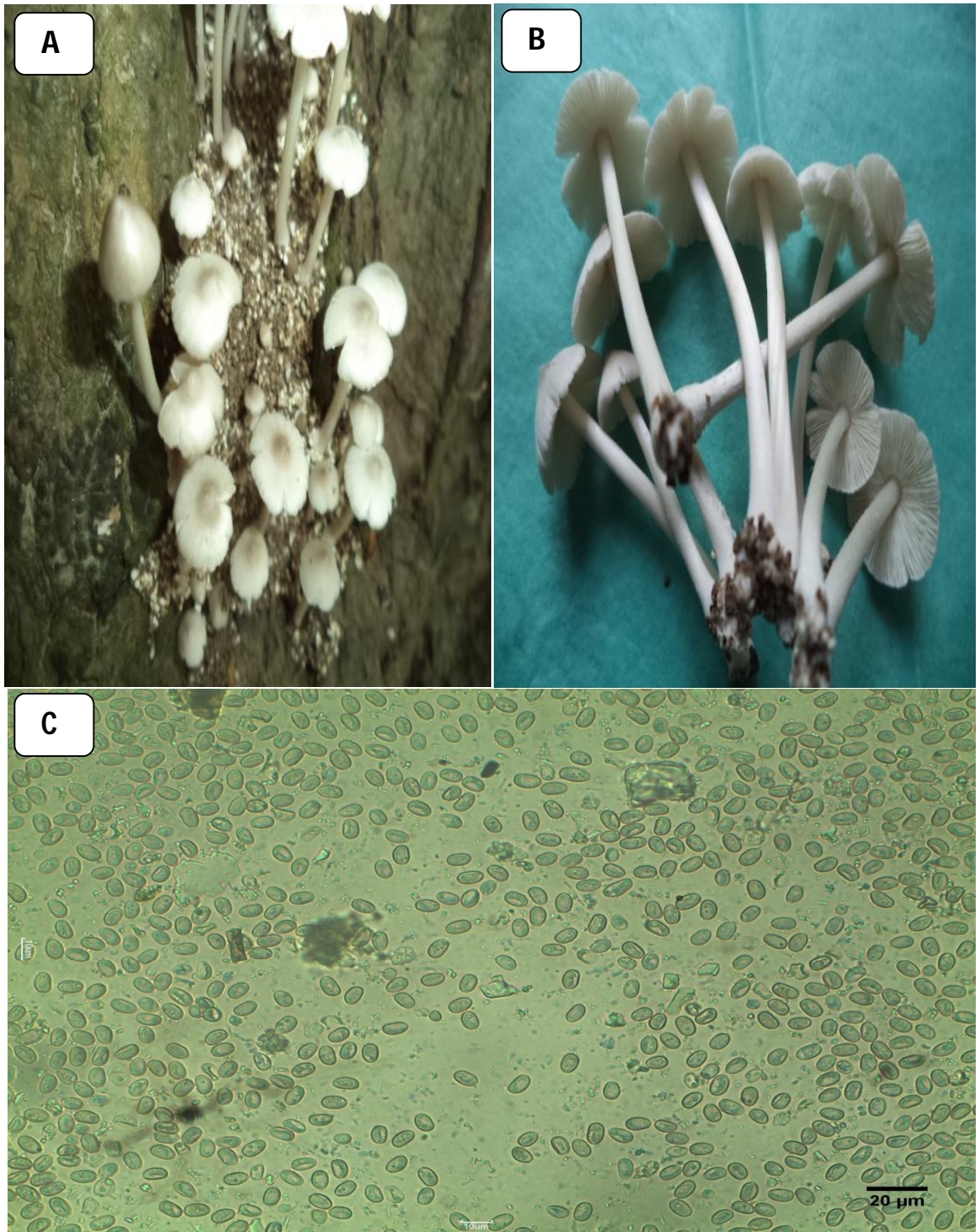
Average size of fructification was 2.6×1.1cm. The color of pileus (cap) was white. The shape of cap was convex and umbonate shaped. The cap edge was round cracked. Fleshy white Color scale was found on the cap. Beneath the cap hymenophores were present. Regular shaped gills (lamellae) were present underside of the cap. The color of gills was white. Color of stipe was whitish. The average length and width of stipe was 2.2 and 0.2 cm, respectively. Ring or anal was absent on the stipe and volva was absent on the lower part of the stipe. Spore color was white, spore shaped were single walled, smooth and irregular shaped and average spore size was  $8.78 \times 5.5 \mu\text{m}$  (Plate-9).

#### **Habitat of *Lepiota atrodisca***

The mushroom was found on the root zone of Sissoo (*Dalbergia sissoo*) tree. Average Relative Humidity was 82%, soil pH was 6.7 and soil type was sandy to sandy loam. Average recorded temperature was 28°C.

#### **Biodiversity of *Lepiota atrodisca***

*Lepiota atrodisca* was found in Mongla Upazilla of Bagerhat district. A total 26 number of mushrooms of *Lepiota atrodisca* were found during collection. The frequency of its presence was 50% and the density was 74.29%.



**PLATE-9:** *Lepiota atrodisca* ; Mature fruiting body (A), Gills (B), Spores (C).

## **4.5 Morphology, habitat and biodiversity of *Trametes* sp.**

### **4.5.1 *Trametes versicolor***

**Common name :** Turkey tail

**Family :** Polyporaceae

#### **Morphology of *Trametes versicolor***

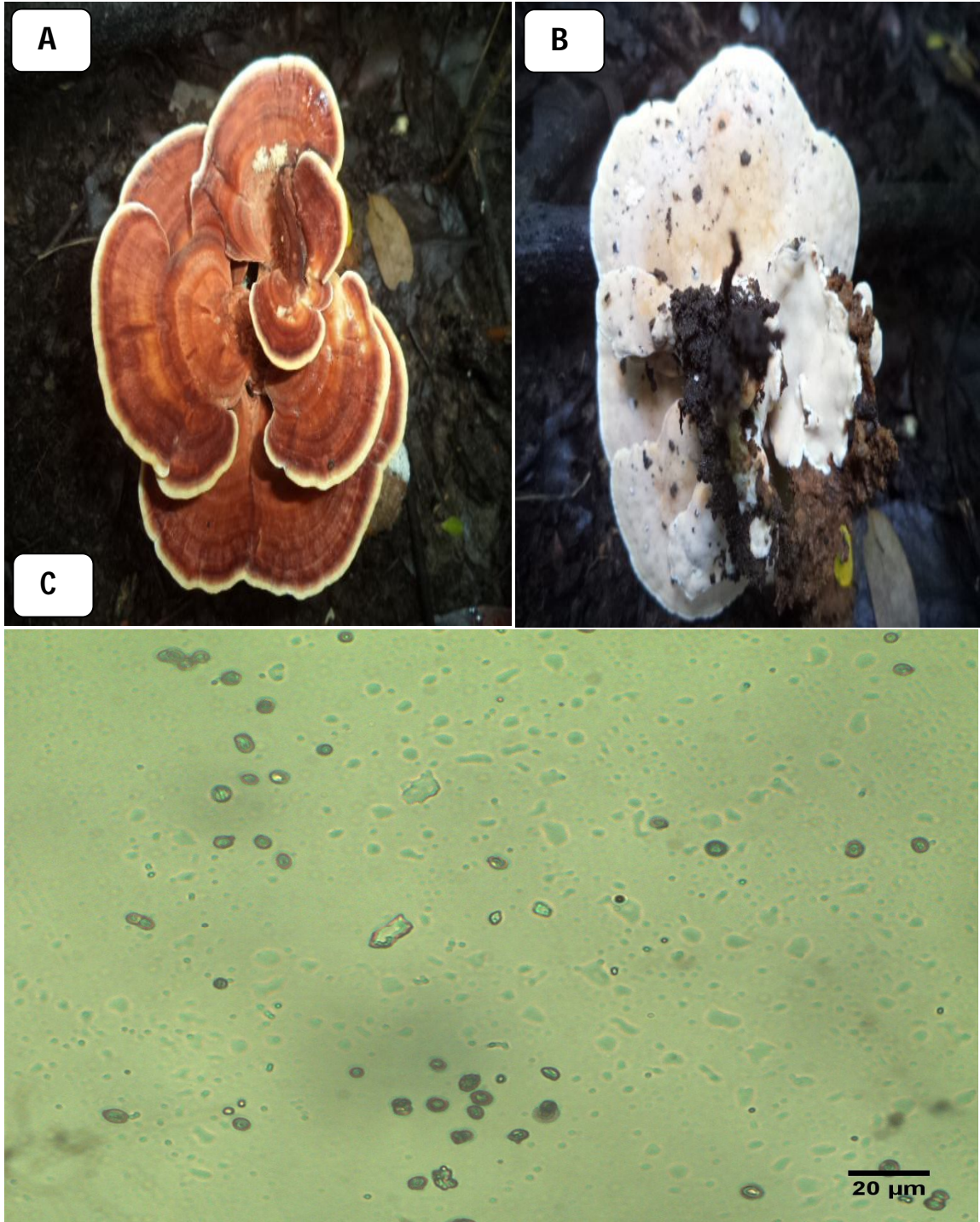
The size of fructification was 9.6×6.3 cm. The color of pileus (cap) was brick red and creamy. The shape of cap was convex and umbonate shaped. The cap edge was triangular or round. Beneath the cap hymenophores were absent. Regular shaped pores were present underside of the cap. The color of pore was white. The length and width of stipe was 8.2 and 6.8 cm, respectively. Spore color was brown, spore shaped were single walled, rough, irregular and oval shaped. The average spore size was 6.1 × 4.38 μm (Plate-10).

#### **Habitat of *Trametes versicolor***

The mushroom was found on the into the dead bark of Coconut (*Cocos nucifera*) tree. Average Relative Humidity was 81%, soil pH was 6.8 and soil type was clay loam. Average recorded temperature was 29°C.

#### **Biodiversity of *Trametes versicolor***

*Trametes versicolor* was found in Mongla Upazilla of Bagerhat district. Only one number of mushroom of *Trametes versicolor* were found during collection. The frequency of its presence was 25% and the density was 2.86%.



**PLATE-10:** *Trametes versicolor* ; Mature fruiting body (A), Pores (B), Spores (C).

#### **4.5.2 *Trametes* sp.**

**Family :** Polyporaceae

#### **Morphology of *Trametes* sp.**

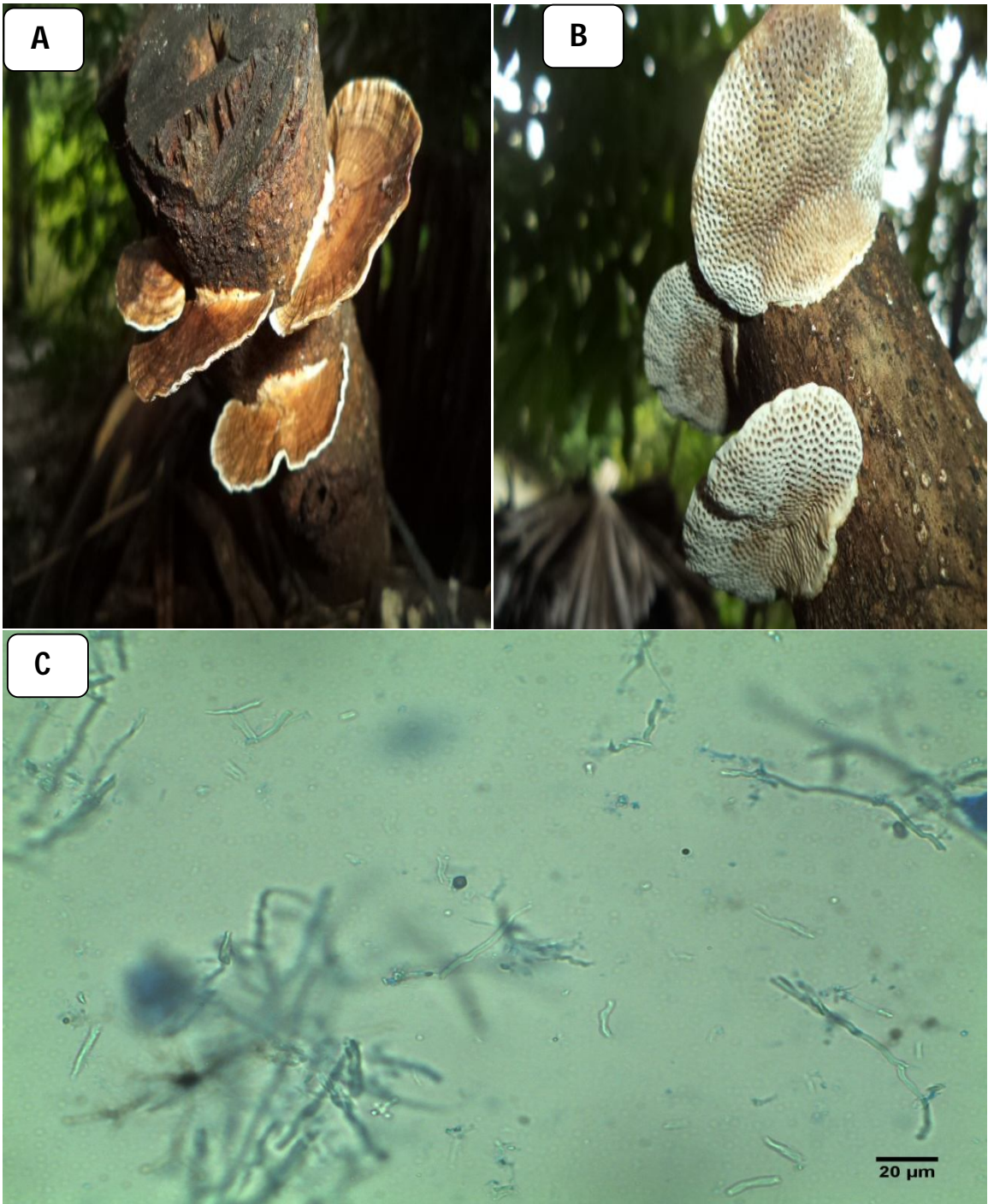
The average size of fructification was 2.3×3.7 cm. The color of pileus (cap) was brown and creamy. The shape of cap was hard and flat. The cap edge was undulating. Scale was found on the cap. Beneath the cap hymenophores were absent. Pores were present underside of the cap. Pseudostem present under the cap. Ring and volva was absent. The length and width of stipe was 0.5-1 cm and 0.3 cm, respectively. Ring or anal was absent. Spore color was dark brown, spore shaped were thick walled, round and spore size was 6.8 × 5 μm (Plate-11).

#### **Habitat of *Trametes* sp.**

The mushroom was found on the dead wood. Average Relative Humidity was 78%, soil pH was 6.5 and soil type was clay loam. Average recorded temperature was 31°C.

#### **Biodiversity of *Trametes* sp.**

*Trametes* sp. was found in Sarankhola and Shamnagar Upazilla of Bagerhat and Satkhira district, respectively. A total four number of mushrooms of *Trametes* sp. were found during collection. The frequency of its presence was 50% and the density was 11.43%.



**PLATE-11:** *Trametes* sp.; Mature fruiting body (A), Pores (B), Spores (C).



## **4.6 Morphology, habitat and biodiversity of *Tyromyces* sp.**

### **4.6.1 *Tyromyces lacteus***

**Family :** Polyporaceae

#### **Morphology of *Tyromyces lacteus***

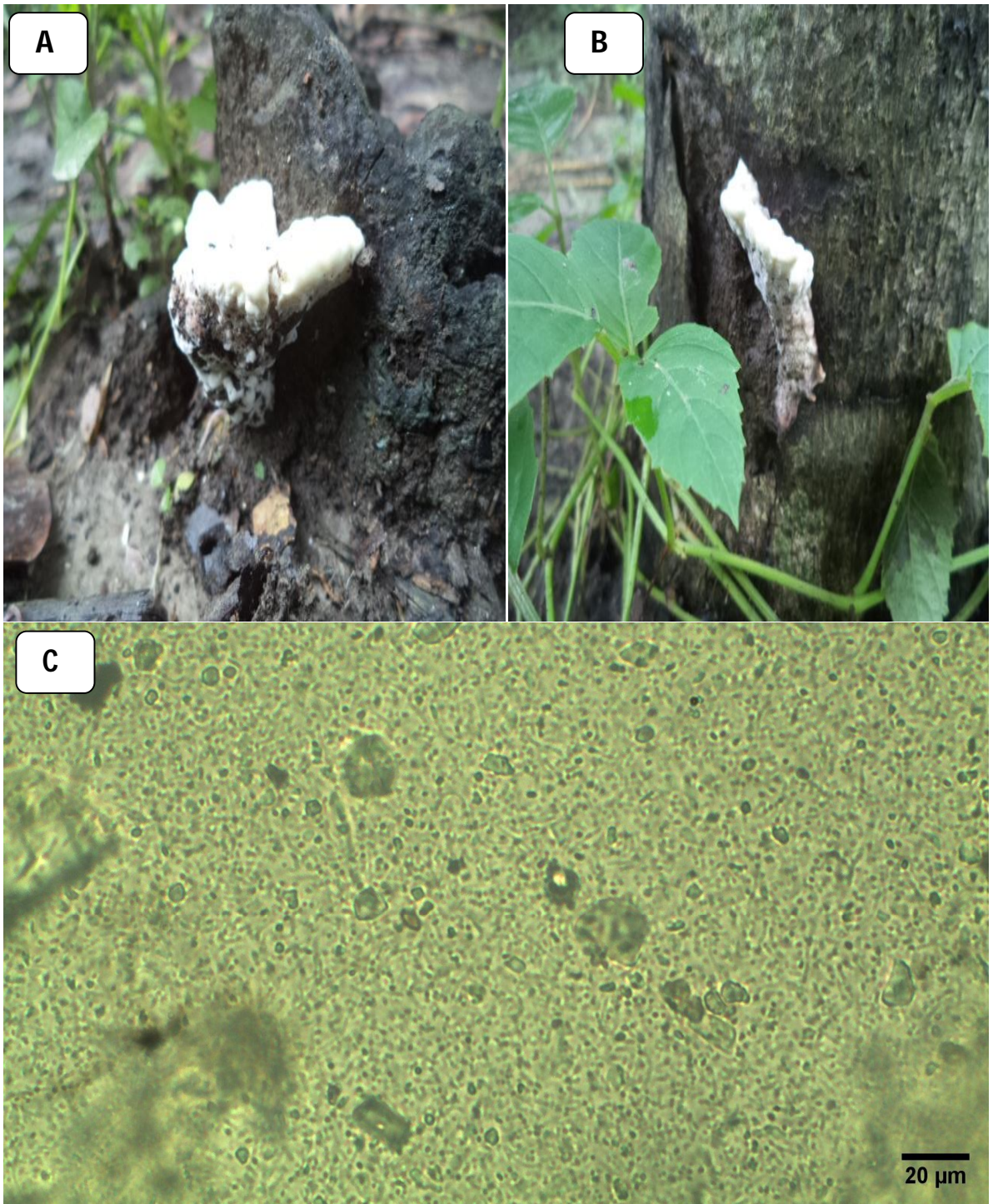
Size of fructification was 4.5×2.1 cm. The color of pileus (cap) was white. The shape of cap was irregular. Beneath the cap hymenophores were absent. Pores were present underside of the cap. The color of pores was white. The texture of the fruiting body was brittle and woody. Spore color was brown, spore shaped were thick walled, rough and ellipsoidal shaped and average spore size was 5.8 × 3.2 μm (Plate-12).

#### **Habitat of *Tyromyces lacteus***

The mushroom was found on the on the root zone of Coconut (*Cocos nucifera*) tree. Average Relative Humidity was 82%, soil pH was 6.8 and soil type was sandy to clay loam. Average recorded temperature was 29°C.

#### **Biodiversity of *Tyromyces lacteus***

*Tyromyces lacteus* was found in Mongla Upazilla of Bagerhat district. Only one number of mushroom of *Tyromyces lacteus* were found during collection. The frequency of its presence was 25% and the density was 2.86%.



**PLATE-12:** *Tyromyces lacteus* ; Mature fruiting body (A,B), Spores (C).

## **4.7 Morphology, habitat and biodiversity of *Daedaleopsis* sp.**

### **4.7 .1 *Daedaleopsis confragosa***

**Common name :** Thin walled maze polypore or the blushing bracket

**Family :** Polyporaceae

#### **Morphology of *Daedaleopsis confragosa***

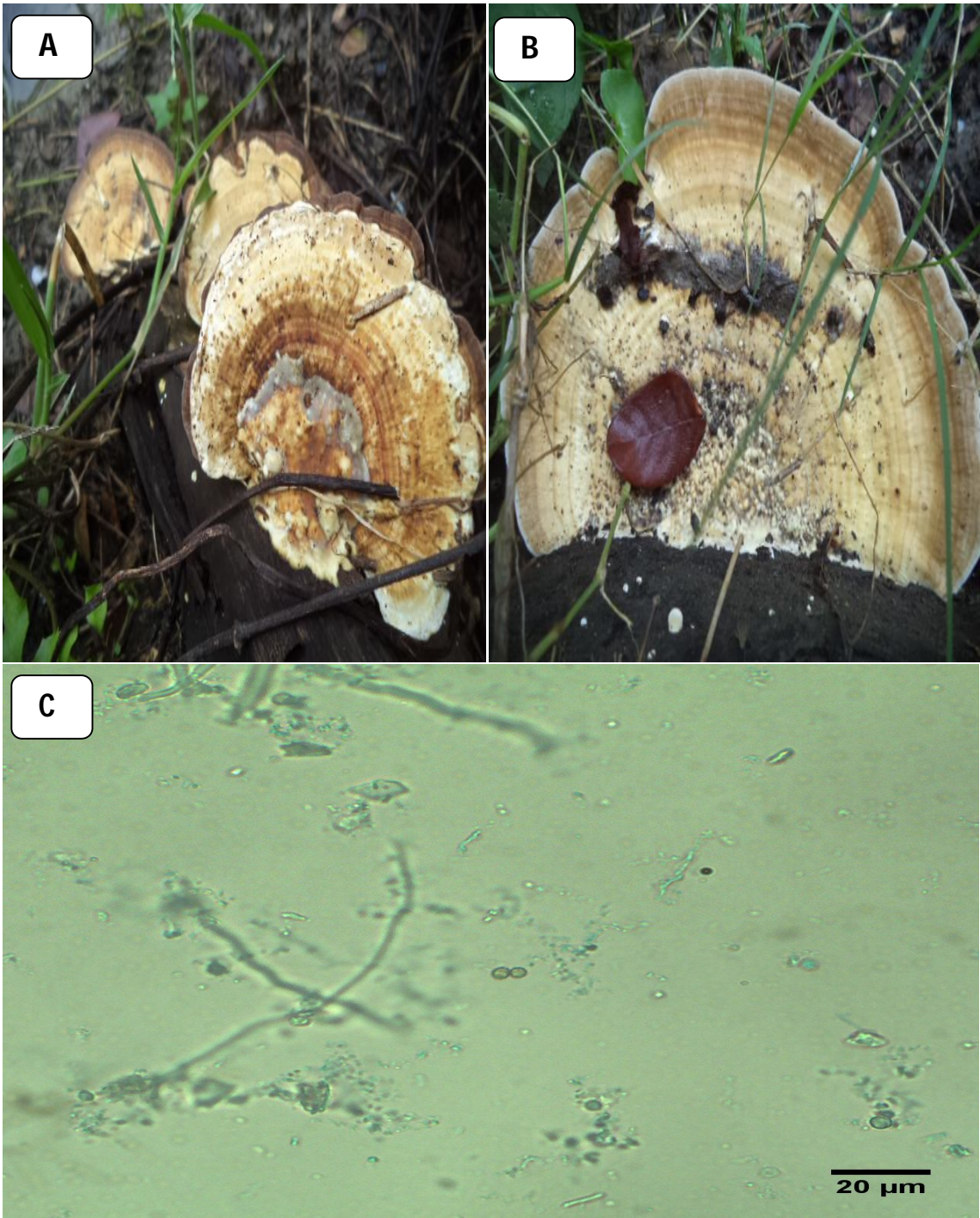
The average size of fructification was 10.4×16.1 cm. The color of pileus (cap) was yellow with white margin. The shape of cap was concave shaped. The cap edge was round wavy. Brown Color scale was found on the cap. The stipe was absent. Beneath the cap hymenophores were absent. Ring or anal was absent. The spore color was brown, single walled, rough and elongated shaped and average size was  $5.63 \times 4.13 \mu\text{m}$  (Plate-13).

#### **Habitat of *Daedaleopsis confragosa***

The mushroom was found into the dead bark of Coconut (*Cocos nucifera*) tree. Average Relative Humidity was 80%, soil pH was 6.8 and soil type was clay to clay loam. Average recorded temperature was 29°C.

#### **Biodiversity of *Daedaleopsis confragosa***

*Daedaleopsis confragosa* was found in Mongla and Sarankhola Upazilla of Bagerhat district. A total five number of mushrooms of *Daedaleopsis confragosa* were found during collection. The frequency of its presence was 50% and the density was 14.29%.



**PLATE-13:** *Daedaleopsis confragosa* ; Mature fruiting body (A,B), Spores (C).

## **4.8. Morphology, habitat and biodiversity of *Pycnoporus* sp.**

### **4.8.1 *Pycnoporus sanguineus***

**Common name :** Bracket fungi

**Family :** Polyporaceae

#### **Morphology of *Pycnoporus sanguineus***

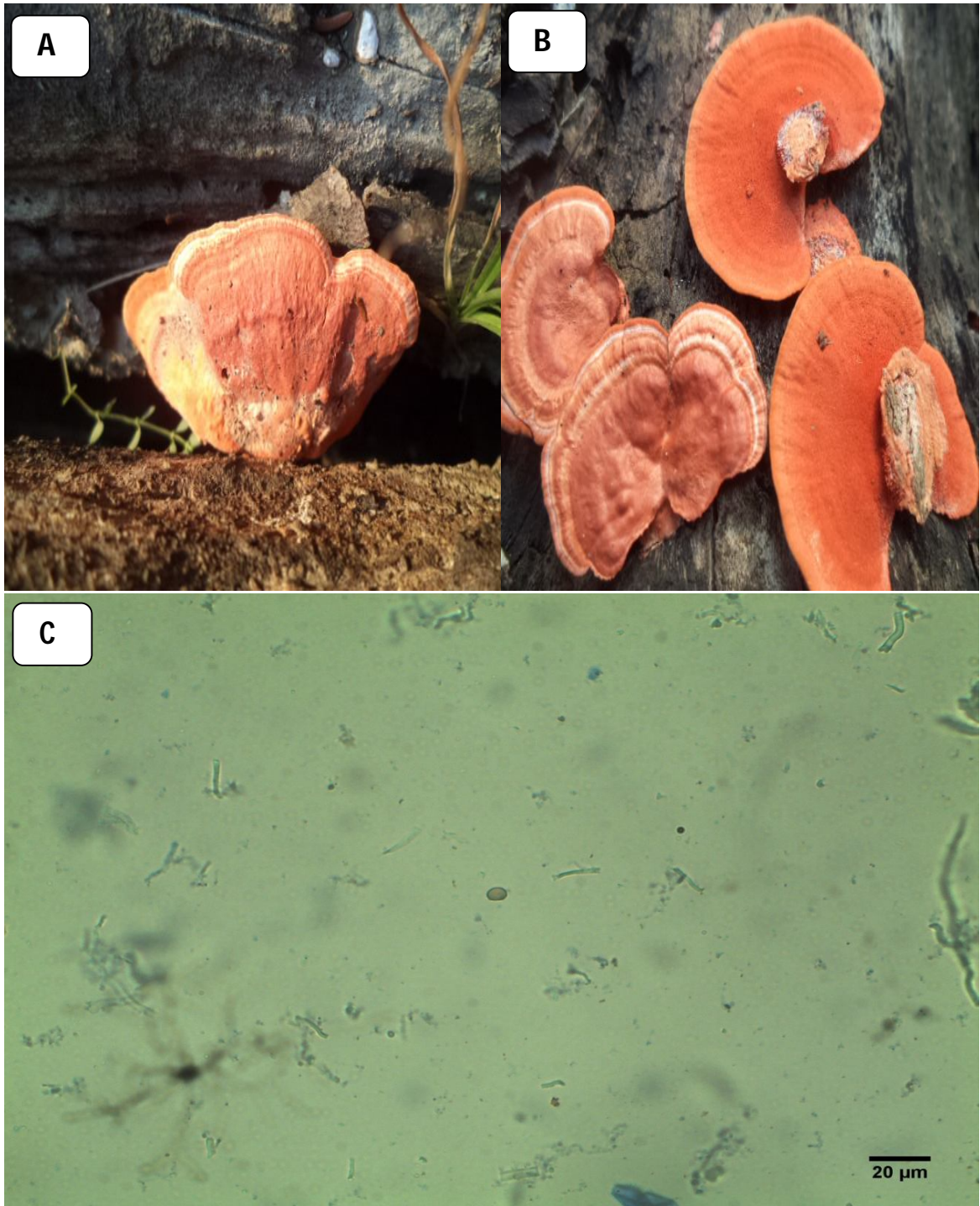
The average size of fructification was 3.2×6.1 cm. The color of pileus (cap) was red with white margin. The shape of cap was hard, concave and flat shaped. The cap edge was round smooth and wavy. Beneath the cap hymenophores were absent. Regular shaped gills (lamellae) were absent underside of the cap. Pores were present underside of the cap. The color of pores was red. Pseudostem was present under the cap. Ring or anal was absent. Spore color was brown and red, spore shaped were single walled, smooth, regular shaped and average spore size was  $7.4 \times 5.17 \mu\text{m}$  (Plate-14).

#### **Habitat of *Pycnoporus sanguineus***

The mushroom was found on the Sundari (*Heritiera fomes*) tree. Average Relative Humidity was 82%, soil pH was 6.5 and soil type was clay loam. Average recorded temperature was 32°C.

#### **Biodiversity of *Pycnoporus sanguineus***

*Pycnoporus* sp. was found in Mongla and Sarankhola Upazilla of Bagerhat district. A total eight number of mushrooms of *Pycnoporus* sp. were found during collection. The frequency of its presence was 50% and the density was 22.86%.



**PLATE-14:** *Pycnoporus sanguineus* ; Mature fruiting body (A), Pores (B), Spores (C).

## **4.9 Morphology, habitat and biodiversity of *Marasmius* sp.**

### **4.9.1 *Marasmius* sp.**

**Family :** Marasmiaceae

#### **Morphology of *Marasmius* sp.**

The average size of fructification was 3.6×2.2 cm. The color of pileus (cap) was light yellow. The shape of cap was sunken shaped. The cap edge was round and wavy. Fleshy yellow Color scale was found on the cap. Beneath the cap hymenophores were absent. Regular shaped ridges were present underside of the cap. The color of ridges was yellow. Color of stipe was yellowish and blackish . The average length and width of stipe was 1.1 and 0.3 cm, respectively. The texture of the fruiting body was soft and spongy. Spore color was brown, spore shaped were single walled, oval, irregular shaped and average spore size was 5.25 ×5.18 μm (Plate-15).

#### **Habitat of *Marasmius* sp.**

The mushroom was found on the dead stem of Sissoo (*Dalbergia sissoo*) tree. Average Relative Humidity was 79%, soil pH was 6.8 and soil type was sand and clay loam. Average recorded temperature was 29°C.

#### **Biodiversity of *Marasmius* sp.**

*Marasmius* sp. was found in Mongla Upazilla of Bagerhat district. A total eighteen number of mushrooms of *Marasmius* sp. were found during collection. The frequency of its presence was 25% and the density was 51.43%.



**PLATE-15:** *Marasmius* sp.; Mature fruiting body (A), Ridges (B), Spores (C).



#### **4.9.2 *Marasmius siccus***

**Common name :** Orange Pinwheel Marasmius

**Family :** Marasmiaceae

#### **Morphology of *Marasmius siccus***

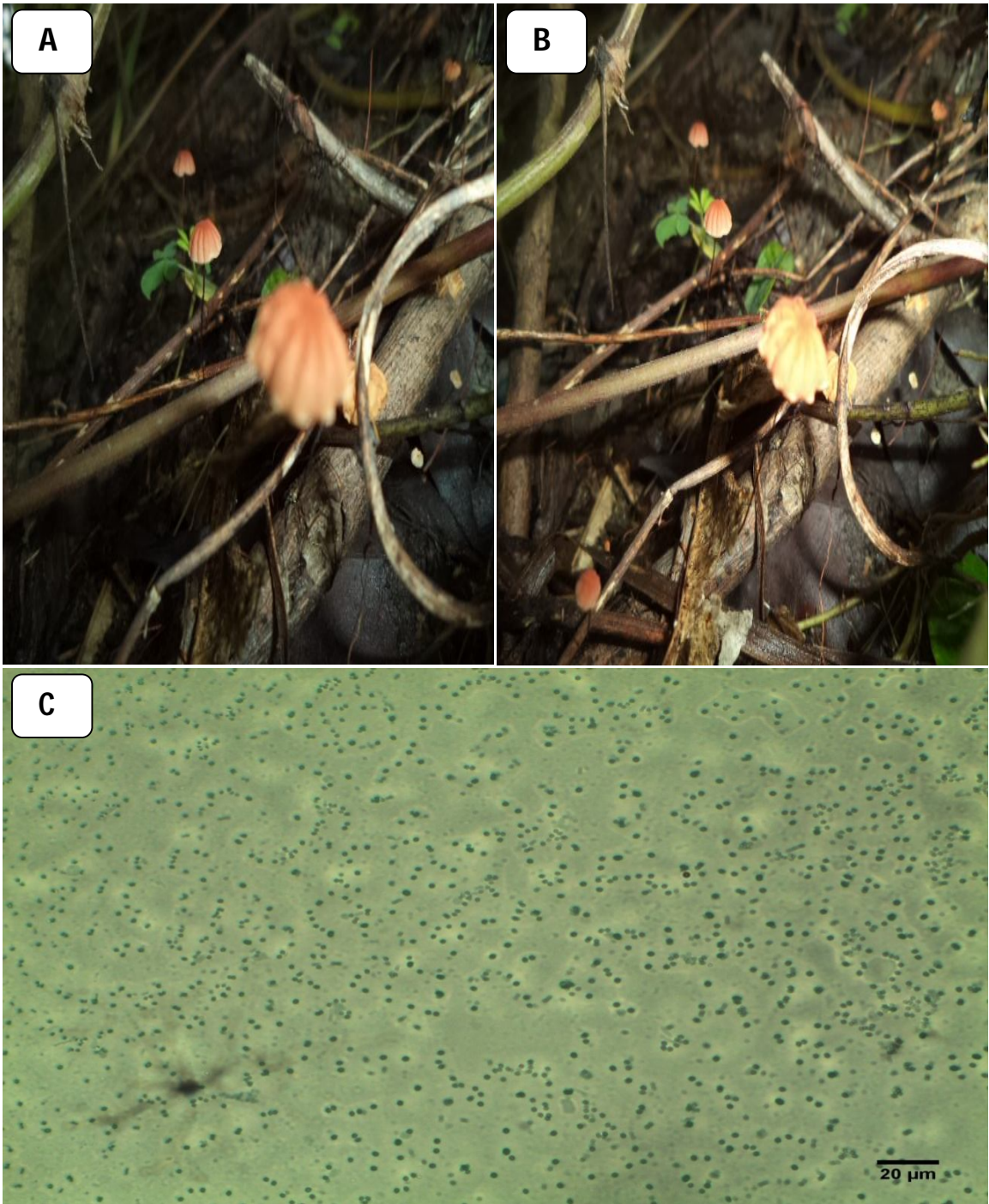
Size of fructification was 3.8×1.2 cm. The color of pileus (cap) was brick red. The shape of cap was ovate shaped. The cap edge was crenate. Fleshy red color scale was found on the cap. Beneath the cap hymenophores were absent. Regular shaped gills (lamellae) were present underside of the cap. The color of gills was white. Color of stipe was dark brownish. The average length of stipe was 2.6 cm and 0.1 cm, respectively. Ring or anal was absent on the stipe and volva was absent on the lower part of the stipe. Spore color was black, spore shaped were single walled, rough and irregular shaped and spore size was 2.5 × 2.3 μm (Plate-16).

#### **Habitat of *Marasmius siccus***

The mushroom was found on the bark of tree. Average Relative Humidity was 81%, soil pH was 6.5 and soil type was clay loam. Average recorded temperature was 28°C.

#### **Biodiversity of *Marasmius siccus***

*Marasmius siccus* was found in Mongla and Rampal Upazilla of Bagerhat district. A total six number of mushrooms of *Marasmius siccus* were found during collection. The frequency of its presence was 50% and the density was 17.14%.



**PLATE-16:** *Marasmius siccus* ; Mature fruiting body (A, B), Spores (C).

## **4.10 Morphology, habitat and biodiversity of *Marasmiellus sp***

### **4.10.1 *Marasmiellus albuscorticis***

**Family :** Marasmiaceae

#### **Morphology of *Marasmiellus albuscorticis***

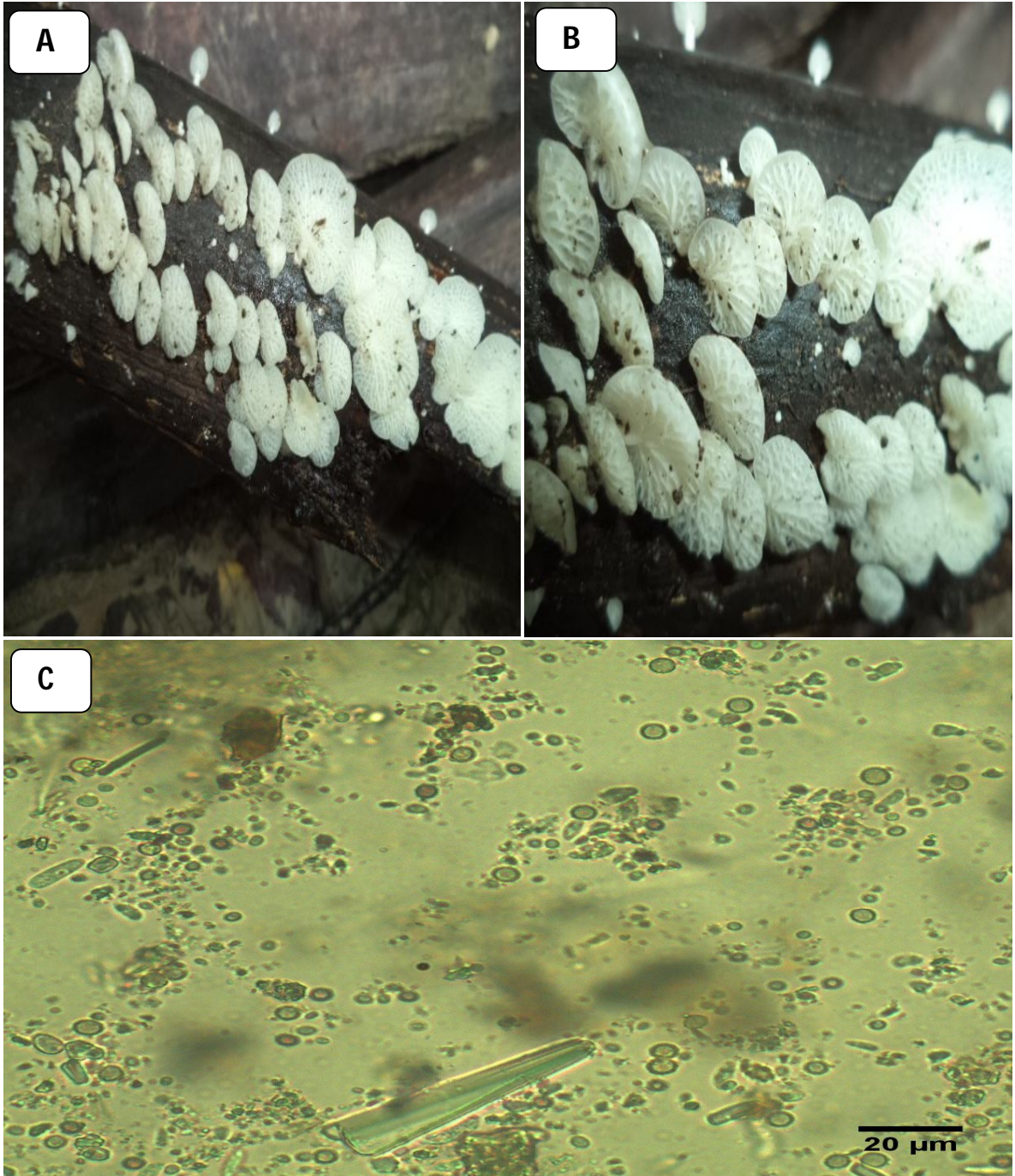
The average size of fructification was 1.4×1.8 cm. The color of pileus (cap) was white. The shape of cap was concave and flat shaped. The cap edge was round and wavy. Fleshy white color scale was found on the cap. Beneath the cap hymenophores were absent. Regular shaped ridges (lamellae) were present underside of the cap. The color of ridges was white. Ring or anal was absent on the stipe and volva was absent on the lower part of the stipe. The texture of the fruiting body was spongy. Spore color was brown, thick walled, round and irregular shaped and average spore size was  $5.58 \times 5.3\mu\text{m}$  (Plate-17).

#### **Habitat of *Marasmiellus albuscorticis***

The mushroom was found on the dead leaf of coconut (*Cocos nucifera*) tree. Average Relative Humidity was 84%, soil pH was 6.4 and soil type was clay loam. Average recorded temperature was 27°C.

#### **Biodiversity of *Marasmiellus albuscorticis***

*Marasmiellus albuscorticis* was found in Mongla, Rampal and Sarankhola Upazilla of Bagerhat district. A total thirty four number of mushrooms of *Marasmiellus albuscorticis* were found during collection. The frequency of its presence was 75% and the density was 97.14%.



**PLATE-17:** *Marasmiellus albuscorticis* ; Mature fruiting body (A), Ridges (B), Spores (C).

#### **4.11 Morphology, habitat and biodiversity of *Schizophyllum* sp.**

##### **4.11.1 *Schizophyllum* sp.**

**Common name :** Split gill

**Family :** Schizophyllaceae

##### **Morphology of *Schizophyllum* sp.**

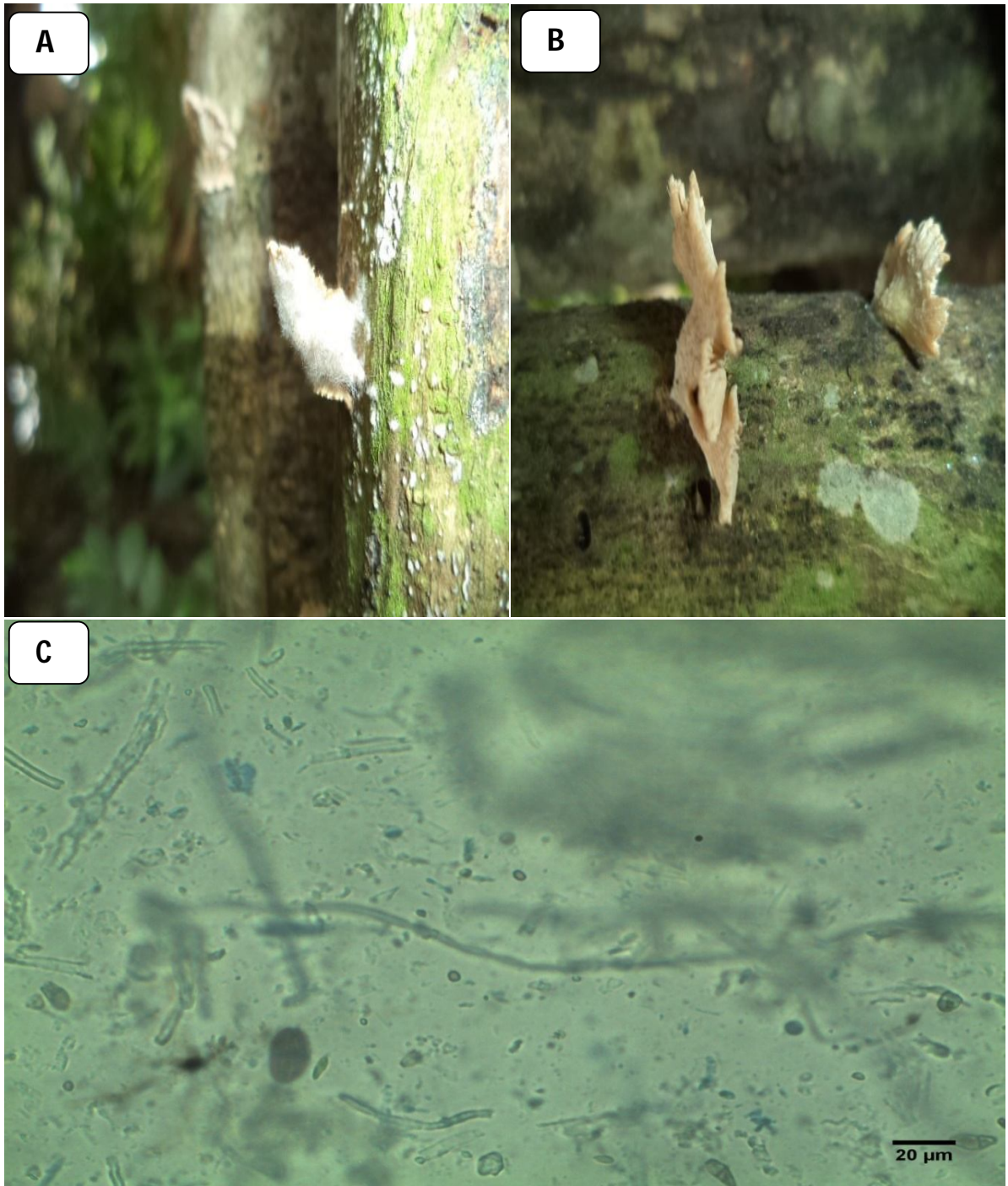
Average size of fructification was 1.3×1.6 cm. The color of pileus (cap) was Grey. The shape of cap was flat and infundibuliform shaped. The cap edge was incurve and crenate. Beneth the cap hymenophores were absent. Regular shaped gills (lamellae) were present underside of the cap. The color of gills was light brown. The surface characters and zonation was leathery. The texture of the fruiting body was spongy and hairy. Spore color was brown, spore shaped were single walled, rough and irregular shaped and average spore size was 5 × 4.1µm (Plate-18).

##### **Habitat of *Schizophyllum* sp.**

The mushroom was found on the bark of Sissoo (*Dalbergia sissoo*) tree. Average Relative Humidity was 78%, soil pH was 6.3 and soil type was sandy to sandy loam. Average recorded temperature was 29°C.

##### **Biodiversity of *Schizophyllum* sp.**

*Schizophyllum* sp. was found in Rampal Upazilla of Bagerhat district and Shamnagar Upazilla of Satkhira district. A total seventeen number of mushrooms of *Schizophyllum* sp. were found during collection. The frequency of its presence was 50% and the density was 48.57%.



**PLATE-18:** *Schizophyllum* sp. ; Mature fruiting body (A), Ridges (B), Spores(C).

#### **4.11.2 *Schizophyllum commune***

**Common name :** Split gill

**Family :** Schizophyllaceae

#### **Morphology of *Schizophyllum commune***

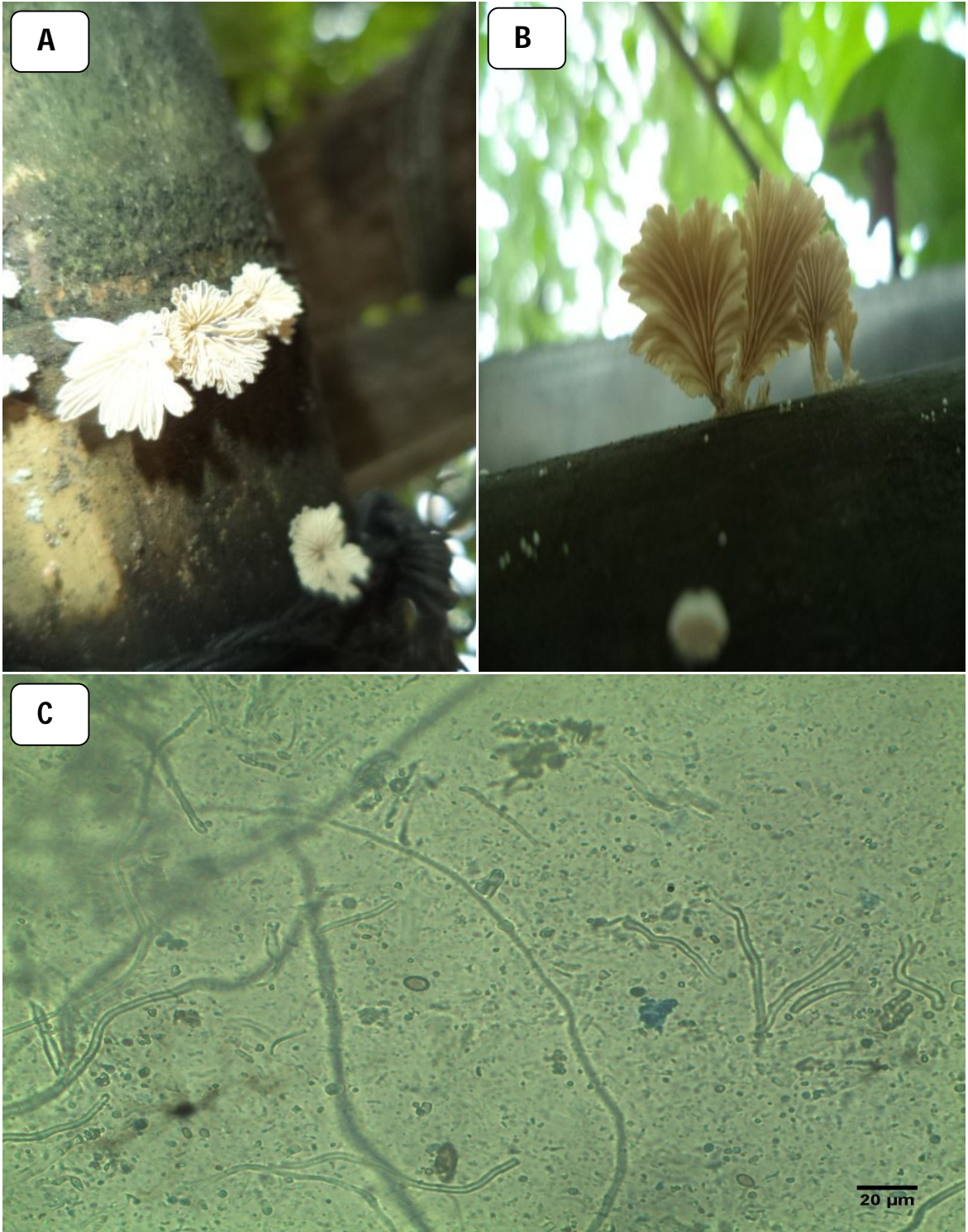
Average size of fructification was  $1.2 \times 0.7$  cm. The color of pileus (cap) was light brown. Beneath the cap hymenophores were absent. Regular shaped gills (lamellae) were present underside of the cap. The color of gills was slightly brown. Ring or anal was absent on the stipe and volva was absent on the lower part of the stipe. Spore color was brown, spore shaped were single walled, ellipsoidal, rough, irregular shaped and average spore size was  $7.03 \times 4.86 \mu\text{m}$  (Plate-19).

#### **Habitat of *Schizophyllum commune***

The mushroom was found on the common bamboo (*Bambusa vulgaris*) tree. Average Relative Humidity was 78%, soil **pH** was 6.2 and soil type was clay loam. Average recorded temperature was 28°C.

#### **Biodiversity of *Schizophyllum commune***

*Schizophyllum commune* was found in Rampal Upazilla of Bagerhat and Shamnagar Upazilla of Satkhira district. A total 13 number of mushrooms of *Schizophyllum commune* was found during collection. The frequency of its presence was 50% and the density was 37.14%.



**PLATE-19:** *Schizophyllum commune* ; Mature fruiting body (A), Gills (B), Spores (C).



## **4.12 Morphology, habitat and biodiversity of *Volvariella* sp.**

### **4.12.1 *Volvariella hypopithys***

**Family:** Pluteaceae

#### **Morphology of *Volvariella hypopithys***

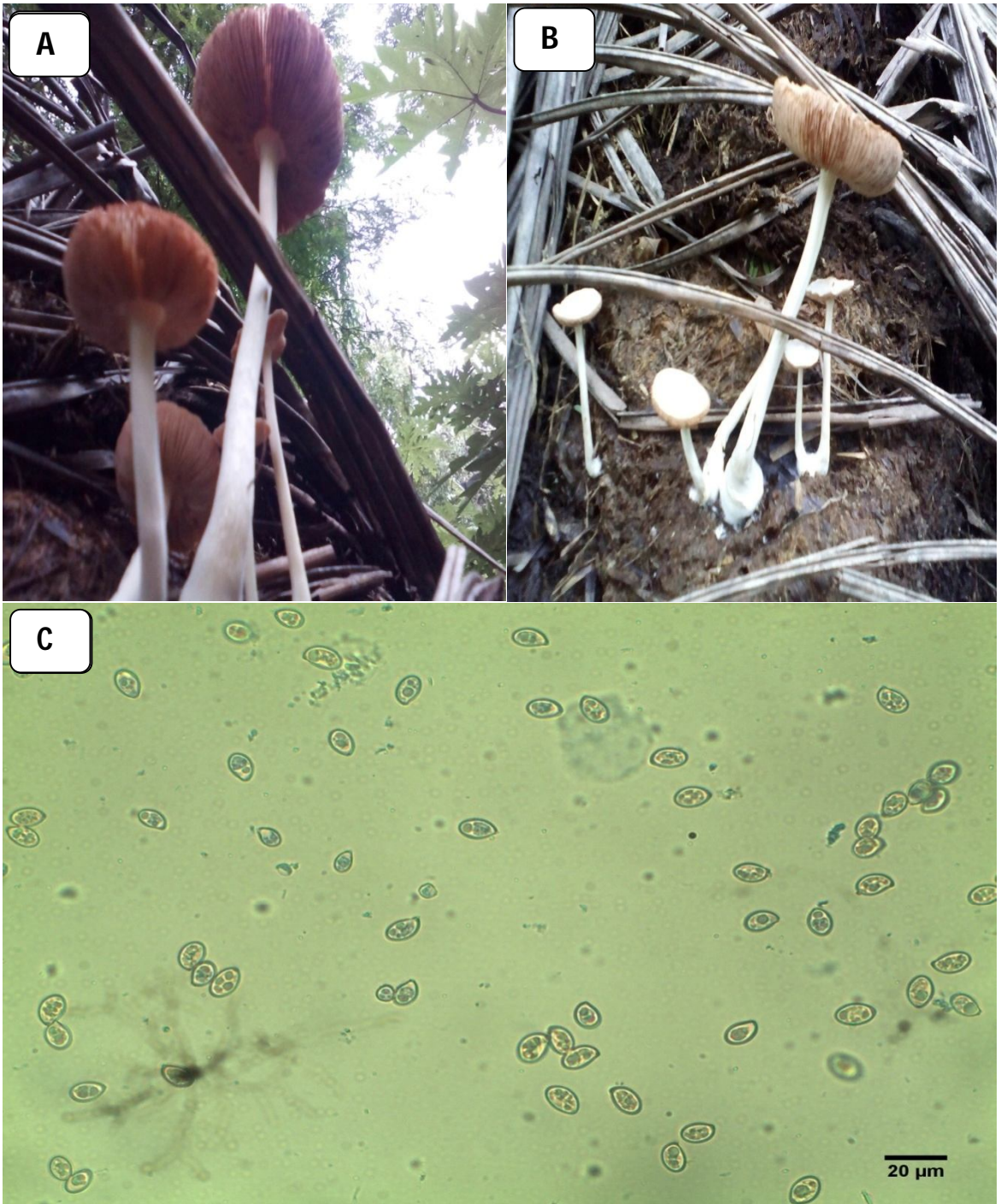
The average size of fructification was 13.1×3.6 cm. The color of pileus (cap) was brown. The shape of cap was depressed and umbonate. The cap edge was round and striate. White color scale was found on the cap. Beneath the cap hymenophores were present. Regular shaped gills (lamellae) were present underside of the cap. The color of gills were light brown. The color of stipe was white color. The average length and width of stipe was 10.4 and 1.2 cm, respectively. Ring or anal was absent on the upper part of stipe and volva was present on the lower part of stipe. Spore color was light brown, spore shaped were single walled, smooth and ellipsoidal and average spore size was 12.38 × 7.6 μm (Plate -20).

#### **Habitat of *Volvariella hypopithys***

The mushroom was found on the straw of rice (*Oryza sativa*) plants. Average Relative Humidity was 83%, soil pH was 6.2 and soil type was clay. Average recorded temperature was 28°C.

#### **Biodiversity of *Volvariella hypopithys***

*Volvariella hypopithys* was found in in Mongla and Sarankhola Upazilla of Bagerhat disdriect. A total 6 number of mushrooms of *Volvariella hypopithys* were found during collection. The frequency of its presence was 50% and the density was 17.14%.



**PLATE-20:** *Volvariella hypopithys* ; Mature fruiting body (A), Gills (B), Spores (C).

#### **4.12.2 *Volvariella speciosa***

**Common name:** Stubble Rosegill

**Family:** Pluteaceae

#### **Morphology of *Volvariella speciosa***

Average size of fructification  $3.2 \times 1.4$  cm. The color of pileus (cap) was brown and creamy. The shape of cap was flat. The cap edge was smooth and striate. Cream color scale was found on the cap. Beneath the cap hymenophores were present. Regular shaped gills (lamellae) were present underside of the cap. The color of gills was brown. Color of stipe was reddish to whitish. The length and width of stipe was 3.1 and 0.2 cm, respectively. Ring or anal was absent on the stipe and volva was absent on the lower part of the stipe. Spore color was light brown and light red, spore was thick wall, ellipsoidal shaped and average spore size was  $7.96 \times 5.56$   $\mu\text{m}$  (Plate-21).

#### **Habitat of *Volvariella speciosa***

The mushroom was found on the natural humus of the forest. Forest type was Mangrove. Average Relative Humidity was 83% , soil pH was 7.0 and soil type was clay loam. Average temperature was recored 29.5°C during collection.

#### **Biodiversity of *Volvariella speciosa***

*Volvariella speciosa* was found in Mongla, Rampal and Sarankhola Upazilla of Bagerhat district. A total four number of mushrooms of *Volvariella speciosa* were found during collection The frequency of its presence was 75% and the density was 11.43%.



**PLATE-21:** *Volvariella speciosa*; Mature fruiting body (A), Gills (B), Spores (C).

## **4.13 Morphology, habitat and biodiversity of *Ganoderma* sp.**

### **4.13.1 *Ganoderma praelongum***

**Family :** Ganodermataceae

#### **Morphology of *Ganoderma praelongum***

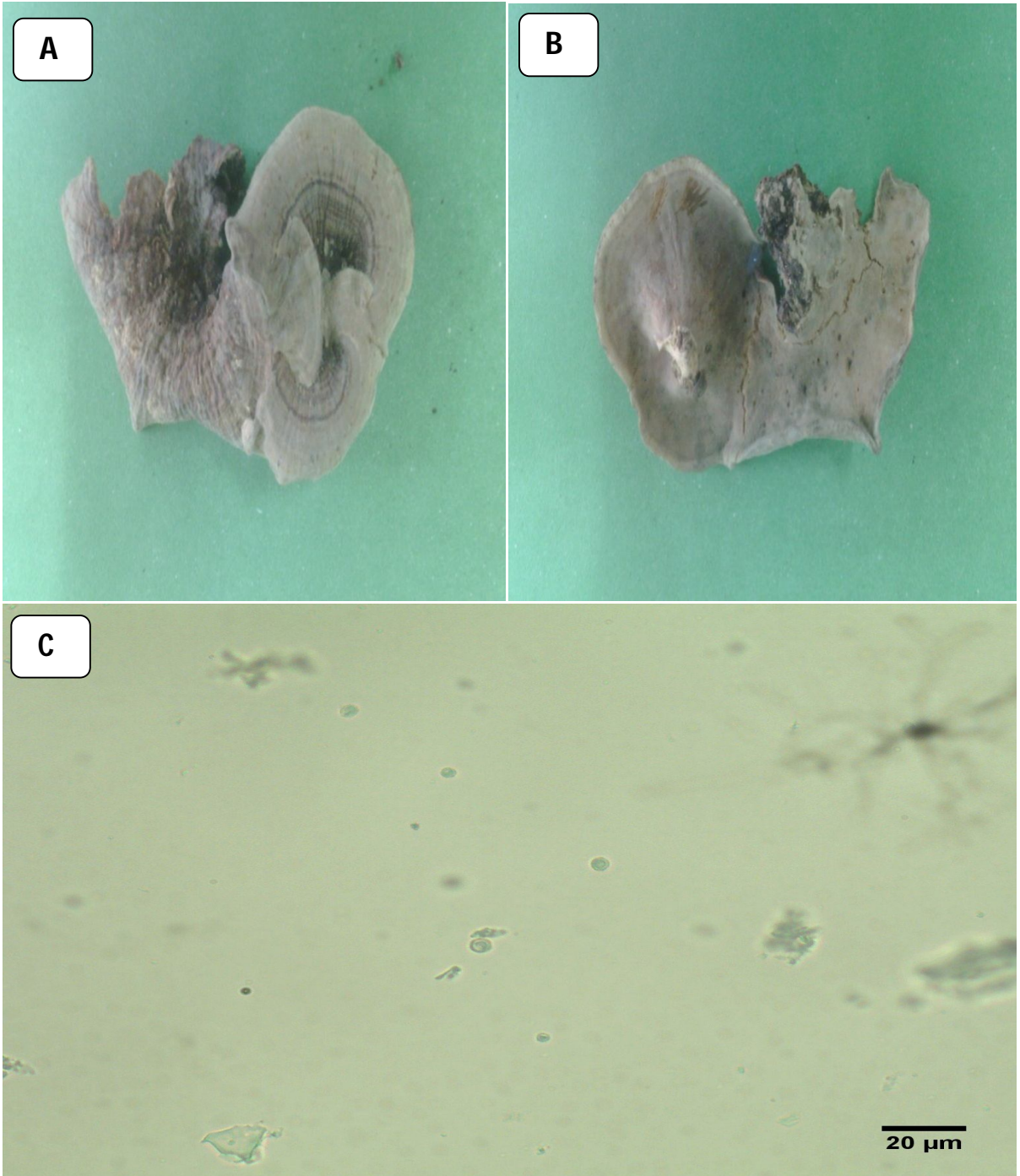
Size of fructification was 11.2×6.4 cm. The color of pileus (cap) was grey. The shape of cap was infundibuliform shaped. The cap edge was round and hardy. Beneath the cap hymenophores were absent. Regular shaped pores were present underside of the cap. The color of pores was grey. Surface characters and zonation was dry. The texture of the fruiting body was brittle and corky. Spore color was hyaline, spore shaped were single walled, smooth and irregular shaped and average spore size was  $8.2 \times 4.6 \mu\text{m}$  (Plate-22).

#### **Habitat of *Ganoderma praelongum***

The mushroom was found on the bark dead log of River abony(*Diospyros ebony*) tree. Average Relative Humidity was 78%, soil pH was 6.5 and soil type was sandy to clay loam. Average recorded temperature was 32°C.

#### **Biodiversity of *Ganoderma praelongum***

*Ganoderma praelongum* was found in Shamnagar Upazilla in Satkhira district. A total two number of mushrooms of *Ganoderma praelongum* were found during collection. The frequency of its presence was 25% and the density was 5.71%.



**PLATE-22:** *Ganoderma praelongum*; Mature fruiting body (A), Pores (B), Spores (C).

#### **4.13.2 *Ganoderma* sp.**

**Family :** Ganodermataceae

#### **Morphology of *Ganoderma* sp.**

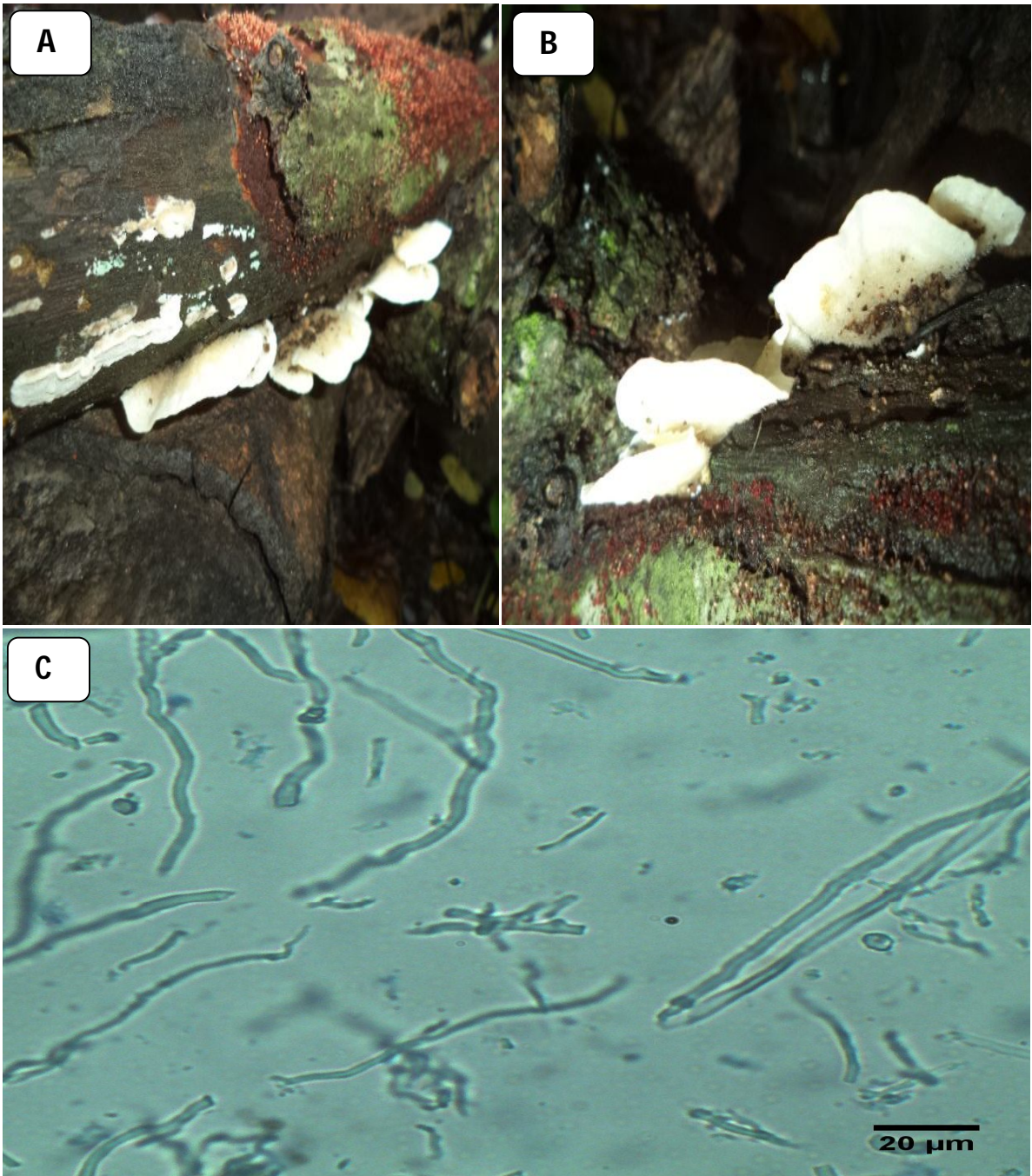
Average size of fructification was 3.2 × 3.8 cm. The color of pileus (cap) was white. The shape of cap was concave and flat shaped. The cap edge was round and wavy. Beneath the cap hymenophores were absent. Regular shaped pores were present underside of the cap. The color of pores was white. Ring or anal was absent on the stipe and volva was absent. The texture of the fruiting body was spongy and brittle. Spore color was hyaline, spore shaped were single walled, rough and irregular shaped and spore size was 7.03 × 4.86 μm (Plate-23).

#### **Habitat of *Ganoderma* sp.**

The mushroom was found on the dead log of Sissoo (*Delbarzia sissoo*) tree. Average Relative Humidity was 81%, soil pH was 6.8 and soil type was clay loam. Average recorded temperature was 28°C.

#### **Biodiversity of *Ganoderma* sp.**

*Ganoderma* sp. was found in Shamnagar Upazilla of Satkhira and Rampal Upazilla of Bagerhat district. A total eight number of mushrooms of *Ganoderma* sp. were found during collection. The frequency of its presence was 50% and the density was 22.86%.



**PLATE-23:** *Ganoderma* sp. ; Mature fruiting body (A), Pores (B), Spores (C).



#### **4.14 Morphology, habitat and biodiversity of *Crepidotus* sp.**

##### **4.14 .1 *Crepidotus* sp.**

**Common name :** Oysterling Mushroom

**Family :** Crepidotaceae

##### **Morphology of *Crepidotus* sp.**

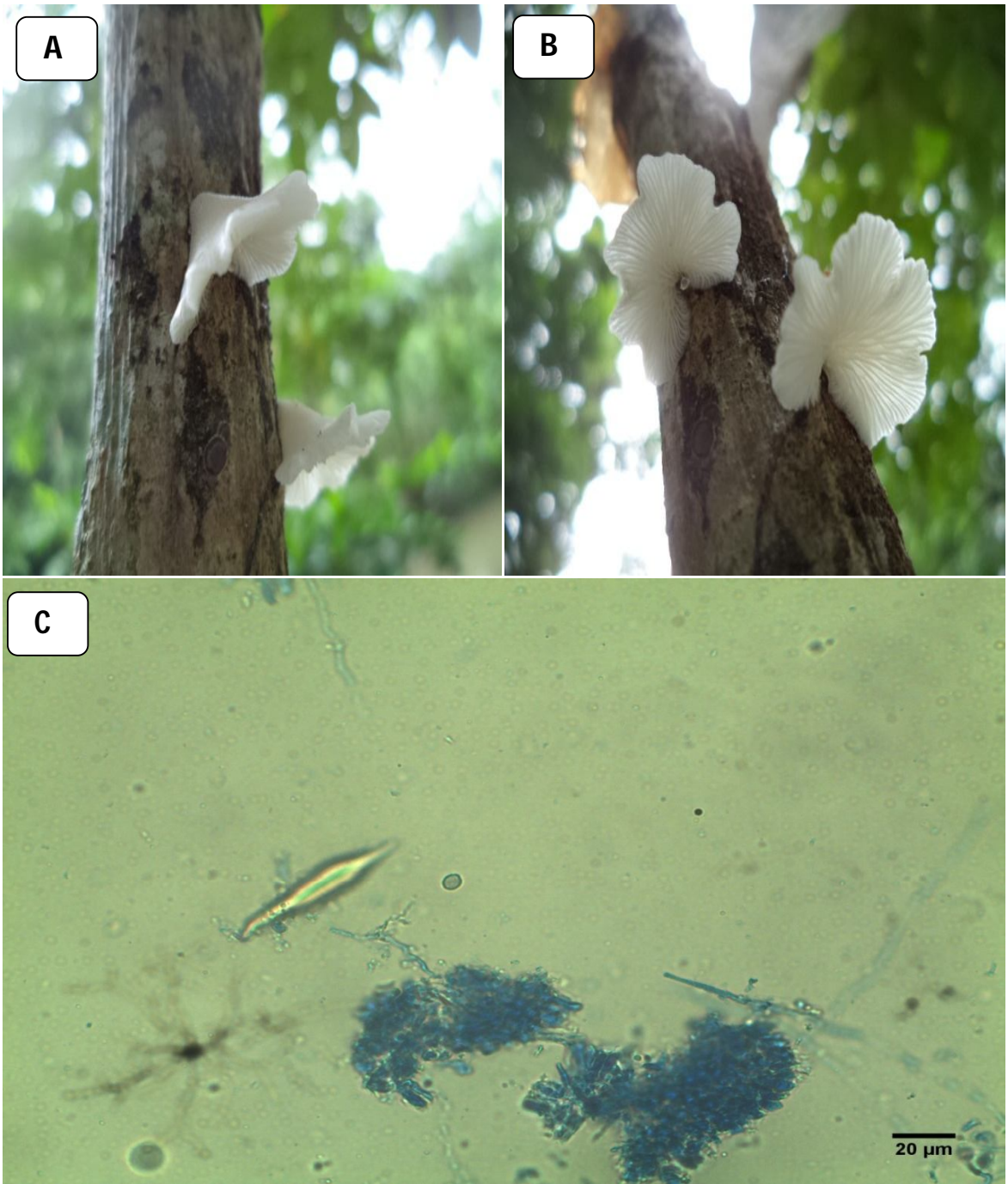
Average size of fructification was 1.8×2.2 cm. The color of pileus (cap) was white. The shape of cap was convex. The cap edge was round and wavy. Fleshy white Color scale was found on the cap. Beneath the cap hymenophores were absent. Regular shaped ridges were present underside of the cap. The color of ridges was white. Ring or anal was absent on the stipe and volva was absent on the lower part of the stipe. Spore color was brown, spore shaped were thick walled, slightly rough and oval shaped and spore size was 6.95× 6.65 μm (Plate-24).

##### **Habitat of *Crepidotus* sp.**

The mushroom was found on the wood log of rain (*Albizia saman*) tree. Average Relative Humidity was 78%, soil pH was 6.6 and soil type was sandy to sandy loam. Average recorded temperature was 31°C.

##### **Biodiversity of *Crepidotus* sp.**

*Crepidotus* sp. was found in Mongla, Bagerhat. A total four number of mushrooms of *Crepidotus* sp. were found during collection. The frequency of its presence was 25% and the density was 11.43%.



**PLATE-24:** *Crepidotus* sp. ; Mature fruiting body (A), Ridges (B), Spores (C).

#### **4.14.2 *Crepidotus alabamenis***

**Common name :** Flat crep

**Family :** Crepidotaceae

#### **Morphology of *Crepidotus alabamenis***

The average size of fructification was 2.2×2.6 cm. The color of pileus (cap) was brown. The shape of cap was flat and infundibuliform shaped. The cap edge was concave and wavy. Beneath the cap hymenophores were absent. Regular shaped gills (lamellae) were present underside of the cap. The color of gills was brown and black. Color of stipe volva was absent. The texture of the fruiting body was spongy and leathery. Spore color was brown, single walled, rough and irregular shaped and average spore size was  $6.4 \times 4.65 \mu\text{m}$  (Plate-25).

#### **Habitat of *Crepidotus alabamenis***

The mushroom was found on the fruit of coconut (*Cocos nucifera*) tree. Average Relative Humidity was 79%, soil pH was 6.7 and soil type was clay loam. Average recorded temperature was 31°C.

#### **Biodiversity of *Crepidotus alabamenis***

*Crepidotus alabamenis* was found in Mongla and Rampal Upazilla of Bagerhat district. A total 13 number of mushrooms of *Crepidotus alabamenis* were found during collection. The frequency of its presence was 50% and the density was 37.14%.



**PLATE-25:** *Crepidotus alabamensis* ; Mature fruiting body (A), Ridges (B), Spores(C).

#### **4.15 Morphology, habitat and biodiversity of *Amanita* sp.**

##### **4.15.1 *Amanita* sp.**

**Family :** Amanitaceae

##### **Morphology of *Amanita* sp.**

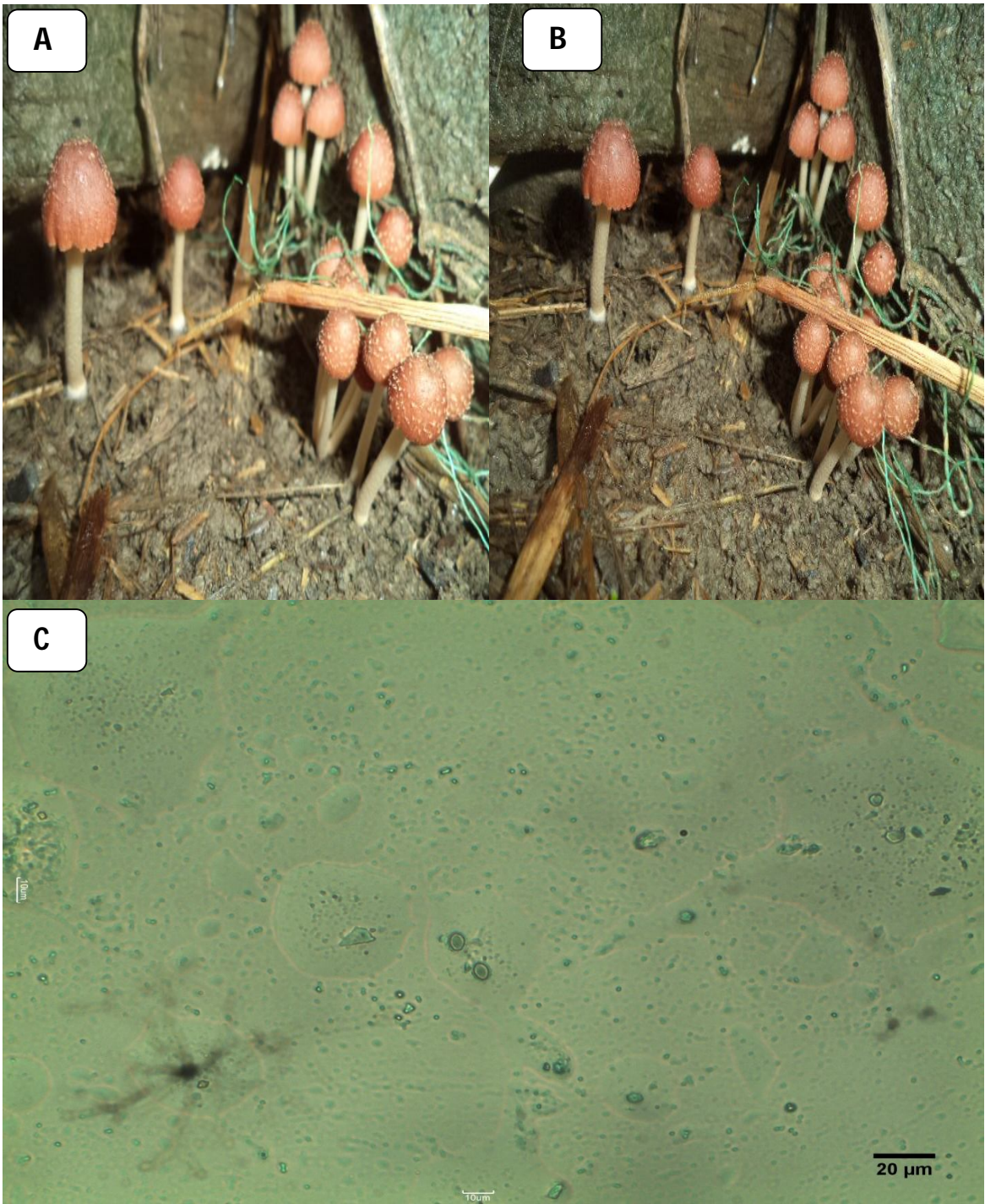
Average size of fructification was 3.2×1.2 cm. The color of pileus (cap) was brick red. The shape of cap was ovate. The cap edge was round and crenate. Powdery substances were found on the cap. Beneath the cap hymenophores were absent. Regular shaped gills (lamellae) were present underside of the cap. The color of gills was brick red. Color of stipe was whitish. The average length and width of stipe was 1.6cm and 0.2 cm, respectively. Ring or anal was absent on the stipe and volva was absent on the lower part of the stipe. Spore color was brown, thick walled, rough and irregular shaped and average spore size was  $7.2 \times 4.6 \mu\text{m}$  (Plate-26).

##### **Habitat of *Amanita* sp.**

The mushroom was found on humus and soil surface. Average Relative Humidity was 78%, soil pH was 6.4 and soil type was loam to sandy loam. Average recorded temperature was 29°C.

##### **Biodiversity of *Amanita* sp.**

*Amanita* sp. was found in Mongla Upazilla of Bagerhat district. A total 15 number of mushrooms of *Amanita* sp. were found during collection. The frequency of its presence was 25% and the density was 42.86%.



**PLATE-26:** *Amanita* sp. ; Mature fruiting body (A,B), Spores (C).

#### **4.17 Morphology, habitat and biodiversity of *Cortinarius* sp.**

##### **4.17.1 *Cortinarius semisanguineus***

**Common name :** Surprise webcap or red-gilled webcap.

**Family :** Cortinariaceae

##### **Morphology of *Cortinarius semisanguineus***

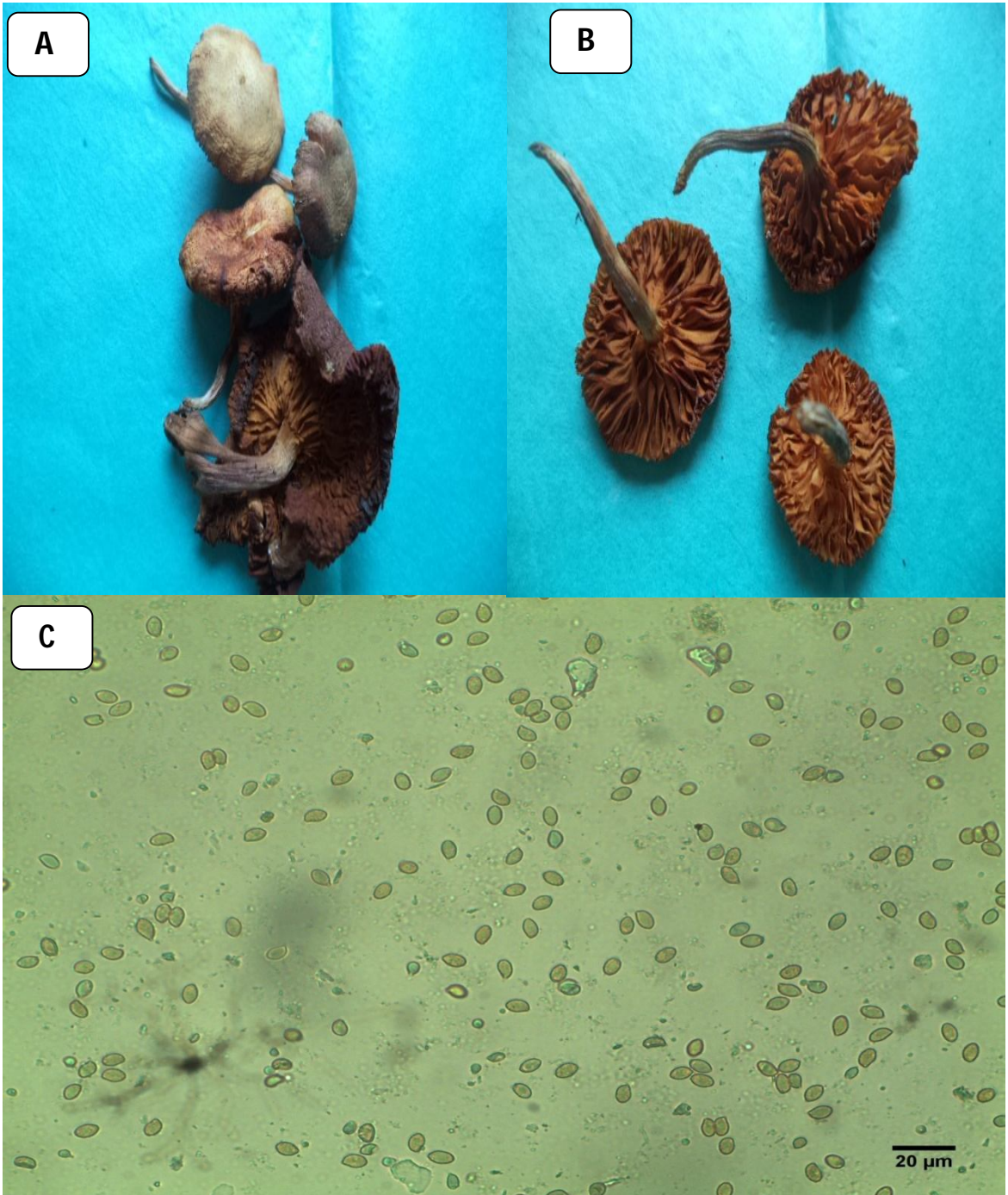
Size of fructification was 4.6×3.2 cm. The color of pileus (cap) was yellow and orange. The shape of cap was convex. The cap edge was round striate. Fleshy dark yellow color margin was found on the cap. Beneath the cap hymenophores were absent. Regular shaped gills (lamellae) were present underside of the cap. The color of gills was dark yellow. Color of stipe was greyish. The length and width of stipe was 2.1 cm and 0.3 cm, respectively. Ring or anal was absent on the stipe and volva was absent on the lower part of the stipe. Spore color was rusty brown, spore shaped were single walled, rough, ellipsoidal and irregular shaped. The average spore size was  $8.2 \times 4.8 \mu\text{m}$  (Plate-27).

##### **Habitat of *Cortinarius semisanguineus***

The mushroom was found on the dead root zone of Coconut (*Cocos nucifera*) tree. Average Relative Humidity was 78%, soil pH was 6.2 and soil type was sandy to clay loam. Average recorded temperature was 29°C.

##### **Biodiversity of *Cortinarius semisanguineus***

*Cortinarius semisanguineus* was found in Mongla Upazilla of Bagerhat district. A total five number of mushrooms of *Cortinarius semisanguineus* were found during collection. The frequency of its presence was 25% and the density was 11.29%.



**PLATE-27:** *Cortinarius semisanguineus* ; Mature fruiting body (A), Gills (B), Spores(C).



#### **4.18 Morphology, habitat and biodiversity of *Dacryopinax* sp.**

##### **4.18.1 *Dacryopinax spathularia***

**Common name :** Jelly fungus

**Family :** Dacrymycetaceae

##### **Morphology of *Dacryopinax spathularia***

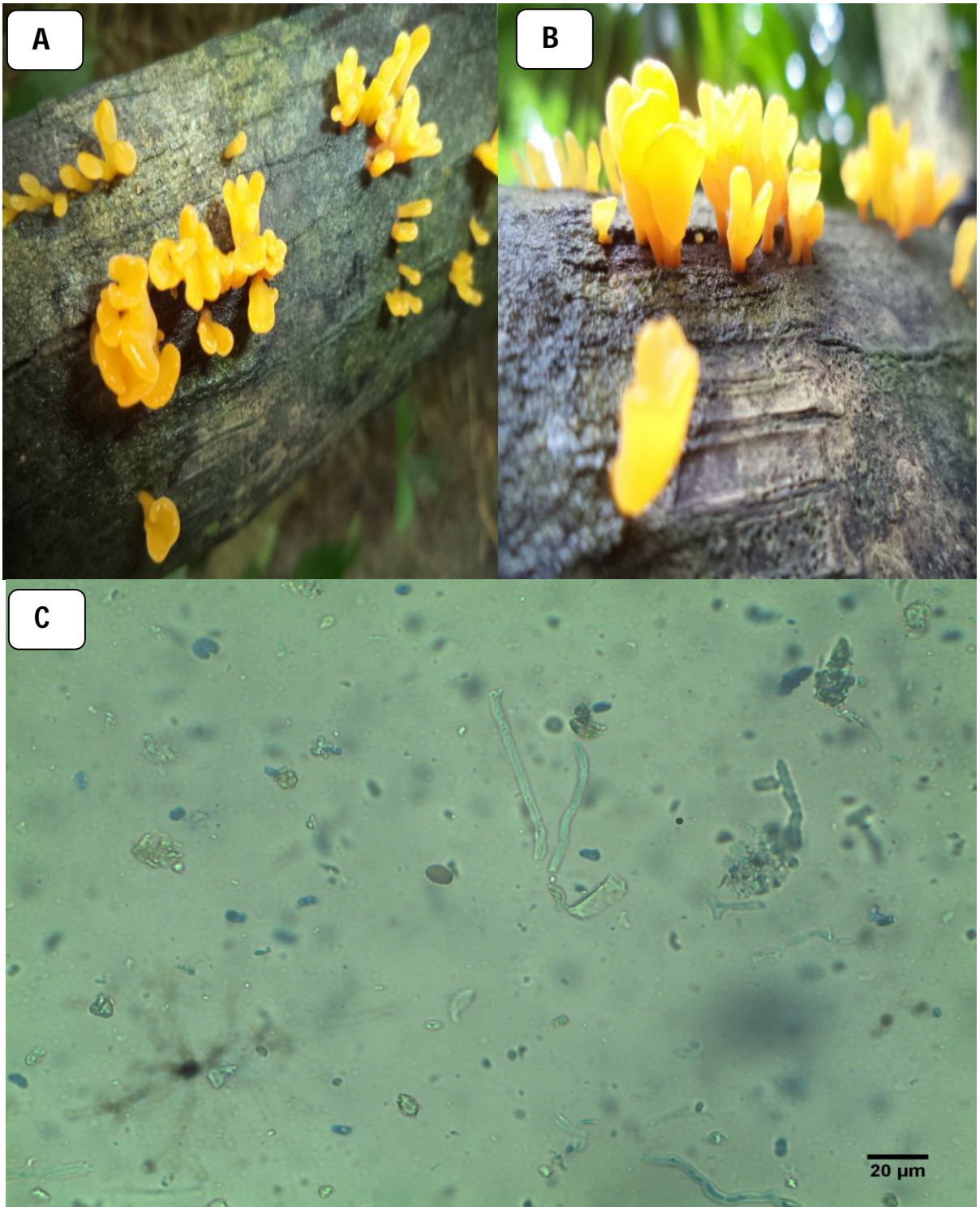
Average size of fructification was 1.1×0.4 cm. The color of pileus (cap) was yellow and orange when fresh, but it darkens to orangish-red when dry. The shape of cap was spatula-shaped. The cap edge was round smooth surfaced. Beneath the cap hymenophores were absent. Regular shaped gills (lamellae) were absent underside of the cap. Spore color was hyaline (translucent), brown, spore shaped were single walled, ellipsoid, shaped and average spore size was 9.5 × 5.96 μm (Plate-28).

##### **Habitat of *Dacryopinax spathularia***

The mushroom was found on the on dead bark of betel nut (*Areca catechu*) tree. Average Relative Humidity was 84%, soil pH was 6.7 and soil type was sandy to clay loam. Average recorded temperature was 27°C.

##### **Biodiversity of *Dacryopinax spathularia***

*Dacryopinax spathularia* was found in Mongla Upazilla of Bagerhat district. A total 33 number of mushrooms of *Dacryopinax spathularia* were found during collection. The frequency of its presence was 25% and the density was 94.28%.



**PLATE-28:** *Dacryopinax spathularia* ; Mature fruiting body (A,B), Spores (C).

## **4.19 Morphology, habitat and biodiversity of *Didymium* sp.**

### **4.19.1 *Didymium iridis***

**Family :** Didymiaceae

#### **Morphology of *Didymium iridis***

Size of fructification was 0.4 × 0.3 cm. The color of pileus (cap) was white. The shape of cap was bell-shaped. The cap edge was round smooth. Beneath the cap hymenophores were absent. Regular shaped gills (lamellae) were absent underside of the cap. The stipe was absent. Ring or anal was absent on the stipe and volva was absent on the lower part of the stipe. Spore color was hyaline, spore shaped were single walled, oval and irregular shaped and average spore size was 4.72 × 4.2 μm (Plate-29).

#### **Habitat of *Didymium iridis***

The mushroom was found on the wood log of wax zambo (*Syzygium samarangense*) tree. Average Relative Humidity was 81%, soil pH was 6.6 and soil type was clay loam. Average recorded temperature was 28°C.

#### **Biodiversity of *Didymium iridis***

*Didymium iridis* was found in Mongla Upazilla of Bagerhat district. A total 16 number of mushrooms of *Didymium iridis* were found during collection. The frequency of its presence was 25% and the density was 45.71%.



**PLATE-30:** *Didymium iridis* ; Mature fruiting body (A , B), Spores (C).

## **4.20 Morphology, habitat and biodiversity of *Gloeophyllum* sp.**

### **4.20.1 *Gloeophyllum sepiarlum***

**Common name :** Rusty gilled polypore

**Family :** Gloeophyllaceae

#### **Morphology of *Gloeophyllum sepiarlum***

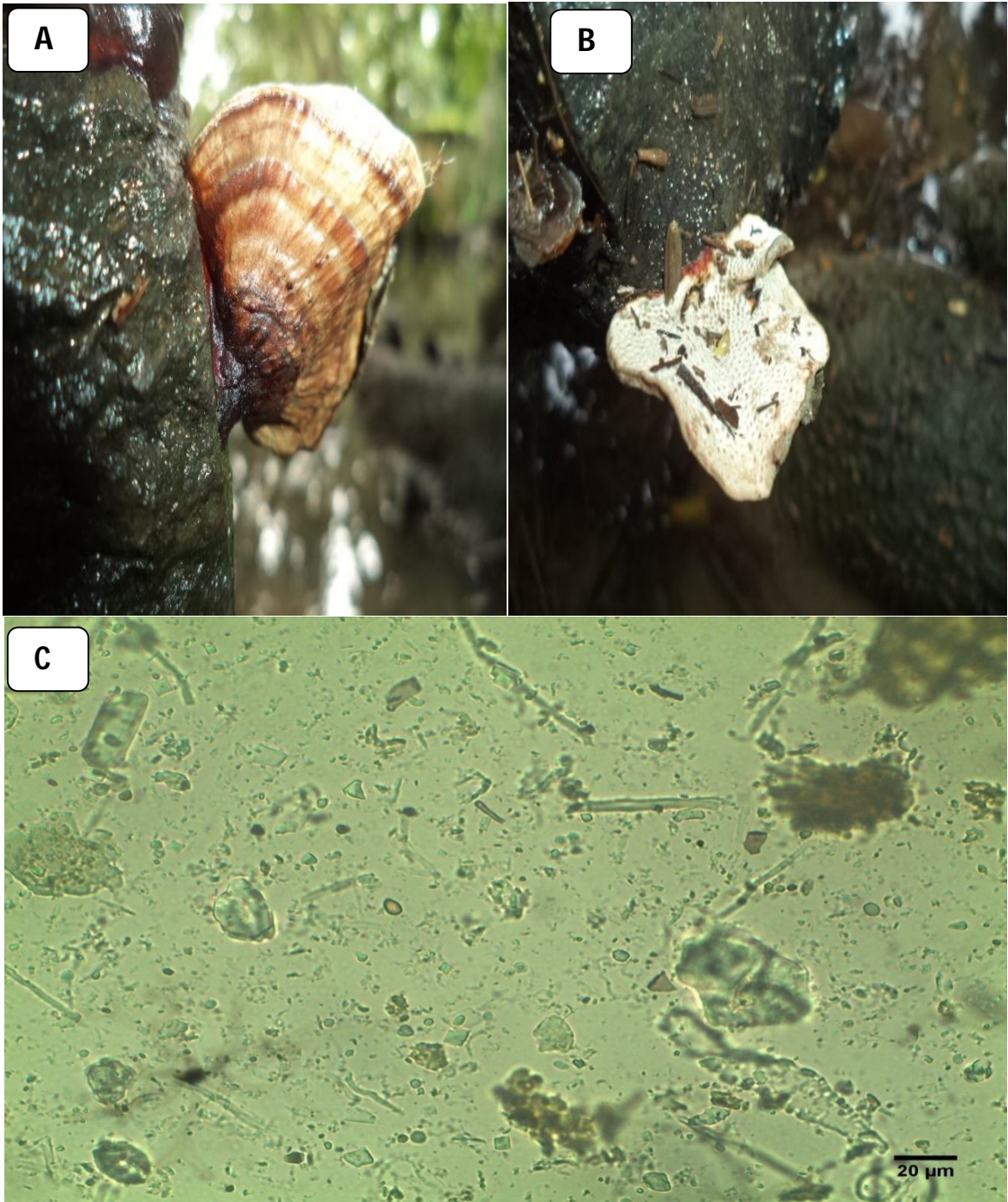
Size of fructification was 2.3×2.6 cm. The color of pileus (cap) was brown with margin. The shape of cap was infundibuliform shaped.. The cap edge was round wavy. Fleshy brown and creamy color margin was found on the cap. Beneath the cap pores were present. The color of pores was white. Ring or anal was absent on the stipe and volva was absent on the lower part of the stipe. Spore color was pink , hyaline and brown. Spore shaped were single walled, rough , ellipsoidal and irregular shaped and spore size was 5.56 × 4.08 μm (Plate-30).

#### **Habitat of *Gloeophyllum sepiarlum***

The mushroom was found on the dead wood log Bohera (*Terminalia bellirica*) tree. Average Relative Humidity was 88%, soil pH was 6.7 and soil type was clay loam. Average recorded temperature was 26°C.

#### **Biodiversity of *Gloeophyllum sepiarlum***

*Gloeophyllum sepiarlum* was found in Mongla Upazilla of Bagerhat district. Only one number of mushrooms of *Gloeophyllum sepiarlum* were found during collection. The frequency of its presence was 25% and the density was 2.86%.



**PLATE-30:** *Gloeophyllum sepiarium* ; Mature fruiting body (A), Pores (B), Spores(C).

## **4.21 Morphology, habitat and biodiversity of *Coltricia* sp.**

### **4.21.1 *Coltricia cinnamomea***

**Family :** Hymenochaetaceae

#### **Morphology of *Coltricia cinnamomea***

Average size of fructification was 7.1×4.2 cm. The color of pileus (cap) usually concentric bands of color. The color was brown and pale white margin. The shape of cap was funnel shaped. The cap edge was round and wavy. The flesh is tough and leathery, and when sliced open is rusty brown or even orange. Regular shaped gills (lamellae) were absent underside of the cap. Beneath the cap pores were present. The color of pore was white. Ring or anal was absent on the stipe and volva was absent on the lower part of the stipe. Spore color was brown, spore shaped were single walled, oval shaped and spore size was 7-8 × 3-4µm (Plate-31).

#### **Habitat of *Coltricia cinnamomea***

The mushroom was found on the dead log of the mahogany (*Swietenia mahagoni*) tree. Average Relative Humidity was 83%, soil pH was 6.4 and soil type was sandy to clay loam. Average recorded temperature was 28°C.

#### **Biodiversity of *Coltricia cinnamomea***

*Coltricia cinnamomea* was found in Shamnagar Upazilla of Satkhira and Mongla Upazilla of Bagerhat district. A total five number of mushrooms of *Coltricia cinnamomea* were found during collection. The frequency of its presence was 25% and the density was 14.23%.



**PLATE-31:** *Coltricia cinnamomea* ; Mature fruiting body (A), Pores (B), Spores (C).



## **4.22 Morphology, habitat and biodiversity of *Auricularia* sp.**

### **4.22.1 *Auricularia cornea***

**Common name :** Wood ear or Jews ear

**Family :** Auriculariaceae

#### **Morphology of *Auricularia cornea***

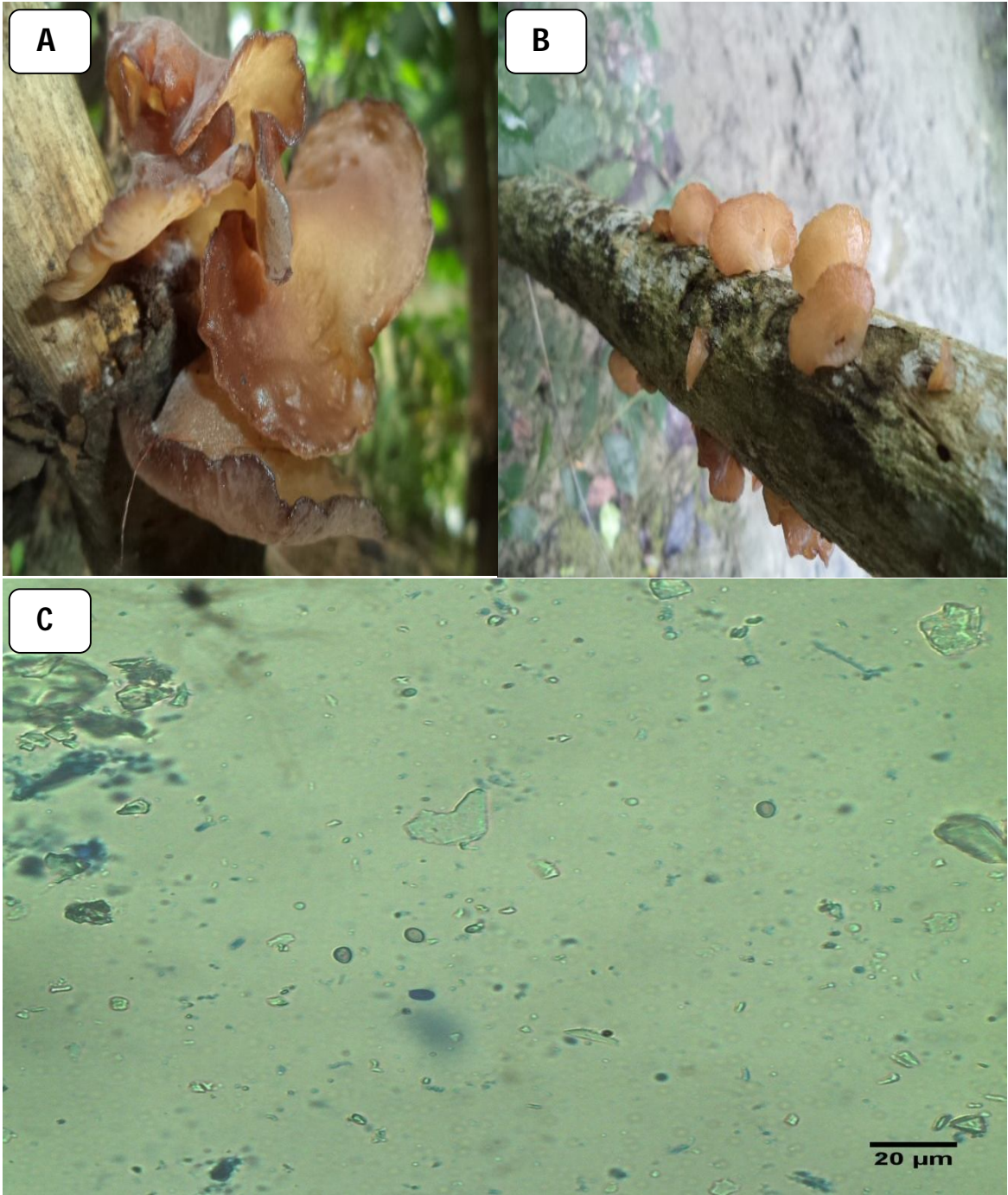
Average size of fructification was 3.1×3.8 cm. The color of pileus (cap) was pink purple. The shape of cap was infundibuliform shaped. The cap edge was incurved. Beneath the cap hymenophores were absent. Regular shaped gills (lamellae) were absent underside of the cap. Ring or anal was absent on the stipe and volva was absent on the lower part of the stipe. Texture of the fruiting was soft and spongy. Spore color was brown, spore shaped were thick walled, oval and irregular shaped and average spore size was 6 × 3.92 μm (Plate-32).

#### **Habitat of *Auricularia cornea***

The mushroom was found on the wood log of rain (*Albizia saman*) tree. Average Relative Humidity was 84%, soil pH was 6.4 and soil type was sandy loam. Average recorded temperature was 27°C.

#### **Biodiversity of *Auricularia cornea***

*Auricularia cornea* was found in Shamnagar Upazilla of Satkhira , Mongla and Rampal Upazilla of Bagerhat district. A total 14 number of mushrooms of *Auricularia cornea* were found during collection. The frequency of its presence was 75% and the density was 40%.



**PLATE-32:** *Auricularia cornea* ; Mature fruiting body (A,B), Spores (C).

## **4.23 Morphology, habitat and biodiversity of *Heimiomyces* sp.**

### **4.23.1 *Heimiomyces neovelutipes***

**Family :** Mycenaceae

#### **Morphology of *Heimiomyces neovelutipes***

Average size of fructification was 2.6×1.2 cm. The color of pileus (cap) was white. The shape of cap was convex and umbonate shaped. The cap edge was round smooth. Fleshy white Color scale was found on the cap. Beneath the cap hymenophores were absent. Regular shaped gills (lamellae) were present underside of the cap. The color of gills was white. Color of stipe was whitish. The length and width of stipe was 0.5-1 cm and 0.3 cm, respectively. Ring or anal was absent on the stipe and volva was absent on the lower part of the stipe. Spore color was brown, spore shaped were single walled, rough and irregular ellipsoidal shaped and average spore size was 7.1 × 4.94 μm (Plate-33).

#### **Habitat of *Heimiomyces neovelutipes***

The mushroom was found on the dead root zone of Coconut (*Cocos nucifera*) tree. Average Relative Humidity was 78%, soil pH was 6.8 and soil type was sandy to clay loam. Average recorded temperature was 28°C.

#### **Biodiversity of *Heimiomyces neovelutipes***

*Heimiomyces neovelutipes* was found in Shamnagar Upazilla of Satkhira district. A total six number of mushrooms of *Heimiomyces neovelutipes* were found during collection. The frequency of its presence was 50% and the density was 17.14%.



**PLATE-33:** *Heimiomyces neovelutipes* ; Mature fruiting body (A), Gills (B), Spores (C).

## **4.24 Morphology, habitat and biodiversity of *Pleurotus* sp.**

### **4.24.1 *Pleurotus ostreatus***

**Common name :** Oyster mushroom

**Family :** Pleurotaceae

#### **Morphology of *Pleurotus ostreatus***

Size of fructification was 5.1×4.3 cm. The color of pileus (cap) was milky white. The mushroom has a broad, fan or oyster-shaped cap. Beneath the cap hymenophores were absent. Regular shaped ridges were present underside of the cap. The color of ridges was milky white. Ring or anal was absent on the stipe and volva was absent on the lower part of the stipe. Spore color was hyaline, spore shaped were single walled, smooth and irregular shaped and average spore size was  $5.6 \times 44.25 \mu\text{m}$  (Plate-34).

#### **Habitat of *Pleurotus ostreatus***

The mushroom was found on soil surface. Average Relative Humidity was 78%, soil pH was 6.8 and soil type was sandy to sandy loam. Average recorded temperature was 28°C.

#### **Biodiversity of *Pleurotus ostreatus***

*Pleurotus ostreatus* was found in Shamnagar Upazilla of Satkhira and Mongla Upazilla of Bagerhat district. Only one number of mushrooms of *Pleurotus ostreatus* were found during collection. The frequency of its presence was 25% and the density was 2.85%.



**PLATE-34:** *Pleurotus ostreatus* ; Mature fruiting body(A), Gills (B), Spores (C).

## **4.25 Morphology, habitat and biodiversity of *Irpex* sp.**

### **4.25.1 *Irpex lacteus***

**Common name :** Milk-white toothed polypore.

**Family :** Steccherinaceae

#### **Morphology of *Irpex lacteus***

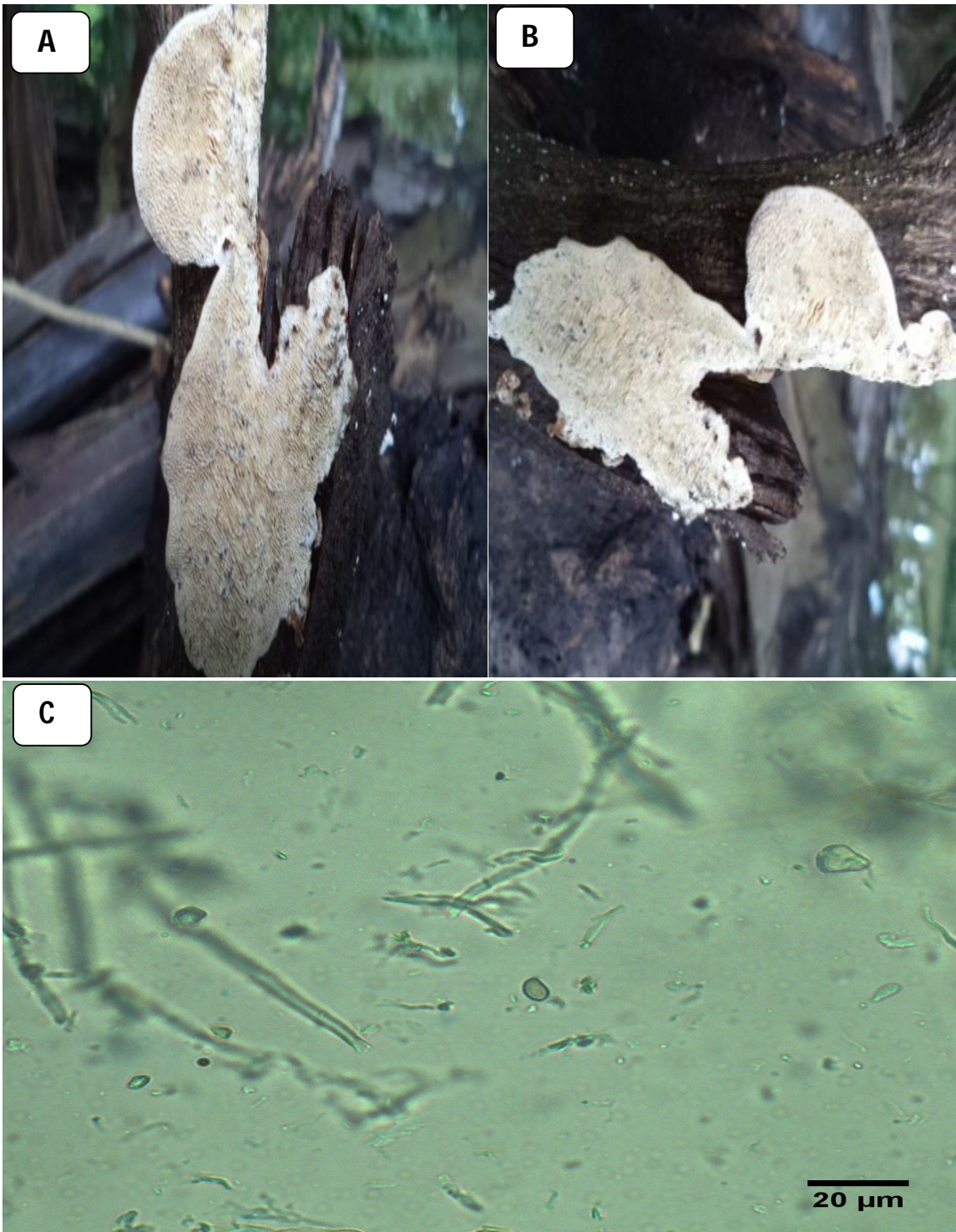
Average size of fructification was 2.5×6.8 cm. The color of pileus (cap) was white. The shape of cap was flat shaped. The cap edge was round and rough. Beneath the cap hymenophores were absent. Regular shaped teeth were present underside of the cap. The color of teeth was whitish to grayish (often zoned), velvety to hairy upper surface; flesh thin, whitish, and tough; without a stem. Spore color was brown, spore shaped were thick walled, rough and oval shaped and spore size was 7.2×4.2 μm (Plate-35).

#### **Habitat of *Irpex lacteus***

The mushroom was found on the hard wood logs of Mango (*Mangifera indica*) tree. Average Relative Humidity was 83%, soil pH was 6.6 and soil type was sandy to clay loam. Average recorded temperature was 28°C.

#### **Biodiversity of *Irpex lacteus***

*Irpex lacteus* was found in Mongla Upazilla of Bagerhat district. A total three number of mushrooms of *Irpex lacteus* were found during collection. The frequency of its presence was 50% and the density was 8.57%.



**PLATE-35:** *Irpex lacteus* ; Mature fruiting body and Teeth (A , B), Spores (C).



## DISCUSSION

Detailed survey was carried out in four Upazilla (Mongla, Rampal, Sarankhola and Shamnagar) of Bagerhat and Satkhira district of Khulna division in mangrove forest regions of Bangladesh from July to October, 2015 to record the morphological variability, distribution, habitat, and biodiversity of the mushrooms population.

In the present study 35 mushrooms species were found under 17 families. Five species of *Agaricus* were recorded in Mongla, Rampal and Sarankhola Upazilla of Bagerhat district of mangrove forest viz *Agaricus campestris*, *Agaricus xanthodermus*, *Agaricus silvicola*, *Agaricus aungustus* and *Agaricus arvensis*. These mushrooms were found on the on soil and the forest type was mixed. And These species was also reported for Bangladesh in tropical moist deciduous forest which was recorded in associated with *Dalbergia sissoo* tree (Rumainul *et al.*, 2015). *Agaricus xanthodermus* was found in Shamnagar Upazilla of Satkhira district associated with mangrove forest with the frequency and the density of 25 and 17.14%, respectively. The mushroom was found on humus and soil surface. On the other hand *Agaricus silvicola* was also found in Mongla, Rampal and Sarankhola Upazilla of Bagerhat district in mangrove forest with the frequency and the density of 25 and 11.43%, respectively. But in the present survey this species was recorded that the mushroom was found on humus. This species was also reported in Bangladesh forest (Rumainul *et al.*, 2015). But this species was recorded in associated with *Swietenia macrophylla* tree. *Agaricus aungustus* was found in Mongla, Rampal and Sarankhola Upazilla of Bagerhat district in mangrove forest with the frequency and the density of 50 and 22.86%, respectively.

And *Agaricus arvensis* was recorded in Shamnagar upazilla of Satkhira district with the frequency and density of 25 and 5.71%, respectively. This mushroom was also found on the root zone of coconut tree. The genus *Agaricus* sp. was also reported from India (Mohanani, 2011; Thiribhuvanamala *et al.*, 2011; Hansen, 1992 ).

One species of *Coprinus silvaticus* was recorded in Sarankhola Upazilla of Bagerhat district in mangrove forest with the frequency and density of 50 and 262.86%, respectively. The mushroom was found on the root zone of burflower-tree (*Neolamarckia cadamba*). *Chlorophyllum molybdites* was found in Shamnagar Upazilla of Satkhira district associated with mangrove forest with the frequency and the density of 25% and the density was 2.86%. The mushroom was found on the root zone of Coconut (*Cocos nucifera*) tree.

Two species of *Lepiota* sp. as *Lepiota atrodisca* and *Lepiota* sp. were found in Mongla, Rampal and Sarankhola Upazilla of Bagerhat district. The frequency and the density of *Lepiota* sp. was 25 and 11.43%, respectively. The mushroom was found on soil surface. This species was also reported for Bangladesh in tropical moist deciduous forest (Rahaman *et al.*, 2016). The mushroom was found on Bamboo (*Bambusa vulgaris*) tree and during the collection the frequency of its presence was 25% and density was 10.81% (Rahaman *et al.*, 2016). And *Lepiota atrodisca* was found in Mongla Upazilla of Bagerhat district with the frequency and the density of 50% and 74.29%, respectively. The mushroom was found on the on the root zone of Sissoo (*Dalbergia sissoo*) tree.

Two species of *Trametes* sp. viz *Trametes versicolor* and *Trametes* sp. were found in Mongla, Rampal and Sarankhola Upazilla of Bagerhat district. The frequency and density of *Trametes versicolor* was 25 and 2.86%, respectively. Another *Trametes* sp. was also recorded in Sarankhola and Shamnagar Upazilla of Bagerhat and Satkhira district, respectively. During the collection the frequency of *Trametes* sp. was 50 and 11.43%, respectively. *Tyromyces lacteus* was found in Mongla Upazilla of Bagerhat district with the frequency of 25% and the density was 2.86%. This species of mushroom was traced on the root zone of Coconut (*Cocos nucifera*) tree.

*Daedaleopsis confrogosa* was found in Mongla and Sarankhola Upazilla of Bagerhat district with the frequency and the density of 50% and the density was 14.29%. This species of mushroom was found on the dead root zone of Coconut (*Cocos nucifera*) tree. This species was also reported for Bangladesh in tropical moist deciduous forest (Rumainul *et al.*, 2015). These species were also found in Dhaka, Bangladesh (Rumainul *et al.*, 2015) associated with *Swietenia macrophylla*. *Daedaleopsis* sp. is the widely distributed genus contains six species (Kirk *et al.*, 2008).

*Pycnoporous sanguineus* was recorded in Mongla and Sarankhola Upazilla of Bagerhat district with the frequency and the density of 75% and 22.86%, respectively. This species of mushroom was found on the dead logs of Sundari (*Heritiera fomes*) tree.

Two species of *Marasmius* sp. were found Mongla Upazilla of Bagerhat district with the frequency and the density of *Marasmius siccus* was 50% and 17.14%, respectively. Another *Marasmius* sp. was also recorded with the frequency and the density of 25 and 51.43%, respectively.

This mushroom species was found on the dead stem of Sissoo (*Dalbergia sissoo*) tree. But this species was also reported for Bangladesh in tropical moist deciduous forest at Dhaka (Rumainul *et al.*, 2015). In the present study this species was recorded in associated with *Acacia auriculiformis*. It was also found in on humus. Three species of *Marasmius* was reported from Dhaka district of Bangladesh (Islam, 2013) whereas about 500 species have been described (Kirk *et al.*, 2008) and it was also reported in madagascar as well as the Mascarenes (Antonin and Buyck, 2006).

*Marasmiellus albuscorticis* was recorded in Mongla, Rampal and Sarankhola Upazilla of Bagerhat district with the frequency and density of 75 and 97.14%, respectively.

Two species of *Schizophyllum* were found in Rampal Upazilla of Bagerhat district and Shamnagar Upazilla of Satkhira district. The frequency and density of *Schizophyllum* sp. was 50% and 48.57%, respectively. On the other hand, the frequency and density of *Schizophyllum commune* was 50 and 37.14%, respectively. The mushroom was found on the common bamboo (*Bambusa vulgaris*) tree. But It was found in dead wood of deciduous trees in Nagaland, India ( Rajesh Kumar *et al.*, 2013).

*Volvariella hypopithys* was recorded in Mongla and Sarankhola Upazilla of Bagerhat disdriect with the frequency and density of 50 and 17.14%, respectively. This species was also reported for Bangladesh forest (Rumainul *et al.*, 2015). But this species was recorded on the humus of moist soil. On the other hand, *Volvariella speciosa* was found in Mongla, Rampal and Sarankhola Upazilla of Bagerhat district with the frequency and density of 75 and 11.43%, respectively.

This genus was also reported for Bangladesh in tropical moist deciduous forest at Dhaka (Islam, 2013). Furthermore, it was also reported in India (Thiribhuvanamala *et al.*, 2011).

Two species of *Ganoderma* sp. such as *Ganoderma praelongum* and *Ganoderma* sp. were found Shamnagar Upazilla in Satkhira district and Rampal Upazilla of Bagerhat district with the frequency and density of 25, 50, 5.71 and 22.86%, respectively. *Ganoderma* were also found at Rajshahi, Pabna, Jaipurhat, and Dhaka districts of Bangladesh in 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).

Two species of *Crepidotus* were found in Mongla Upazilla of Bagerhat district with the frequency and density of 50 and 37.14%, respectively. And the frequency and density of *Crepidotus* sp. was 25 and 11.43%, respectively. But this species was recorded in association with *Swietenia macrophylla* tree. *Crepidotus* sp. was reported in India (Thiribhuvanamala *et al.*, 2011).

*Amanita* sp. was found in Mongla Upazilla of Bagerhat district with the frequency and density of 25 and 42.86%, respectively. The mushroom species was found on humus and soil surface. This species was also reported for Bangladesh in tropical moist deciduous forest (Rumainul *et al.*, 2015). But in the present survey this species was recorded in associated with Sissoo (*Dalbergia sissoo*) tree.

*Cortinarius semisanguineus* was found in Mongla Upazilla of Bagerhat district with the frequency and density of 25% and 11.29%, respectively. This mushroom was found on the dead root zone of Coconut (*Cocos nucifera*) tree. *Cortinarius corrugates* was found in Sadar and Pathorghata of Patuakhali and Barguna districts in southern region with a frequency and the density of 12.5 and 16.7%, respectively. This species was also reported at Pathorghata in association with *Musa* sp. tree (Rashid, 2013). But in this study the species was also recorded in association with *Musa* sp. tree. *Cortinarius* sp. were also found in North America and Europe (Hansen and Knudsen, 1992).

*Dacryopinax spathularia* was found in Mongla Upazilla of Bagerhat district with the frequency and density of 25 and 94.28%, respectively. This mushroom was found on the on dead bark of betel nut (*Areca catechu*) tree. *Didymium iridis* found in Mongla Upazilla of Bagerhat district with the frequency and density of 25% and 45.71%, respectively. This mushroom was found on the wood log of wax zambo (*Syzygium samarangense*) tree. *Gloeophyllum sepiarium* was found in Mongla Upazilla of Bagerhat district with the frequency and density of 25 and 94.28%, respectively. This mushroom was found on the on dead bark of Bohera (*Terminalia bellirica*) tree.

*Coltricia cinnamomea* was found in Shamnagar Upazilla of Satkhira district and Mongla Upazilla of Bagerhat district with the frequency and density of 25 and 14.23%, respectively. This mushroom was found on the dead log of the mahogany (*Swietenia mahagoni*) tree. This mushroom species found in Cameroon (Andrew *et al.*, 2013).

*Auricularia cornea* was found in Shamnagar Upazilla of Satkhira district and Mongla and Rampal Upazilla of Bagerhat district with the frequency and density of 75 and 40%, respectively. This mushroom was found on the wood log of rain (*Albizia saman*) tree.

*Heimiomyces neovelutipes* was found in Shamnagar Upazilla of Satkhira district with frequency and density of 50 and 17.14%, respectively. This mushroom was found on the dead root zone of Coconut (*Cocos nucifera*) tree. *Pleurotus ostreatus* was found in Shamnagar Upazilla of Satkhira district and Mongla Upazilla of Bagerhat district with the frequency and density of 25% and 2.85%, respectively. The mushroom was found on soil surface. *Irpex lacteus* was found in Mongla Upazilla of Bagerhat district with the frequency and density of 50 and 8.57%, respectively. The mushroom was found on the dead wood logs of Mango (*Magnifera indica*) tree.

## CHAPTER V

### SUMMARY AND CONCLUSION

Mangrove (Sundarbans), the largest single block of tidal halophytic mangrove forest in the world, located in the southwestern part of Bangladesh. It lies on the Ganges-Brahmaputra Delta at the point where it merges with the Bay of Bengal. The forest lies a little south to the Tropic of Cancer between the latitudes 21°30'N and 22°30'N, and longitudes 89°00'E and 89°55'E. With its array of trees, natural resources and wild life the forest is a showpiece of natural history. The possible reason for the growth and survival of various kinds of naturally occurring mushroom can be prevailing climatic conditions with different vegetation which provided the favorable environment. This survey was conducted Mongla, Rampal, Sarankhola of Bagerhat and Shamnagar of Satkhira district in Khulna division of mangrove forest regions in Bangladesh.

In this survey, thirty five species of mushrooms belonging to 24 genera and 17 families were collected and identified from mangrove forest regions of Bangladesh. The identified five species of *Agaricus* were recorded as *Agaricus campestris*, *Agaricus xanthodermus*, *Agaricus silvicola*, *Agaricus aungustus* and *Agaricus arvensis*. Two species of *Trametes* sp. viz *Trametes versicolor* and *Trametes* sp; *Lepiota* as *Lepiota atrodisca*; *Marasmius* as *Marasmius siccus*; *Schizophyllum* as *Schizophyllum commune* and each had one unidentified species respectively. Two species of *Volvariella* as *Volvariella hypopithys* and *Volvariella speciosa*. Two species of *Crepidotus* as *Crepidotus alabamenis* and *Ganoderma* as *Ganoderma praelongum* and one species was unidentified species in each. One species of each *Coprinus silvaticus*, *Chlorophyllum molybdites*, *Tyromyces lacteus*, *Daedaleopsis*



*confragosa*, *Pycnoporus* sp., *Marasmiellus albuscorticis*, *Amanita* sp., *Cortinarius semisanguineus*, *Dacryopinax spathuaria*, *Didymium iridis*, *Gloeophyllum sepiarlum*, *Coltricia cinnamomea*, *Auricularia cornea*, *Hemiomyces neovelutipes*, *Pleurotus ostreatus* and *Irpex lacteus* were recorded.

The highest frequency was 75% for *Volvariella speciosa*, *Auricularia cornea*, *Marasmiellus albuscorticis*, then 50% for *Agaricus campestris*, *Agaricus aungustus*, *Lepiota atrodisca*, *Trametes* sp., *Daedaleopsis confragosa*, *Pycnoporus* sp., *Marasmius siccus*, *Schizophyllum* sp., *Schizophyllum commune*, *Volvariella hypopithys*, *Ganoderma* sp., *Crepidotus alabamensis*, *Hemiomyces neovelutipes* and *Irpex lacteus*. The lowest frequency was 25% for the rest of the species.

Highest density was 262.86% for *Coprinus silvaticus* followed by 97.14% for *Marasmiellus albuscorticis* and lowest density was 2.86% for *Chlorophyllum molybdites*, *Trametes versicolor*, *Gloeophyllum sepiarlum*, and *Pleurotus ostreatus*.

Among the total 35 species, highest nine species were found under the Agaricaceae family. Then five species were found under the Polyporaceae family. Three species were found under the Marasmiaceae family. Two species were found under each Schizophyllaceae, Pluteaceae, Ganodermataceae and Crepidotaceae family. And the lowest one species of each Amanitaceae, Cortinariaceae, Dacrymycetaceae, Didymiaceae, Gloeophyllaceae, Hymenochataceae, Auriculariaceae, Mycenaceae, Pleurotaceae and Steccherinaceae family. The investigation proves that mangrove forest regions of Bangladesh has distinct biodiversity of mushroom population.

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