Advances in Research

13(5): 1-17, 2018; Article no.AIR.36800
ISSN: 2348-0394, NLM ID: 101666096

Diversity and Ecology of Macrofungi in Rangamati of Chittagong Hill Tracts under Tropical Evergreen and Semi-Evergreen Forest of Bangladesh

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Authors' contributions

This work was carried out in collaboration between all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/AIR/2018/36800
Editor(s):
(1) Salem Aboglila, Assistant Professor, Department of Geochemistry & Environmental Chemistry, Azzaytuna University, Libya.
Reviewers:
(1) Peter K. Maina, Nairobi University, Kenya.
(2) Paul Olusegun Bankole, Federal Polytechnic Ilaro, Nigeria.
Complete Peer review History: http://www.sciencedomain.org/review-history/23301

Original Research Article

Received 16th September 2017
Accepted 15th February 2018
Published 23rd February 2018

ABSTRACT

A detailed survey was made in Rangamati district of Chittagong hill tracts from July to October, 2016 to collect and record the morphological and ecological variability of macrofungi fruiting body. Collected macrofungi were washed with water and dried by electric air flow drier. Permanent glass slides were made from rehydrated basidiocarp for microscopic characterization. Morphology of basidiocarp and characteristics of basidiospore were recorded. Ecological features of the collected macrofungi and the collection sites such as location of collection, host, habit, frequency of occurrence, density and environmental temperature, soil type and soil moisture conditions were also recorded during collection time. A total of 66 samples of macrofungi were collected, recorded, photographed and preserved. Twenty species of macrofungi were identified under 17 genera and 15 families. The highest frequency of occurrence (44.44%) was recorded for *Xylaria polymorpha.* The highest density was found for *Xylaria polymorpha* also (55.56%) followed by *Coprinus disseminatus* (52.78%), *Auricularia cornea* (38.89%), *Xylaria hypoxylon* (27.78%) and *Clavulina coralloides* (16.67%). This is the first detail reports on macrofungi collected from Rangamati Hill Tracts forest of Bangladesh. Collected specimens were deposited to the SAU Herbarium of Macrofungi (SHMF).

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Keywords: Morphology; ecology; diversity; macrofungi; density.

1. INTRODUCTION

Macrofungi 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 [1]. 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 [2]. 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 [3].

Macrofungi 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 macrofungi i.e. *Volvarias*, polypore and tubers fungi that used ethno botanical food by the tribal of forest regions of India and Nepal [4]. 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 [5]. 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 types of diseases and also as an aphrodisiac and tonic [6]. Ample species 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 mushrooms are found growing in association with trees of a particular family or genus [7,8]. Macrofungi are one of the promising concepts for crops diversification in Bangladesh as well as the whole world. Biodiversity and morphology of macrofungi have been carried out in National Botanical Garden, Dhaka [9], in mangrove forest of Bangladesh [10] and social forest region under Bogra district, Bangladesh [11]. The present survey was conducted in Rangamati of Chittagong hill tracts under tropical evergreen and semi-evergreen forest region of Bangladesh to identify the macrofungi up to the genus and species level and to study the morphology, ecology and distribution of identified macrofungi.

2. MATERIALS AND METHODS

2.1 Experimental Site

The samples were collected from Rangamati district of Chittagong hill tracts, Bangladesh. Experiment was conducted at the Laboratory, Department of Plant Pathology (DPP), Sher-e-Bangla Agricultural University (SAU), Dhaka.

2.2 Sampling Procedure

A systematic sampling procedure was used baseline survey. Seven locations under the division of Chittagong in Bangladesh were selected for conducting a survey on mushroom ecology, distribution and morphology. A pre-designed collection procedure was used to collect information on level of knowledge on biodiversity, habitat and morphology of mushroom in selected regions of Bangladesh.

2.3 Collection of Mushroom Sample

Samples were collected during July to October, 2016, to record the morphological variability in the mushrooms population. The collection was made following standard method [12]. Spotted mushrooms were inspected in their natural habitats and brought to laboratory for detailed study. The collected fleshy fungi were studied for their macroscopic detail on 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.

2.4 Collection Site

Collection sites were Kaptai, Kawkhali, Rangunia, Manikchari, Ruma, Rama and Rowangchari of Rangamati of Chittagong hill tracts of Bangladesh (Fig. 1) which consists of three wildlife sanctuaries. 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 Teak/Segun (*Tectona grandis*), Gamari (*Gmelina arborea*), Koroi (*Albizia procera*), Rubber (*Hevea brasiliensis*), Mahogony (*Macrophyla mahogoni*), Sisso (*Dalbergia sissoo*), Bamboo (*Bambusa vulgaris*), *Chapalish tree* (*Artocarpus chaplasha*), Rain tree (*Albizia lebbeck*).

2.5 Processing and Drying of Macrofungi

Freshly harvested macrofungi was washed with water for removing dust. 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 [13].

2.6 Storage

Dried macrofungi 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 and preserved with 10% silica gel [13].

2.7 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 vail, annuls (position), volva [14]. 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

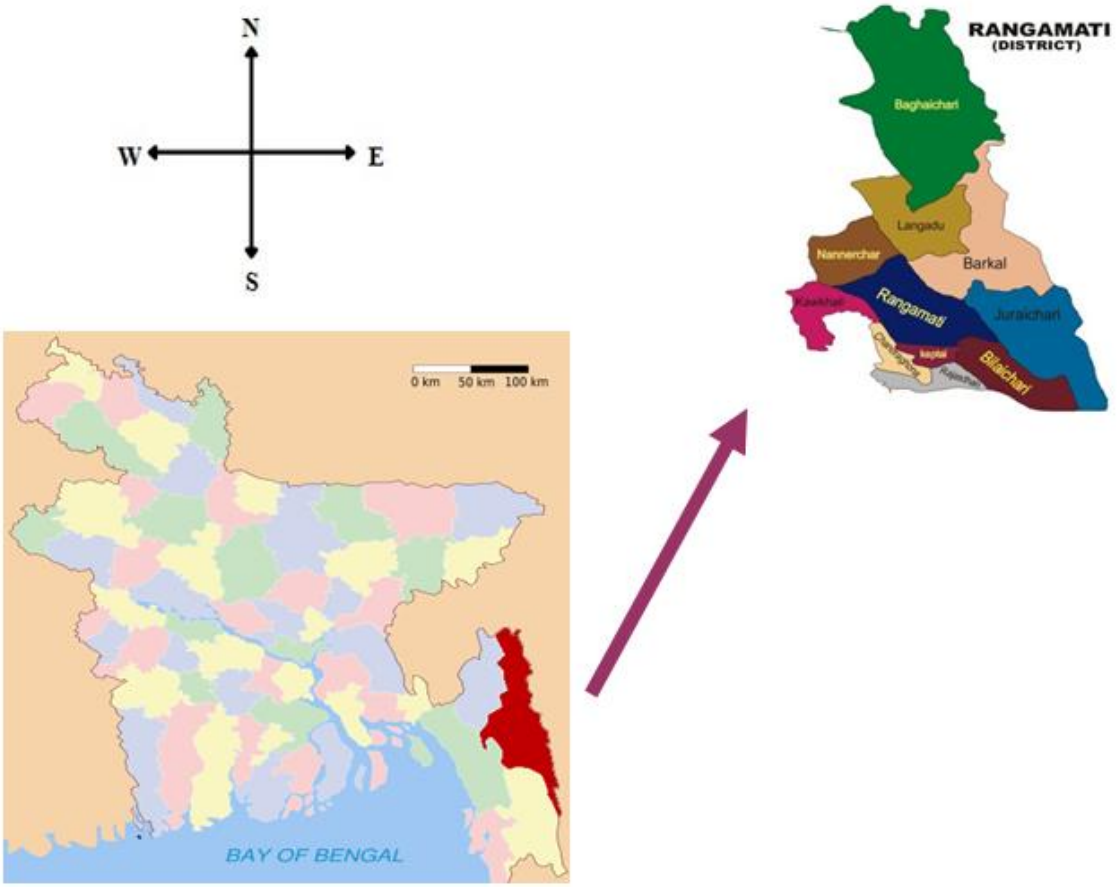

Fig. 1. Survey areas of Rangamati of Chittagong Hill Tracts in Bangladesh

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 [15], the encyclopedia of fungi of Britain and Europe [16] and the mushroom identifier [17].

2.8 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.

2.9 Habitat, Distribution and Diversity Analysis

The different forests under survey of mixed type of forests 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 and vegetation were recorded for biodiversity of mushroom. Soil pH and soil moisture were measured by pH meter and air temperature by thermometer during collection period, respectively. 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 [18]:

% Frequency of fungal species = {(Number of sites in which the species is present x 100) / Total number of sites}

(%) Density = {(Total number of individual of a particular species x 100) / Total number of sites}

3. RESULTS

The survey was conducted in Rangamati of Chittagong Hill Tracts to collect and identify macrofungi associated with forest trees of that region. A total of 66 samples were collected and identified to 20 species under 17 genera and 15 families. Morphology of basidiocarp and spore characterization were recorded and shown in Table 1. Ecological characterization of collected macrofungi were recorded and presented in tabular form (Table 2).

4. DISCUSSION

During investigation, 66 macrofungi samples were collected from Rangamati and identified to 20 species under 15 families. One species of *Coprinus* namely *Coprinus disseminatus* and one unidentified species under the genus *Coprinus* were found with a frequency of 11.11% and 33.33% and a density of 5.56 and 52.78%, respectively. This *Coprinus* sp. was previously reported from Bangladesh and found in mangrove forest regions [19].

Moreover, two species of *Volvariella* under the family pluteaceae were detected such as *Volvariella dunensis* and *Volvariella gloiocephala* found on *Dalbergia sissoo* and humus respectively. During the collection of these speceis the temperature was 31°c to 35°c with the moist weather. *Volvariella gloiocephala* was previously reported on humus from south western regions of Bangladesh [20]. But in another study *Volvariella hypoithys* and *V. speciosa* was reported from mongla and Sarankhola Upazilla of Bagerhat district of Bangladesh in association with rice straw and humus respectively [19]. One species of *Ganoderma* under the family ganodermataceae namely *Ganoderma lucidum* was found during investigation with the frequency of 11.11% and density of 2.78%. The species was found on the predominant Teak/Segun (*Tectona grandis*) tree. During the collection of *Ganoderma* species the weather was moist in nature and the temperature range was 34°c to 36°c. The genus *Ganoderma* was also reported in China [21], India [22,23,24,25,26,27] and also in Bangladesh [9,10,11].

Table 1. Morphology of basidiocarp and characterization of basidiospore of collected macrofungi from Rangamati of Chittagong hill tracts

Species name	Common name	Characterization	
		Basidiocarp	**Spore**
Coprinus sp.	Hairy, shaggy, lawyer's wig or shaggy mane	Texture of the fruiting body was soft and spongy. Pileus was convex and ovate shaped, dark brown in +color with creamy scale. Size of basidiocarp was 3.1×0.8 cm. The surface character and zonation were scaly and moist in nature. Margin regular shaped and stipe was present. Black colored crowded gills were present.	Dark brown in color, thick walled, smooth, ellipsoid and size of spores was 13.1×6.8 µm.
Coprinus disseminatus	Fairy inkcap or trooping crumble cap	Texture of the fruiting body was soft and spongy. Pileus was convex and cream colored. Size of basidiocarp was 1.3×0.3 cm. The surface character and zonation were moist in nature. Margin smooth and round shaped and stipe was present. Light brown colored less crowded gills were present.	Light brown in color, thick walled, smooth and ellipsoid to oval and size of spores was 8.32×4.7 µm.
Volvariella dunensis	Straw mushroom	Texture of the fruiting body was soft and spongy. Pileus was convex, white with black in center. Size of basidiocarp was 4.2×2.1 cm. The surface character and zonation were moist in nature. Margin regular, smooth and round shaped and stripe was present. Brown with creamy colored and less crowded gills were present.	Hyaline to light brown in color, thick walled, smooth, oval to ellipsoid. The size of spores was 7.8×4.3 µm.
Volvariella gloiocephala	Big sheath mushroom, rose-gilled grisette, or stubble rosegill	Texture of the fruiting body was soft and spongy. Pileus was flat and velvety, cream colored. Size of basidiocarp was 8.0×3.0 cm. The surface character and zonation were moist in nature. Margin regular, smooth and round shaped and stipe was present. Creamy with light brown colored and less crowded gills were present.	Light brown to light yellowish in color, thick walled, smooth, oval and ellipsoid. The size of spores was 14.1×8.2 µm.
Ganoderma lucidum	Lingzhi, Youngzhi or Reishi mushroom	Texture of the fruiting body was tough and woody. Pileus was flat shaped, chocolate colored. Size of basidiocarp was 2.5×2.6 cm. The surface character and zonation were less dry in nature. Margin regular, smooth and round shaped and pseudostype stipe was present. White colored crowded micro pores were present.	Hyaline to light brown in color, thick walled, smooth and oval. The size of spores was 4.6×3.1 µm.
Marasmius rotula	The pinwheel mushroom, the pinwheel marasmius, the little	Texture of the fruiting body was tough and woody. Pileus was ovate shaped, milky white in color. Size of basidiocarp was 2.5×0.6 cm. The surface character and zonation were less moist in nature. Margin regular shaped, crenate and wavy and stipe was	Deep brown in color, thick walled, smooth and round. The size of spores was 11.3×6.7 µm.

Species name	Common name	Characterization	
		Basidiocarp	**Spore**
	wheel, the collared parachute, or the horse hair fungus.	present. white colored, split-gills were present.	
Polyporus arcularius	Spring polypore.	Texture of the fruiting body was tough and brittle. Pileus was flat shaped, light brown in color. Size of basidiocarp was 2.5×1.5 cm. The surface character and zonation were rough and less dry in nature. Margin regular shaped, wavy and stipe was present. Light colored macro pores were present.	Brown in color, thin walled, rough and oval. The size of spores was 10.4×6.3 µm.
Cerrena unicolor	The mossy maze polypore	Texture of the fruiting body was tough and woody. Pileus was flat shaped, light green in color. Size of basidiocarp was 3.2×5.1 cm. The surface character and zonation were rough and less dry in nature. Margin regular shaped, wavy and stipe was absent. Brown colored macro pores were present.	Light brown in color, thick walled, smooth and ellipsoidal. The size of spores was 7.4×4.2 µm.
Trametes sp.	Polypore mushroom	Texture of the fruiting body was tough and brittle. Pileus was flat shaped, white and brick red in color. Size of basidiocarp was 7.1×3.8 cm. The surface character and zonation were leathery and less moist in nature. Margin irregular shaped, wavy and pseudostipe was present. White colored crowded macro pores were present.	Light brown in color, rough and oval. The size of spores was 12.3×8.6 µm.
Xylaria polymorpha	Dead man's fingers	Texture of the fruiting body was tough and brittle. Pileus was finger shaped and black in color. Size of basidiocarp was 4.1×0.4 cm. The surface character and zonation were smooth and less dry in nature. Black colored crowded micro pores were present.	Light brown in color, thick walled, smooth and ellipsoidal. The size of spores was 8.3×8.1 µm.
Xylaria hypoxylon	The candlestick fungus, the candlesnuff fungus, carbon antlers or the stag's horn fungus	Texture of the fruiting body was tough and brittle. Pileus was thin finger shaped and brown in color. Size of basidiocarp was 4.6×0.45 cm. The surface character and zonation were smooth, glabrous and less moist in nature. The white color crowded macro pores were present.	Light brown in color, thick walled, smooth and round. The size of spores was 16.1×12.1 µm.
Coprinellus domesticus	The firerug inkcap	Texture of the fruiting body was soft and spongy. Pileus was convex shaped, brown with brick red color. Size of basidiocarp was 3.2×1.6 cm. The surface character and zonation were	Brown in color, thick walled, smooth, ellipsoid and oval. The size of spores was 10.1×6.2 µm.

Species name	Common name	Characterization	
		Basidiocarp	**Spore**
		smooth, glabrous and less dry in nature. Margin regular shaped and stipe was present. The light creamy colorless crowded gills were present.	
Auricularia cornea	The Jew's ear, wood ear, jelly ear	Texture of the fruiting body was soft, spongy and jelly like. Pileus was ear shaped and purple in color. Size of basidiocarp was 2.1×1.6 cm. The surface character and zonation were moist in nature. Margin irregular shaped and pseudostipe was present. Purple colored extremely crowded micro pores were present.	Dark brown in color, thick walled, smooth and oval. The size of spores was 11.4×8.2 µm.
Mycena sp.	Light mushroom	Texture of the fruiting body was soft and spongy. Pileus was conical shaped and light brown with black in color. Size of basidiocarp was 5.7×1.4 cm. The surface character and zonation were less moist in nature. Margin regular shaped and stipe was present. Black colored and less crowded gills were present.	Deep black in color, thick walled, smooth, oval and ellipsoid. The size of spores was 12.3×8.4 µm.
Steccherinum ochraceum	Ochre spreading tooth	Texture of the fruiting body was tough and brittle. Pileus was flat shaped and light brown in color. Size of basidiocarp was 7.1×12.2 cm. The surface character and zonation were dry in nature. Pileus margin was irregular in shape and tightly attached with the host. Milky white colored crowded teeth were present.	Light brown in color, thick walled, rough and ellipsoid. The size of spores was 12.3×10.2 µm.
Clavulina coralloides	White coral or crested coral fungus	Texture of the fruiting body was soft, tough and brittle. Pileus was complex and branched and white in color. Size of basidiocarp was 5.6×4.3 cm. The surface character and zonation were moist in nature. White colored crowded tiny micro pores were present under the cap.	Brown in color, thick walled, rough and ellipsoid. The size of spores was 7.3×4.8 µm.
Gomphus clavaticus	Pig's ears or the violet chanterelle	Texture of the fruiting body was tough and brittle. Pileus was infundibuliform and light brown in color. Size of basidiocarp was 5.6×3.4 cm. The surface character and zonation were scaly and dry in nature. Light-yellow colored crowded micro pores were present under the cap.	Light brown in color, thick walled, smooth and round. The size of spores was 10.4×8.6 µm.
Cantharella sp.	Chanterelles	Texture of the fruiting body was soft and spongy. Pileus was depressed and deep brown in color. Size of basidiocarp was 3.8×2.4 cm. The surface character and zonation were less dry in nature. Margin regular shaped and brown color stipe was present. Yellow colored less crowded gills were present under the cap.	Black in color, thick walled, smooth and round. The size of spores was 12.3×12.1 µm.

Species name	Common name	Characterization	
		Basidiocarp	Spore
Clitopilus prunulus	The miller or the sweetbread mushroom	Texture of the fruiting body was soft and spongy. Pileus was umbilicate shaped and milky white in color. Size of basidiocarp was 3.6×2.5 cm. The surface character and zonation were moist in nature. Margin regular shaped and light brown color with presence of powdery substances. Milky white and less crowded gills were present under the cap.	Brown in color, thin walled, rough and oval. The size of spores was 9.2×7.3 µm.
Laccaria sp.	Deceiver	Texture of the fruiting body was crack and spongy. Pileus was convex shaped and dark brown in color. Size of basidiocarp was 3.4×1.8 cm. The surface character and zonation were moderately moist in nature. Margin regular shaped and pale color stipe was present. Light brown colored with less crowded gills were present under the cap.	Deep brown in color, thick walled, rough, ellipsoidal and oval. The size of spores was 9.8×6.1 µm.

Table 2. Ecological characterization of collected macrofungi from Rangamati of Chittagong hill tracts

Species name	Family name	Host	Location	Habit	Frequency (%)	Density (%)	Temp. (°c)	Soil type	Weather conditions
Coprinus sp.	Agaricaceae	Soil surface	Kawkhali	Scattered and unabundant	11.11	5.56	28–29	Sandy to sandy loam	Moist
Coprinus disseminatus	Agaricaceae	Soil surface	Rangunia, Kaptai and Manikchari	Clustered and unabundant	33.33	52.78	28-29	Sandy	Moist
Volvariella dunensis	Pluteaceae	*Dalbergia sissoo*	Kaptai	Scattered and unabundant	11.11	2.78	31- 35	Loamy	Moist
Volvariella gloiocephala	Pluteaceae	Humus	Kawkhali	Solitary and unabundant	11.11	2.78	31- 35	Sandy to sandy loam	Moist

Species name	Family name	Host	Location	Habit	Frequency (%)	Density (%)	Temp. (°c)	Soil type	Weather conditions
Ganoderma lucidum	Ganodermataceae	*Tectona grandis*	Kaptai	Solitary and unabundant	11.11	2.78	34-36	Sandy to sandy loam	Moist
Marasmius rotula	Marasmiaceae	Soil surface	Kaptai	Scattered and unabundant	11.11	8.33	29-30	Clay to clay loam	Moist
Polyporus arcularius	Polyporaceae	*Albizia procera*	Kaptai	Solitary and unabundant	11.11	2.78	31-35	Clay to clay loam	Less moist
Cerrena unicolor	Polyporaceae	*Albizia lebbeck*	Kaptai and Kawkhali	Clustered and abundant	22.22	27.78	28-30	Sandy to clay loamy	Moist
Trametes sp.	Polyporaceae	*Albizia lebbeck*	Kaptai	Scattered and abundant	22.22	13.89	25-31	Clay to clay loamy	Moist
Xylaria polymorpha	Xylariaceae	*Dalbergia sissoo*	Rangunia, Kaptai, Manikchhari and Ruma	Scattered and abundant	44.44	55.56	28-36	Clay to clay loamy	Moist
Xylaria hypoxylon	Xylariaceae	*Macrophyla mahogoni*	Kaptai, Manikchhari and Lama	Scattered and abundant	33.33	27.78	28-36	Clay to clay loam	Moist
Coprinellus domesticus	Psathyrellaceae	Soil surface	Kaptai	Scattered and unabundant	11.11	2.78	28-29	Sandy to sandy loam	Moist
Auricularia cornea	Auriculariaceae	*Bambusa vulgaris*	Kaptai and Kawkhali	Clustered and unabundant	22.22	38.89	25-32	Clay to clay loam	Moist
Mycena sp.	Mycenaceae	Soil surface	Kaptai	Scattered and unabundant	11.11	5.56	34	Sandy to sandy loam	Moderately moist

Species name	Family name	Host	Location	Habit	Frequency (%)	Density (%)	Temp. (°c)	Soil type	Weather conditions
Steccherinum ochraceum	Steccherinaceae	*Artocarpus chaplasha*	Kaptai	Solitary and unabundant	11.11	2.78	34	Sandy to loamy	Dry
Calvulina coralloides	Clavulinaceae	Soil surface	Kaptai, Manikchhari and Kawkhali	Scattered and unabundant	30.56	16.67	34-36	Loamy	Moderately moist
Gomphus clavaticus	Gomphaceae	*Albizia lebbeck*	Kaptai	Solitary and unabundant	11.22	2.78	29-32	Sandy	Dry
Cantharella sp.	Cantharellaceae	*Macrophyla mahogoni*	Kaptai	Scattered and unabundant	13.88	11.11	29-31	Sandy to sandy loam	Dry
Clitopilus prunulus	Entolomataceae	Soil surface	Kaptai	Clustered and unabundant	11.11	13.89	28-29	Sandy to clay loam	Moist
Laccaria sp.	Hydnangiaceae	*Dalbergia sissoo*	Rowangchhari	Solitary and unabundant	11.11	2.78	32-33	Sandy	Moist

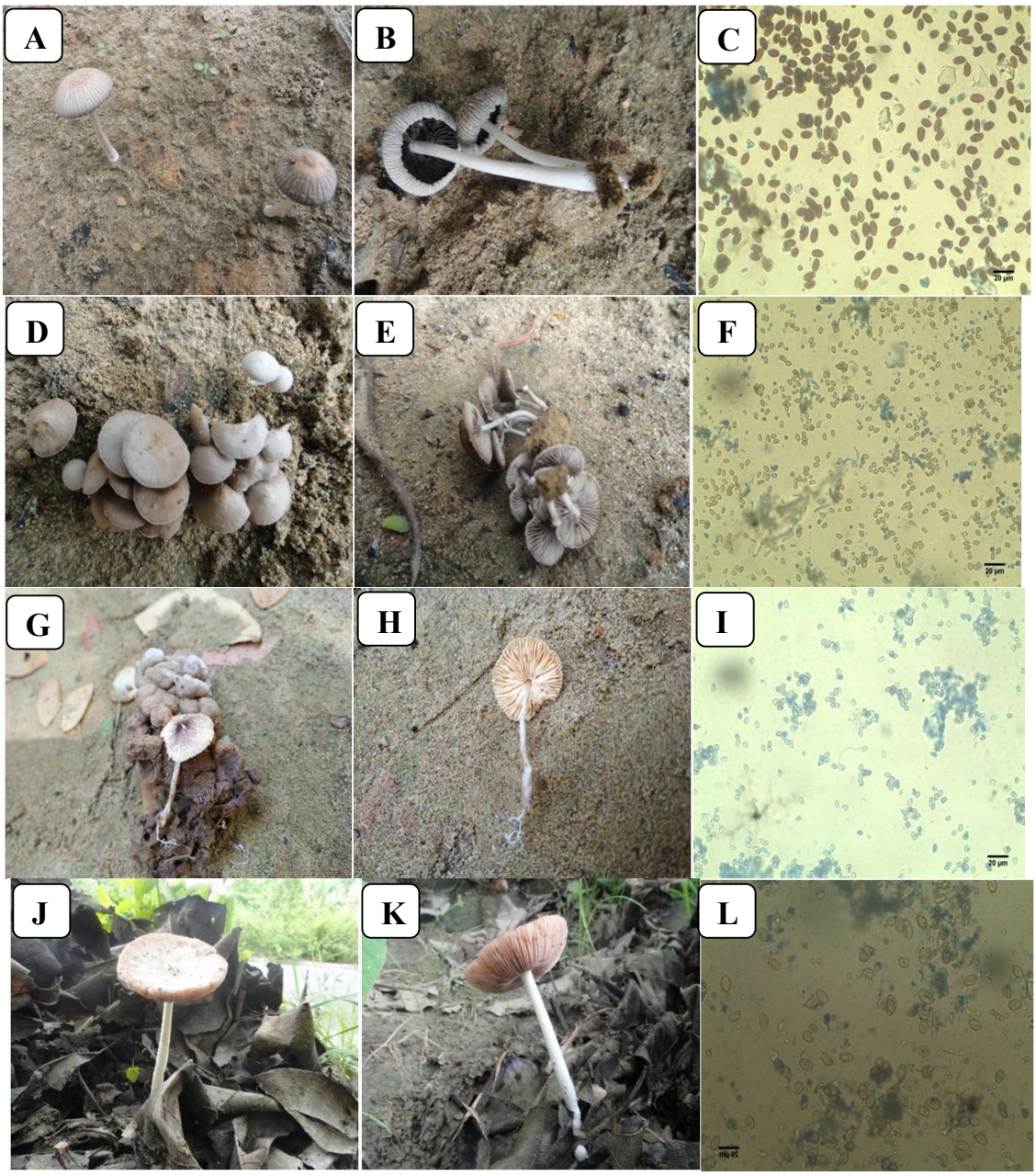

Fig. 2. Fruiting body of *Coprinus* sp.(A), Gills(B), Spores(C); *Coprinus disseminatus* (D), Gills(E), Spores(F)*; Volvariella nigrovolvacea* (G), Gills(H), Spore(I); *Volvariella gloiocephala* (J), Gills (K), Spores (L)

One species of *Marasmius* under the family marasmiaceae was identified as *Marasmius rotula* on the soil surface. The species was scattered in distribution with unabundant in occurrence and found in the moist weather with the range of 29°c to 30°c temperature. This species was also reported in madagascar as well as the Mascarenes [28] and also in Mangrove forest of Bangladesh [19]. *Marasmius* sp. was also reported from tropical moist deciduous forest region of Bangladesh [29]. Two species under Polyporaceae family such as *Polyporus arcularius* and *Cerrena unicolor* and one unidentified species *Trametes* sp. was collected from Kaptai. Among them *Polyporus arcularius* was found associated with Koroi (*Albizia procera*)

tree with the temperature ranged from of 31°c to 35°c and the frequency and density of this fungus was 11.11% and 2.78% respectively. Both of the species was not previously reported from Bangladesh. *Trametes versicolor* and *T. elegans* were previously recorded from mangrove forest region of Bangladesh in association with *Cocos nucifera* tree [10] though in the present study the genus was found associated with *Albizia lebbeck* tree. The genus was scattered and abundant in the Rangamati hill tracts forest though both of the species was found as solitary and scattered, respectively in mangrove forest.

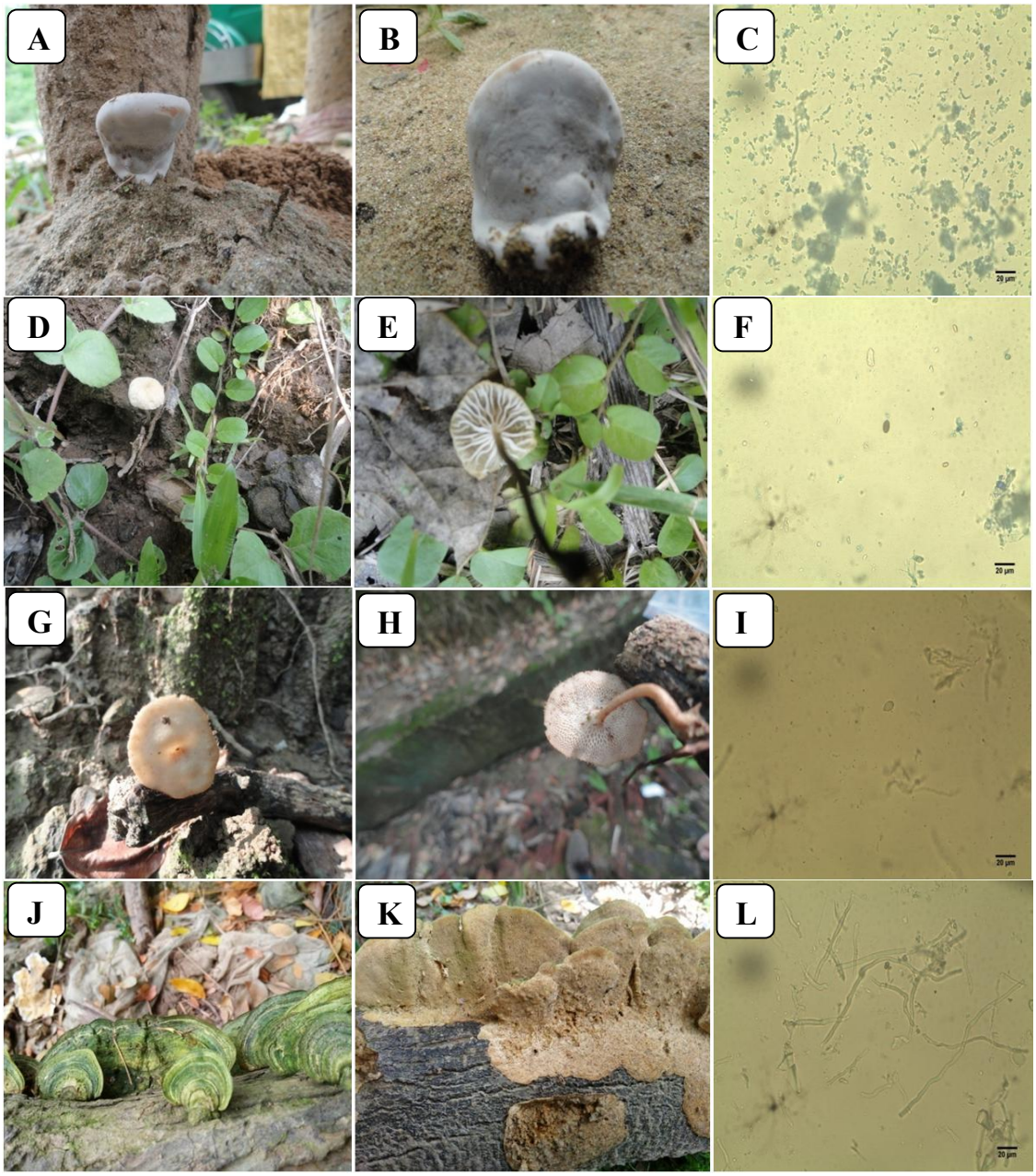

Fig. 3. Fruiting body of *Ganoderma zonatum* (A), Pores(B), Spores(C); *Marasmius rotula* (D), Gills(E), Spores(F); *Polyporus arcularius* (G), Macro pores(H), Spore(I); *Cerrena unicolor* (J), Pores (K), Spores (L)

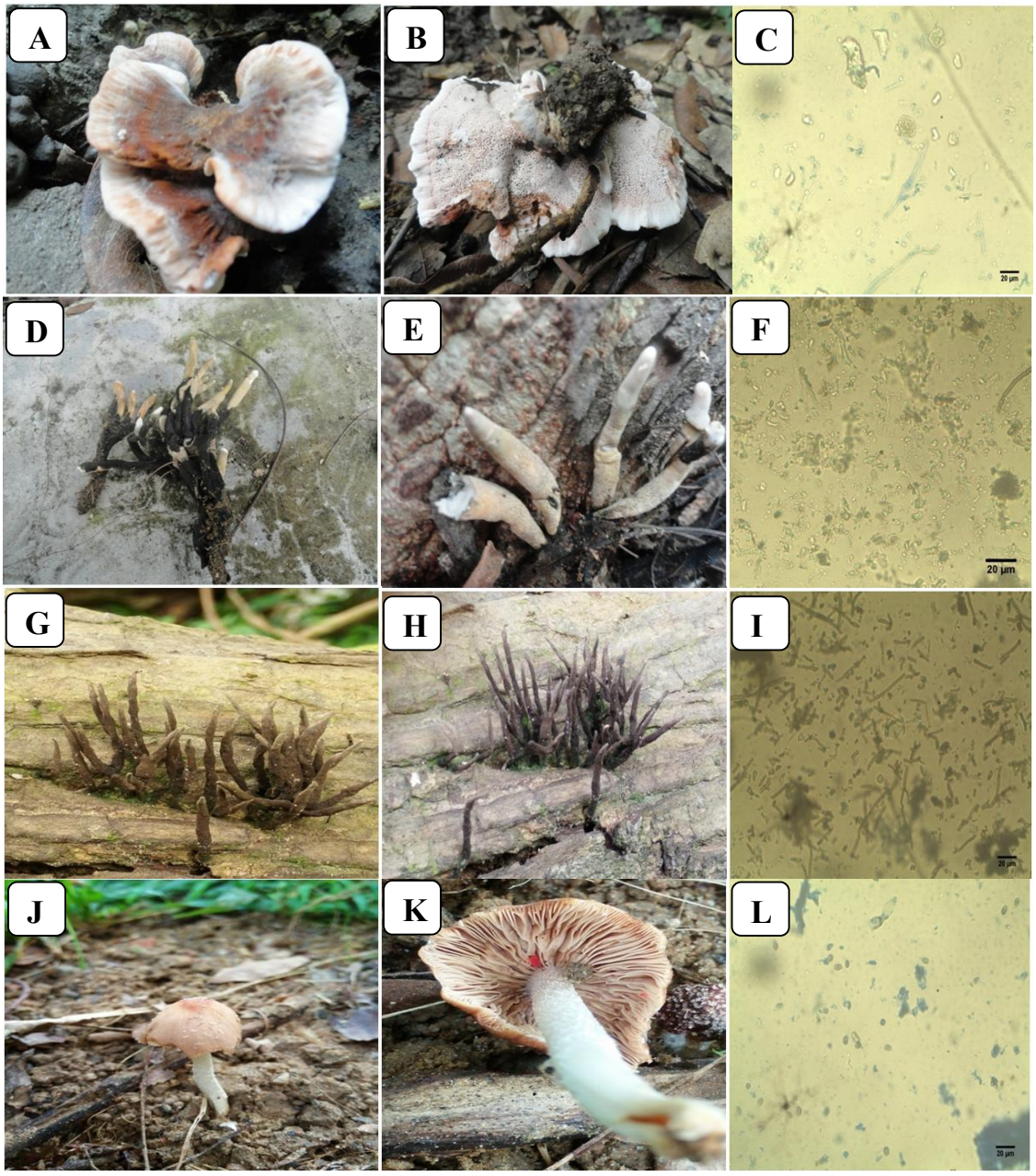

Fig. 4. Fruiting body of *Trametes* sp. (A), Pores (B), Spores (C); *Xylaria polymorpha* (D), Pores (E), Spores (F); *Xylaria hypoxylon* (G), Pores (H), Spore (I); *Coprinellus domesticus* (J), Gills (K), Spores (L)

Xylaria hypixylom and *Xylaria polymorpha* were found with the frequency and density of 33.33% and 44.44%; and 27.78% and 55.56%, respectively. One species was identified under the family Psathyrellaceae as *Coprinellus domesticus* on the soil surface with the frequency of 11.11% and density of 2.78%. One species of *Auricularia cornea* was found in association with the Bamboo (*Bambusa vulgaris*) tree with a frequency and density of 22.22% and 38.89%, respectively. This species was also reported from mangrove forest region of Bangladesh in association with *Albizia saman* (Rain tree).

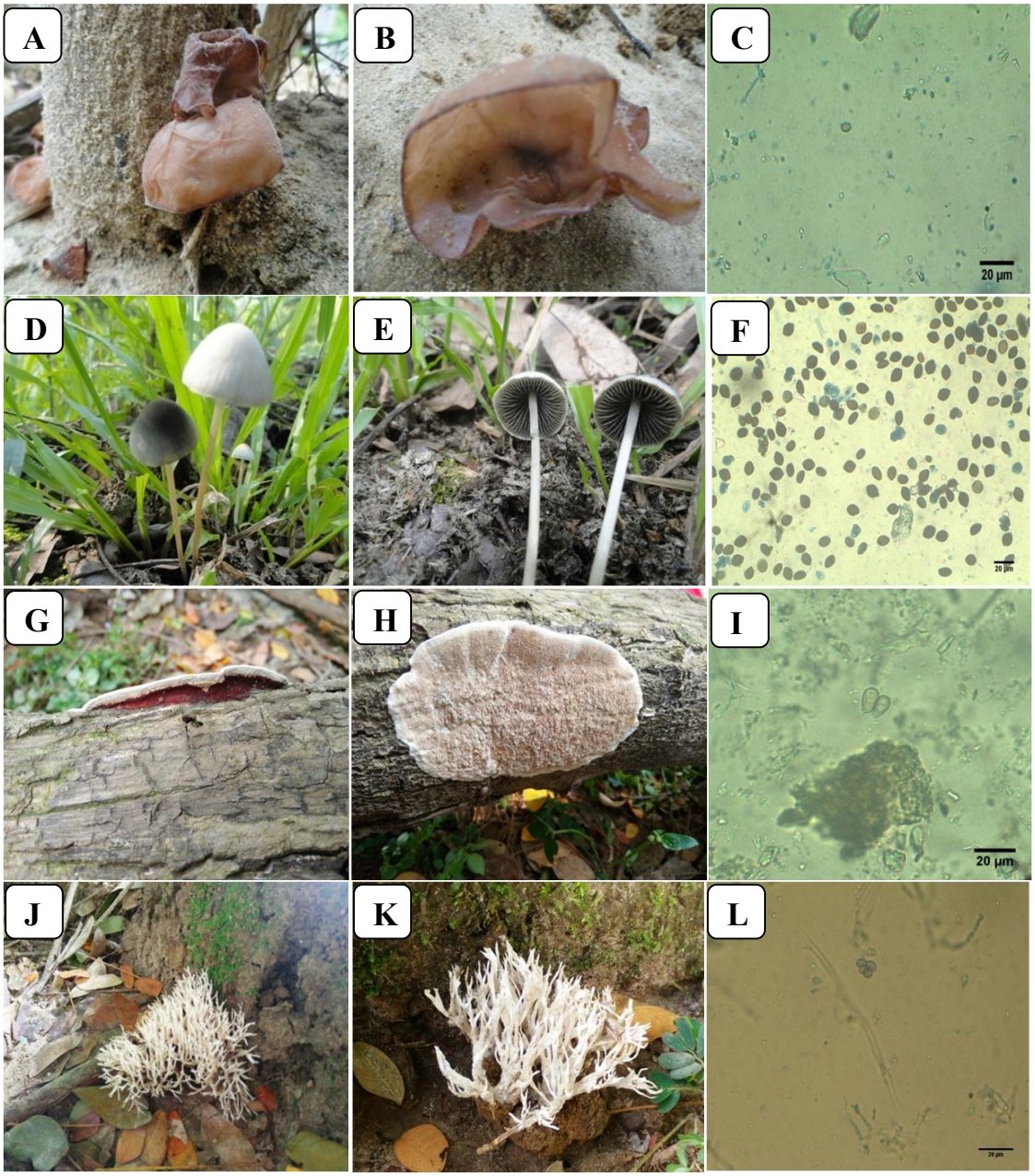

Fig. 5. Fruiting body of *Auricularia cornea* (A), Pores (B), Spores (C); *Mycena* sp. (D), Gills (E), Spores (F)*; Steccherinum ochraceum* (G), Teeth (H), Spore (I); *Calvulina coralloides* (J), Pores (K), Spores (L)

Mycena sp. was identified on soil surface and this genus was previously found on soil surface of Mangrove forest region of Bangladesh [19] and on *Swietenia mahogani* and *Eucalyptus citriodora* tree of botanical garden, Mirpur, Dhaka, Bangladesh under tropical moist deciduous forest region [29]. *Steccherinum ochraceum* under the family of steccherinaceae was collected from the dominant Chapalish tree (*Artocarpus chaplasha*) in dry weather at 34°c. This species was collected and identified from the mangrove forest regions of Bangladesh in association with *Swietenia mahagoni* tree [10]. One species of each of *Calvulina coralloides* and *Gomphus clavaticus* were detected on soil

surface and Rain tree (*Albizia lebbeck*), respectively.

Cantharella sp. was collected from dead trunk of Mahogony (*Macrophyla mahogoni*) tree in dry weather with the range of 29°c to 31°c. This species was not previously reported from any forest regions of Bangladesh.

One species of *Clitopilus prunulus* was collected from soil surface in Rangamti with the frequency of 11.11 and density of 13.89% in moist weather

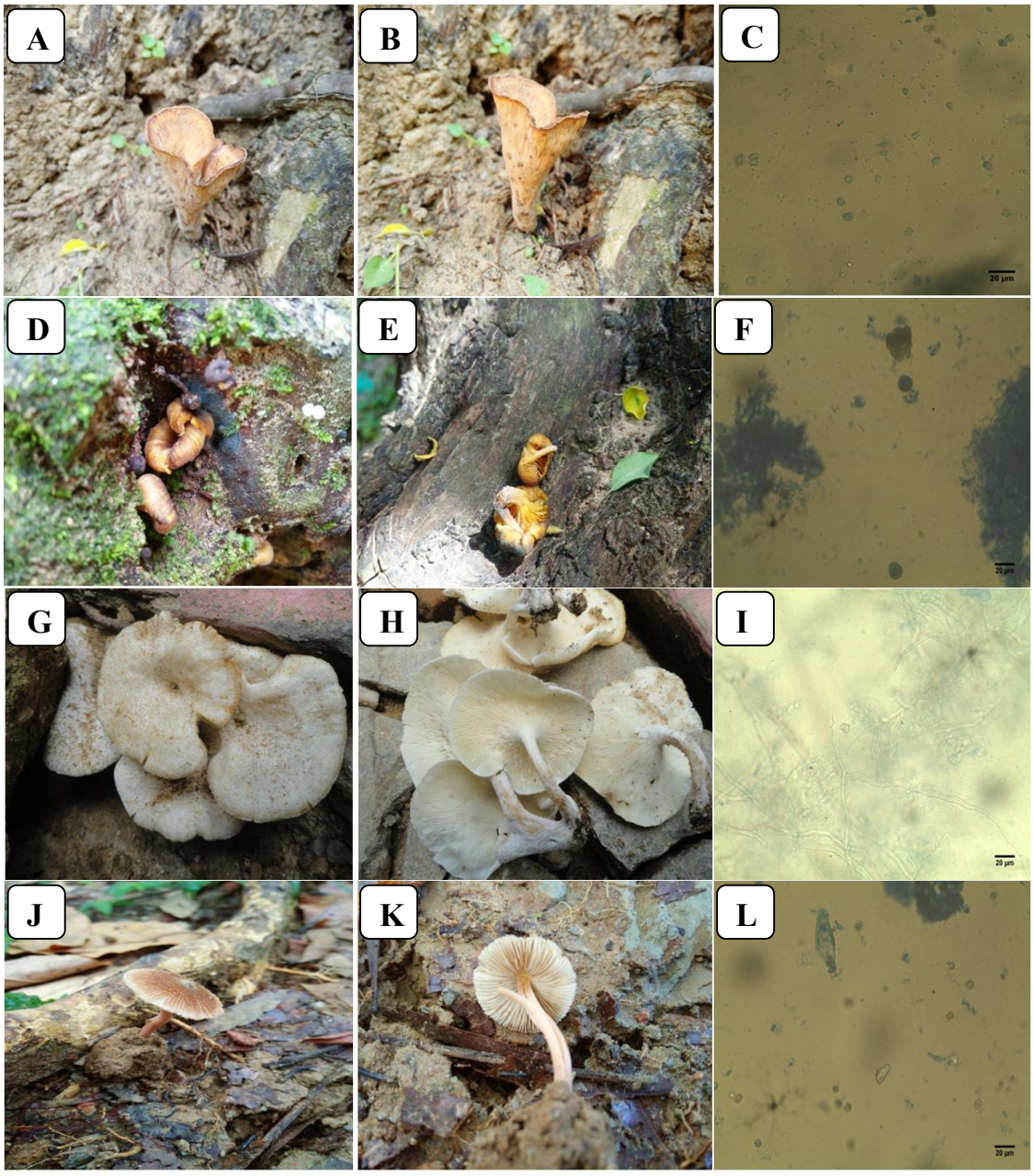

Fig. 6. Fruiting body of *Gomphus clavaticus* (A), Pores (B), Spores (C); *Cantharella* sp. (D), Gills (E), Spores (F)*; Clitopilus prunulus* (G), Gills (H), Spore (I); *Laccaria* sp. (J), Gills (K), Spores (L)

with the temperature ranged from 28°c to 29°c. The species was previously reported from mangrove forest region of Bangladesh in association with *Albizia saman* tree [19]. *Laccaria* sp. under the family hydnangiaceae was identified on *Dalbergia sissoo* tree with the frequency and density of 11.11% and 2.78%, respectively. During the collection time the temperature ranged from 32°c to 33°c.

5. CONCLUSION

After morphological and ecological study in both field and laboratory and spore ornamentation under microscope 20 different species were found from 66 collected samples. So, this study reveals that the Rangamti hill has the important source of wild macrofungi which might be helpful to reduce the unemployment problem by identifying the edible and medicinal macrofungi as well as to improve the economic status of our farmers.

ACKNOWLEDGEMENTS

We thank anonymous reviewers for their kind reviewing this article. This research work was supported by University Grants Commission (UGC), Bangladesh through a grant to F. M. Aminuzzaman (Research Grant No-6(75)/UGC/RSP/Sci. & Tech./Biol.(41)/2015.

COMPETING INTERESTS

Authors have declared that no competing interests exist regarding the publication of this paper.

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Peer-review history:
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