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A checklist of wild mushroom diversity and distribution in the Jahangirnagar University campus area, Bangladesh

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Abstract

This comprehensive study focuses on a checklist survey of wild mushrooms and documents their morphological variability and diversity at Jahangirnagar University, a natural and social forest area in Bangladesh. Through field studies on the campus grounds from June to October 2021, 60 samples were collected from which 40 species were identified by morphological characters, belonging to 33 genera, 26 families, and 10 orders. Most species were identified from the order Agaricales and the highest frequency (83.33%) from the orders Polyporales and Agaricales. The highest species abundance was 83.33% for *Ganoderma* spp., *Crepidotus applanatus* and the density was 70% for *Marasmiellus candidus*. The dominant species were *Ganoderma* spp., *Coprinus disseminates, Marasmius* spp., *Schizophyllum commune, Calvulina coralloides.* The wild mushrooms were prevalent in the natural forest areas of the Jahangirnagar University campus. As far as we are aware, this report is the very first work on wild mushrooms or macro-fungi on the campus of Jahangirnagar University. This survey shows that the campus grounds are enriched with a wide variety of wild mushrooms.

Key words: Wild mushroom, identification, distribution, diversity, Jahangirnagar University.

INTRODUCTION

Mushrooms are an extremely diverse group of organisms, found all around the world. A variety of ecosystem services are contributed by wild mushrooms (Karavani *et al*., 2018). For crop diversification in developing countries like Bangladesh as well as around the world, mushrooms are now one of the promising concepts. The diversity of fungi including mushrooms conquers a major place in the biological world with its natural beauty (Rashid *et al*., 2017). A mushroom or toadstool is the fleshy, spore-bearing fruiting body of a fungus, typically produced above ground, on the ground, or as its food source. Mushrooms are fruiting bodies of macroscopic, filamentous and epigeal fungi composed of hyphae forming an interwoven web of tissue known as mycelium in the substrate on which the fungus feeds; most often their mycelia are buried in the soil around the root of trees, beneath leaf litter, in the tissue of the tree trunk or in their nourishing substrate (Ramsbottom, 1989). The mushroom is mainly used for the fruiting bodies of macrofungi (Ascomycota & Basidiomycota) and is characterized by a short reproductive stage in their life cycle (Das, 2010).

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Mushrooms consist of at least 12,000 species of fungi, of which at least 2000 species are considered edible mushrooms (Chang, 1999). According to Deshmukh, about 41,000 species of fungi were represented by mushrooms alone, and 850 species have been reported from India, most of which belong to the Agaricales, also known as gilled mushrooms (because of the distinct gills) or euagarics (Deshmukh, 2004). To date, around 1200 species of mushrooms out of 14000 species of the order Agaricales, Russulales, and Boletales, have been documented which contribute 10 percent to the global fungal flora (Rai *et al*., 2005).

Macro fungi play an important role in the maintenance of ecosystem by contributing to carbon cycles and also by mobilizing of nitrogen and phosphorus nutrients and thus contributing to the survival of other species (Alam *et al*., 2007; Thormann, 2006; Read *et al*., 2003). For thousands of years, people have been gathering wild edible mushrooms and consuming these mushrooms, as well as using them for medicinal purposes. They contribute as a source of food, income, and health and are becoming a source of income for various rural populations in developing countries (Wani *et al*., 2010; Yoon *et al*., 2011; Alam *et al*., 2019). Compared to commercial mushrooms, wild mushrooms contain less fat and are high in protein (Barros *et al*., 2008; Yoon *et al*., 2012; Alam *et al*., 2010).

Jahangirnagar University (JU) campus is a visually appealing, semi-natural and social forest area, located in Savar Upazila city and Dhaka metropolitan area, known for its natural beauty with rich biodiversity. This campus was a part of the Madhupur Tract, the deciduous forest of Sal in Bangladesh. But it has now been replaced with mixed vegetation and a social forestry practice area. Due to its alluring nature, the number of visitors has increased in recent years, leading to increasing damage to the ecosystem from various human activities. Various baseline data from biodiversity assessments are required for management and conservation purposes. In addition, several surveys of flora and fauna have been conducted on the site of Jahangirnagar University campus (Khan *et al*., 2021; Jahan *et al*., 2018; Akter *et al*., 2013), but studies of fungal flora have not yet been conducted.

To assess the damage or maturity of an ecosystem, the presence or absence of fungi, including mushrooms can be a useful indicator (Egli, 2011). So, it is worth knowing about the status of fungal species at Jahangirnagar University. In addition, the conservation of vegetation in semi-urban areas offers enormous benefits, particularly in terms of social, scientific, economic, and environmental concerns (Hunter, 2007). To achieve this goal, a checklist is very important to know the distribution of mushrooms with their habitat and biodiversity. This very first experiment was conducted to study and catalog the macrofungi and make a checklist of wild mushrooms in the Jahangirnagar University campus area to identify the wild mushrooms based on the morphology at genus and species level and finally learn about the distribution, abundance, and biodiversity of wild mushrooms.

MATERIALS AND METHODS

Collection site: The selected site is within the Jahangirnagar University campus area coordinating between 23.8671-23.8977E and 90.2588-90.2731N, with 282.29 hectares of land. This university is located on the west side of the Asian Highway (Dhaka-Aricha Road), and the distance from the capital is 32 km. in Savar Upazila in the capital Dhaka, Bangladesh. The university has a tropical wet and dry monsoon climate, significant humidity, moderate rainfall and high temperatures (Mondol *et al*., 2019). July and August receive the most rainfall with a total of 919.54 mm of precipitation (https://www.worldweatheronline.com/jahangirnagarweather/bd.aspx). The meeting places were residential areas, natural forests, social forests, academic building areas and riparian vegetation of the Jahangirnagar University campus shown on the map (Figure 1).

Experimental laboratory: This experiment was carried out in the Mycology and Plant Pathology laboratory of the Department of Botany, Jahangirnagar University, Dhaka, Bangladesh.

Sampling procedure: The required collection procedure and the data analysis procedure is based on biodiversity, distribution, habitat and mushroom morphology in the above region in a small part of the Madhupur tract in Bangladesh. But it mainly focuses on the biodiversity of macrofungal vegetation.

Collection of mushrooms: From June to October 2021, a detailed survey was conducted in the area of Jahangirnagar University, Savar, Dhaka, Bangladesh to determine the morphological variability of the mushroom population using the Hailing methodology (Hailing, 1996). Determination of the biodiversity of the mushroom population. Spotted mushrooms have been observed in their natural habitat. Photograph each mushroom and the top and back two sides of it for detailed analysis. Then they were picked up from their location and taken to the laboratory of Mycology and Plant Pathology.

Morphological observation during the collection: The data to identify mushrooms were collected once a number of follow-up parameters such as forest type, habitat, location, habitat, cap morphological features such as color, surface area, gill morphological features such as color, stem as delineated (Srivastava & Bano, 2010). After collection, their identification was confirmed by comparing morphological features with the book Psilocybin Mushrooms of the world (Moore & O'Sullivan, 2013) and data from the following reference (Tanjim *et al*., 2019; Rahaman *et al*., 2016; Marzana *et al*., 2018; Das & Aminuzzaman, 2017).

Mushroom processing: To remove the garbage, carefully wash the collected mushroom with distilled water. After that, those few minutes stayed outdoors to dry the water.

Drying: To prevent microbial growth and proliferation, drying is the best option. This procedure was carried out by a mechanical dewatering process. The samples were wrapped in the newspaper for 1-3 days at 25-30°C in the incubator. This parameter depends on its texture and structure. This procedure easily dehumidified the samples.

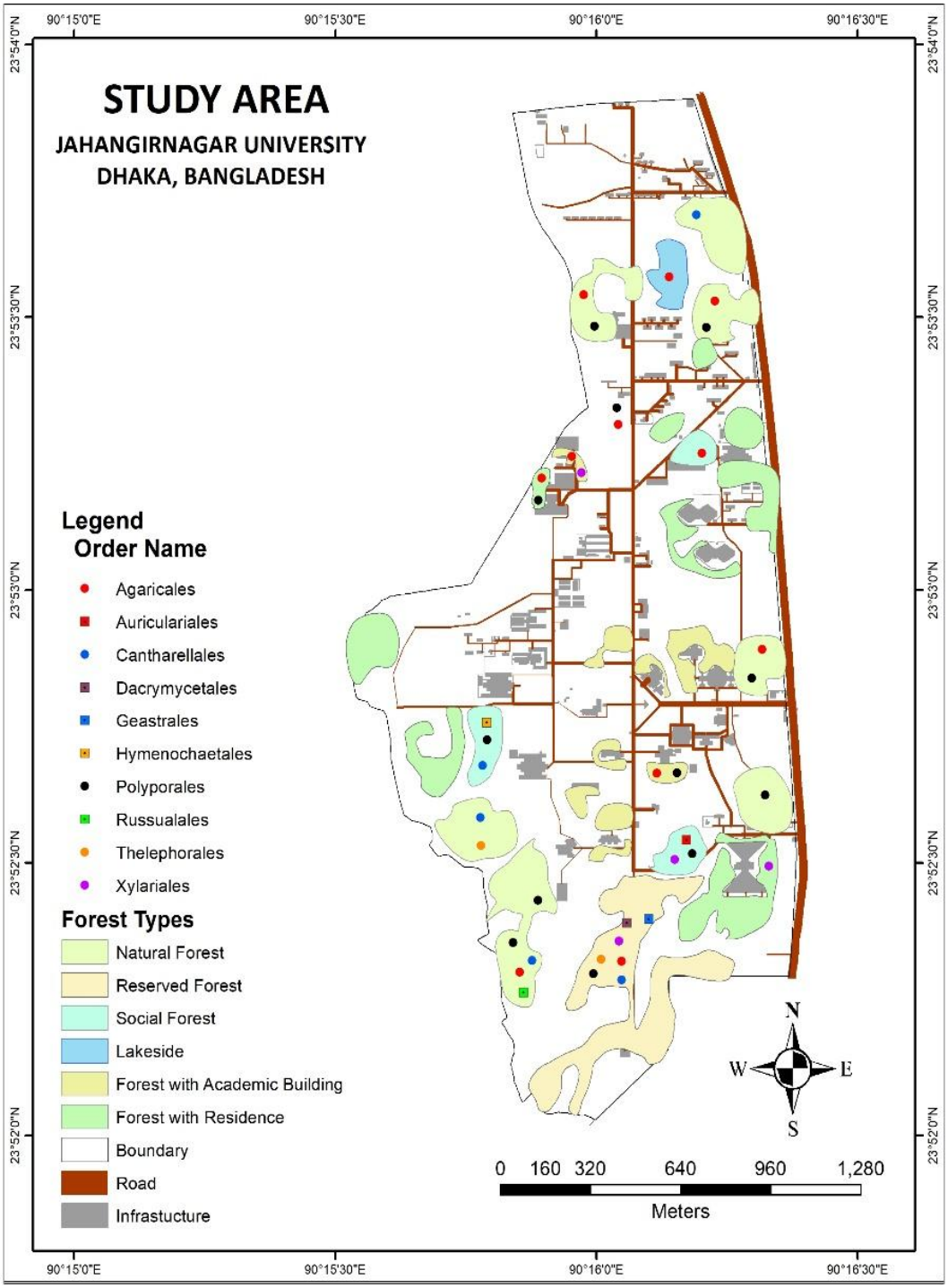

Fig. 1. The map showing different orders present in different areas of the Jahangirnagar University campus area

Storage: Dried mushrooms were stored in a clean glass jar with a solution of 4% FAA (Formalin Aceto Alcohol). Specimens were preserved in the Plant Pathology and Plant Protection laboratory of JU.

Habitat, distribution, and diversity analysis: Same specimens were found on the living host and some were found on dead trees, some are found on humas and some were found on the surface of the soil. They were attached to various substrata. Mushroom biodiversity of the surrounding environment was recorded during collection. For further study, photographs were taken, wrapped the mushrooms in a polybag, and bought in the lab. The frequency and density of different species have been determined by the following formulas (Zoberi, 1993).

Frequency of fungal sp. (%) = (Number of the site in which the sp. is present/Total number of sites) x 100

Density (%) = (Total number of individuals of the particular species/ Total number of species) x 100

RESULTS AND DISCUSSION

The survey was conducted after rain and the temperature was 27°C to 30°C. 40 species belonging to 26 families and 10 orders were identified. The orders identified were Polyporales, Agaricales, Auriculariales, Cantharellales, Russulales, Dacrymycetales, Gaestrales, Thelephorales, Hymenochaetales and Xylariales. The diversity, habitat, and morphology of their orders of collected fungi were documented and described using a checklist provided below.

Table 1. A checklist of Wild Mushrooms at Jahangirnagar University, Savar, Dhaka

Serial No.	Scientific Name	Common Name	Family	Frequency	Density	Habitat	Habit
I	**Polyporales**						
01	*Ganoderma lucidum*	Reishi mushroom	Ganodermataceae	83.33333	55	NF, SF, RF FwR, FwA	Solitary and abundant
02	*Ganoderma sessile*	Rocky mushroom	Ganodermataceae	66.66667	45	NF, FwA, SF, RF	Solitary and abundant
03	*Ganoderma lingzhi*	Bracket Mushroom	Ganodermataceae	16.66667	5	SF	Solitary and abundant
04	*Ganoderma applanatum*	Bracket Mushroom	Ganodermataceae	83.33333	55	RF, FwR, NF, SF, FwA	Solitary and abundant
05	*Daedaleopsis confragosa*	blushing bracket mushroom	Polyporaceae	16.66667	7.5	NF	Scattered and abundant
06	*Microporus xanthopus*	Yellow-footed Polypore	Polyporaceae	16.66667	2.5	RF	Solitary and abundant

07	*Merulius tremellosus*	trembling Merulius or jelly rot	Meruliaceae	33.33333	40	FwA, SF	Scattered and abundant
08	*Trametes gibbosa*	lumpy bracket	Polyporaceae	16.66667	22.5	FwR	Solitary and abundant
09	*Stereum ostrea*	False turke tail	Stereaceae	50	35	NF, SF, FwR	Scattred and unabundant
10	*Hexagonia hydnoides*	Hexagon bracket	Polyporaceae	16.66667	7.5	NF	ScatScattere d unabundant
II	**Agaricales**						
11	*Leucoagaricu samericanus*	-	Agaricaceae	50	37.5	FwA	Scattered and unabundant
12	*Coprinus disseminates*	Fairy in cap	Psathyrellaceae	66.66667	55	RF,NF, LB, FwR	Scattered and abundant
13	*Agaricus campestris*	Button mushroom	Agaricaceae	66.66667	25	SF, NF, LB, RF	Solitary and abundant
14	*Gymnopus sp.*	-	Omphalotaceae	50	30	SF, FwA, NF	Solitary and unabundant
15	*Panaeolus foenisecii*	Brown ha mushroom	Bolbitiaceae	16.666	2.5	RF	Solitary and unabundant
16	*Marasmius pulcherripes*	-	Marasmiaceae	66.66667	55	RF, NF, LB, FwR	Scattered abundant
17	*Crepidotus mollis*	Peeling oysterling	Inocybaceae	66.66667	5	SF, RF, NF, LB	Clustered and unabundant
18	*Marasmius siccus*	-	Marusmiaceae	66.66667	40	FwR, SF, RF, NF	Scattered unabundant
19	*Schizophyllu commune*	Splitgill mushroom	Schizophyllaceae	66.66667	40	RF, NF, SF, FwA	Scattered and abundant
20	*Inocybe Rimosa*	-	Inocybaceae	66.66667	40	LB, SF, FwA, NF	Solitary and unabundant
21	*Crepidotus applanatus*	Flat Oysterling	Crepidotaceae	83.33333	110	SF, RF, NF, FwR, FwA	Scattered and abundant
22	*Amanita melleiceps*	"Honey-Capped Amanita"	Amanitaceae	66.66667	10	FwA, SF, NF, RF	Solitary and unabundant
23	*Lyophyllum connatum*	White domecap	Lyophyllaceae	16.66667	22.5	FwA	Clustered and unabundant

24	*Marasmiellus candidus*	Fairy Parachutes	Marasmiaceae	66.66667	70	FwR, NF, RF, FwA	Scattered and unabundant
25	*Clitocybe nebularis*	Clouded Funnel	Tricholomataceae	16.66667	2.5	NF	Solitary and unabundant
26	*Mycena rosea*	rosy bonne or blushin bell-cap fungus	Mycenaceae	16.66667	45	RF	Solitary and unabundant
27	*Strobilurus esculentus*	Wulfen	Tricholomataceae	50	17.5	SF, NF, RF	Solitary and unabundant
28	*Clitocybula lacerate*		Marasmiaceae	66.66667	55	SF, NF, RF, FwR	Solitary and unabundant
29	*Gymnopus peronatus*	Wood woolly foot	Omphalotaceae	50	25	NF, RF, LB	Scattered and unabundant
30	*Leucocoprinus cygneus*		Agaricaceae	16.66667	5	FwR	Scattered and unabundant
31	*Clitopilus prunulus*	Sweetbread mushroom	Entolomataceae	16.67	2.5	FwA	Clustered and abundant
III	**Russualales**						
32	*Clavicorona pyxidata*	Coral mushroom	Auriscalpiaceae	16.66667	7.5	NF	Clustered and abundant
IV	**Cantharellales**						
33	*Calvulina coralloides*	Coral Mushroom	Clavulinaceae	66.66667	10	NF,SF RF, FwR	Clustered and abundant
V	**Xylariales**						
34	*Xylaria hypoxylon*	Candlestick fungus	Xylariaceae	16.66667	12	RF	Scattered and unabundant
35	*Daldinia concentrica*	Cramp ball Coal fungus	Hypoxylaceae	66.66667	50	FwR, SF, RF, FwA	Solitary and unabundant
VI	**Dacrymycetales**						
36	*Dacryopinax spathularia*	jelly fungus	Dacrymycetaceae	16.66667	55	RF	Scattered and unabundant
VII	**Geastrales**						
37	*Geastrum fimbriatum*	fringed earthstar	Geastraceae	16.66667	2.5	RF	Clustered and unabundant
VIII	**Auriculariales**						
38	*Auricularia auricula-judae*	Wood ear	Auriculariaceae	16.66667	25	SF	Solitary and unabundant
IX	**Thelephorales**						

39	*Thelephora dominicana*		Thelephoraceae	33.33	35	RF, NF	Scattered and abundant
X	**Hymenochaetales**						
40	*Hymenochaete rubiginosa*	Reddish brown crust	Hymenochaetaceae	16.66667	25	SF	Solitary and unabundant

Habitat: I to X orders of the recorded wild mushrooms. **NF**- Natural Forest; **SF**- Social Forest; **RF**- Reserve Forest; **FwA**- Forest with Academic Building; **FwR**- Forest with Resident; **LB**- Lake Bank.

I. Order, Polyporales: During the collection, a total of nine species were identified under polyporales order. These are *Hexagonia hydnoides, Ganoderma lucidum, Ganoderma sessile, Ganoderma lingzhi, Ganoderma applanatum, Daedaleopsis confragosa, Microporus xanthopus, Merulius tremellosa, Trametes gibbosa* and *Stereum ostrea.*

Habitat and biodiversity: The species of this order were almost all found in the areas of Jahangirnagar University during the investigation. The order was found in five regions out of six regions. Most species have been found on the trunk, rotting hardwood, foot, and root of trees. Such as *Hexagonia hydnoides, Ganoderma lucidum, Ganoderma sessile, Ganoderma lingzhi and Merulius tremellosa, Daedaleopsis confragosa*. Some have been found in the wound of dead or living trees. Such as -*Ganoderma applanatum, Microporus xanthopus and Stereum ostrea. Trametes gibbosa* has also been found on soil.

Morphology: The species of the order were dark brown in color and contained 3-4 mm square pores on the back (*Hexagonia hydnoides*) with red color, whitish margin, (*Ganoderma lucidum*), dark reddish to orange-red color with also whitish margin also (*Ganoderma sessile*), red or dark color, the cap looks like kidney (*Ganoderma lingzhi*), dark red with a white margin, the backside of the fruiting body is white (*Ganoderma applanatum*), dark brown color with a white margin, the white backside of the fruiting body (*Microporus xanthopus*), the actual color of the top white, but because of algal growth it looks greenish (*Trametes gibbosa*), light pink in color with a hairy surface and shell-like shaped (*Stereum ostrea*). Stipe was found in *Ganoderma lucidum*.

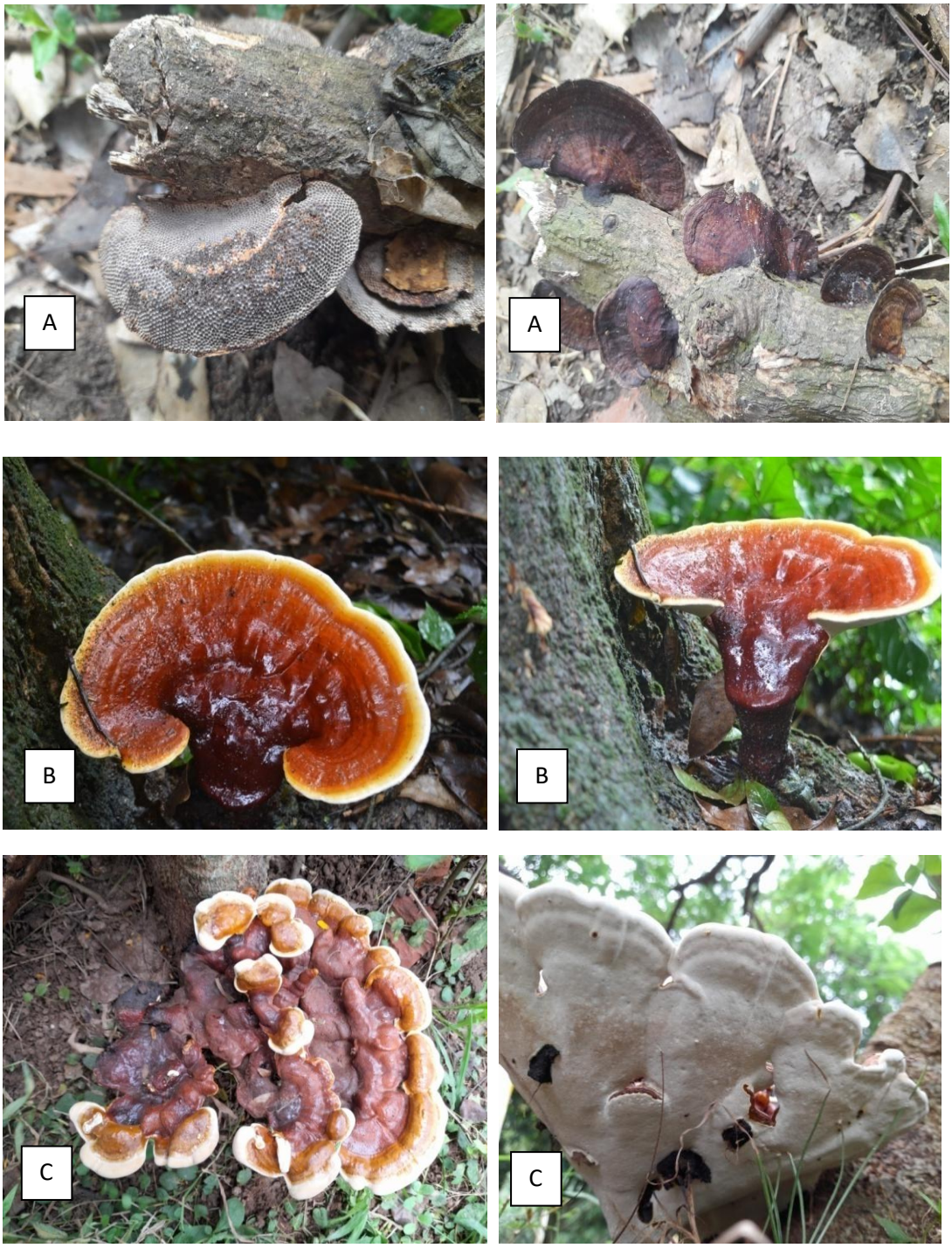
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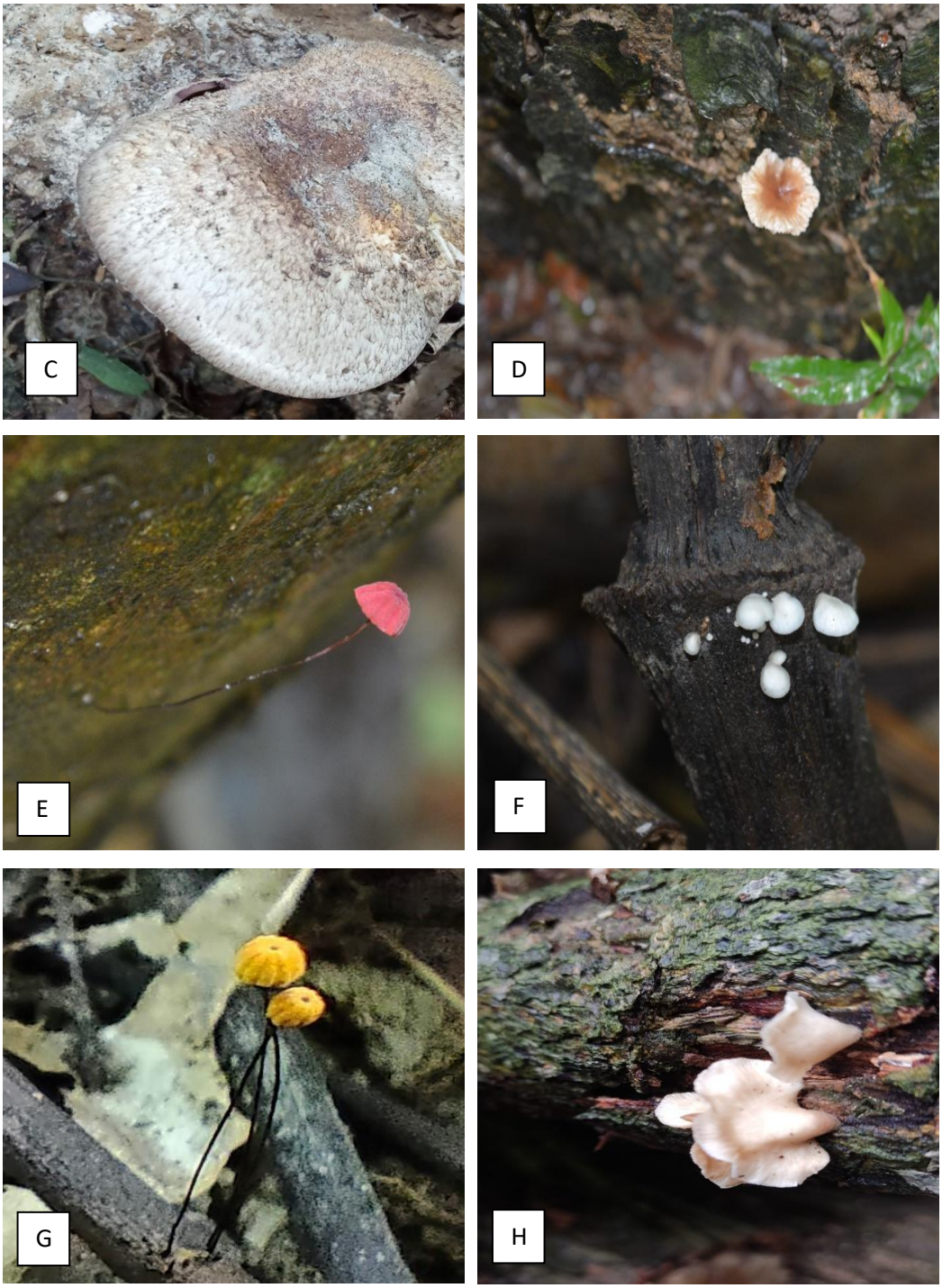
Fig. 2. Fruiting body of *Hexagonia hydnoides* (A); *Ganoderma lucidum* (B); *Ganoderma sessile* (C); *Ganoderma lingzhi* (D); *Ganoderma applanatum* (E); *Daedaleopsis confragosa* (F); *Stereum ostrea* (G); *Microporus xanthopus* (H); *Merulius tremellosa* (I); *Trametes gibbosa* (J)

II. Order, Agaricales: A total of twenty species belonging to the agaricales order were found during the collection. These species are *Leucoagaricus americanus, Coprinus disseminates, Agaricus campestris, Gymnopus* sp., *Marasmius pulcherripes, Crepidotus mollis, Marasmius siccus, Schizophyllum commune, Inocybe rimosa, Crepidotus applanatues, Amanita melleiceps,* Lyophyllum connatum, Marasmiellus candidus, *Clitocybe nebularis, Mycena rosea, Strobilurus esculentus, Clitocybula lacerata, Gymnopus peronatus, Leucocoprinus cygneus* and *Clitopilus prunulus.*

Habitat and biodiversity: The species of the order have been found in most of the area of Jahangirnagar University. The order was found in 80% of the area of Jahangirnagar University. The species have been found on moist soil, wasteland, wet grassy areas, wet logs, dying bamboo stems, rotting trees, garden mulch, and tree roots.

Morphology: Species were white color cap (*Leucoagaricus americanus, Coprinus disseminates, Agaricus campestris, Crepidotus mollis, Marasmius siccus, Schizophyllum commune, Crepidotus applanatues, Lyophyllum connatum*), brown to white color (*Gymnopus sp.*), pink color cap (*Marasmius pulcherripes*), whitish gray gill (*Crepidotus mollis*), white stipe and flower shaped cap (*Inocybe rimosa*), white stipe and brownish color in the middle of the pileus (*Amanita melleiceps*) transparent cap and cluster fruiting body (*Marasmiellus candidus*), pink cap and off-white color stripe (*Mycena rosea*), brownish-gray and convex cap (*Strobilurus esculentus*), gray color in the upper surface and white color on lower surface (*Clitocybe nebularis*), gray color pileus (*Clitocybula lacerate)*, yellowish in color, cap and stem are the same color (*Gymnopus peronatus Clitopilus prunulus,*),white (*Leucocoprinus cygneus*). Pileus convex to flat the gills detached from the stipe and are arranged in a cluster (*Leucoagaricus americanus*) and some other species have cluster fruiting bodies such as *Lyophyllum connatum*. *Marasmius siccus* and *Panaeolus foenisecii* look like parasols.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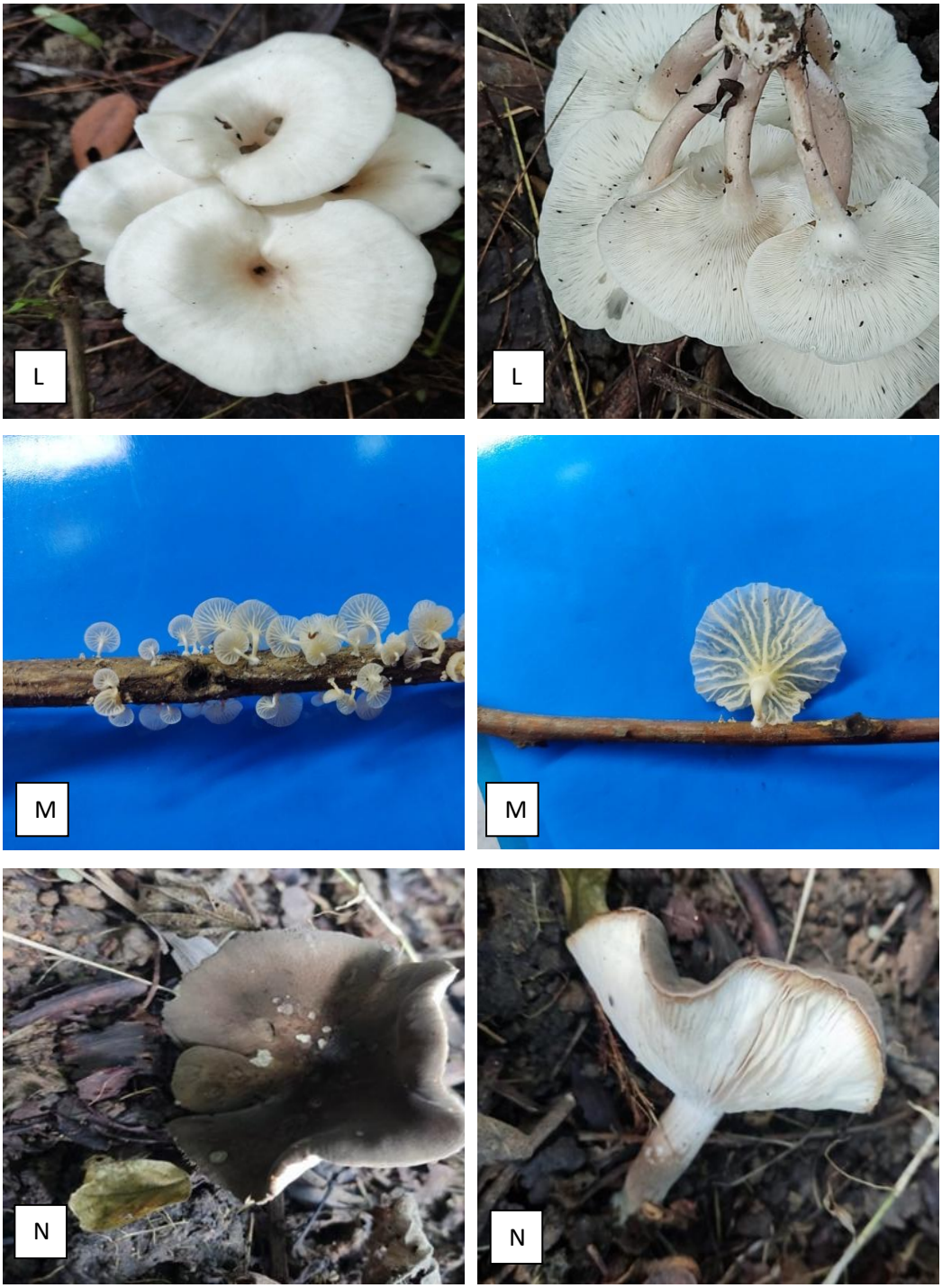
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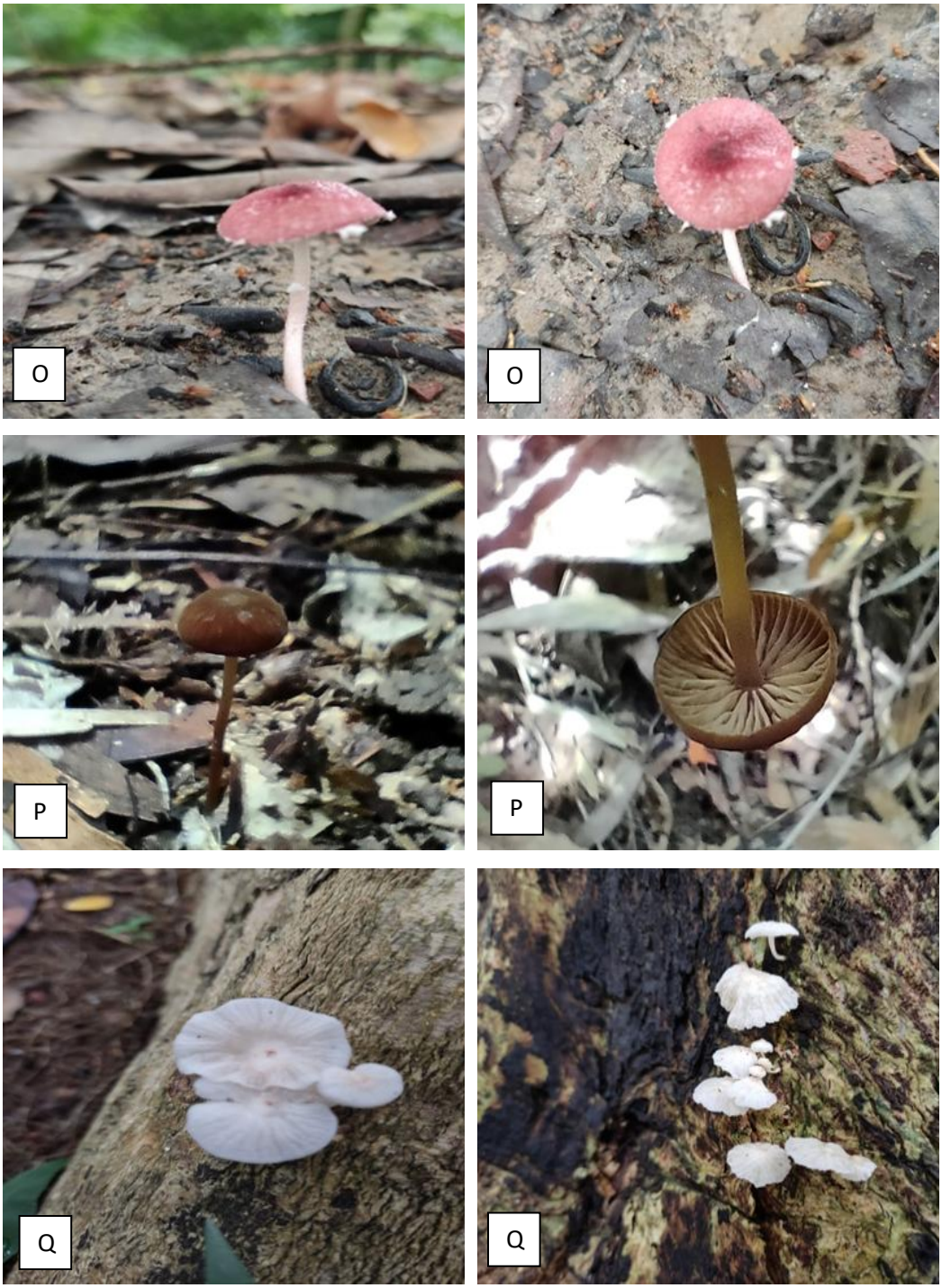
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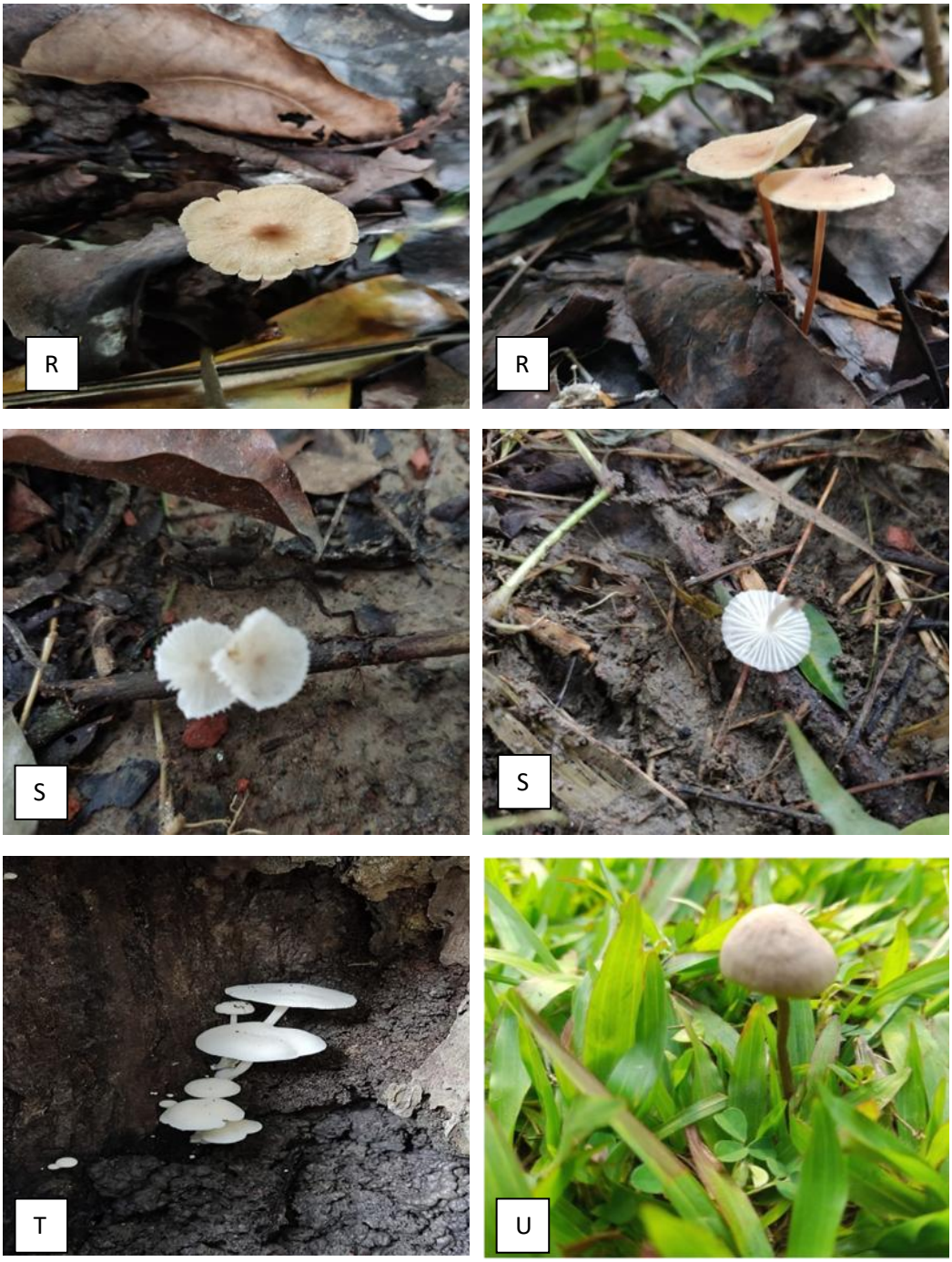

Fig. 3. Fruiting body of *Leucoagaricus americanus* (A); *Coprinus disseminates* (B); *Agaricus campestris* (C); *Gymnopus sp* (D); *Marasmius pulcherripes* (E); *Crepidotus mollis* (F); *Marasmius siccus* (G); *Crepidotus applanatues* (H); *Schizophyllum commune* (I); *Inocybe rimosa* (J); *Amanita melleiceps* (k); *Lyophyllum connatum* (L); *Marasmiellus candidus* (M); *Clitocybe nebularis* (N); *Mycena rosea* (O); *Strobilurus esculentus* (P); *Clitocybula lacerate* (Q); *Gymnopus peronatus* (R); *Leucocoprinus cygneus* (S); *Clitopilus prunulus* (T); *Panaeolus foenisecii* (U)

III. Order, Russualales: *Clavicorona pyxidata* which belongs to russualales order was found at Jahangirnagar University. The frequency of the species was 16.67% and the density was 7.5%.

Habitat and biodiversity: *Clavicorona pyxidata* was found in the only natural forest of Jahangirnagar University. This species has been found in a moist area of soil and in rotting portions of softwood and hardwood.

Morphology: The species was cream in color, with coral-shaped, pointed tips. It was found abundantly and remained in the cluster.

Fig. 4. Fruiting body of *Clavicorona pyxidate*

Fig. 5. Fruiting body of *Calvulina coralloides*

IV. Order, Cantharellales: *Calvulina coralloides* was the only species under the Cantharellales order found at Jahangirnagar University. The frequency and density were 66.67% and 10%, respectively.

Habitat and biodiversity: The species was found in natural forests, social forests, botanical gardens and around the residence. The species has been found in moist places like the base of the tree.

Morphology: The species was white to off-white in color and solitary in form. The fruiting body of the species extensively branched and the tip pointed.

V. Order, Xylariales: During the survey, two species were found under xylariales order. These species are *Xylaria hypoxylon* and *Daldinia concentric*. The frequencies of those species were 16.67% and 66.67%. The densities of those species were 12% and 50%.
Habitat and biodiversity: *Xylaria hypoxylon* was found in the botanical garden and *Daldinia concentric* was found in the botanical garden, social forest, and homeostasis forests of Jahangirnagar University. Both of them were seen as dead wood or dead plants.
Morphology: *Xylaria hypoxylon* was black in color, cylindrical-shaped fruiting body, and very small structures which bear spores. *Daldinia concentric* was ash color and almost rounded shape fruiting body.

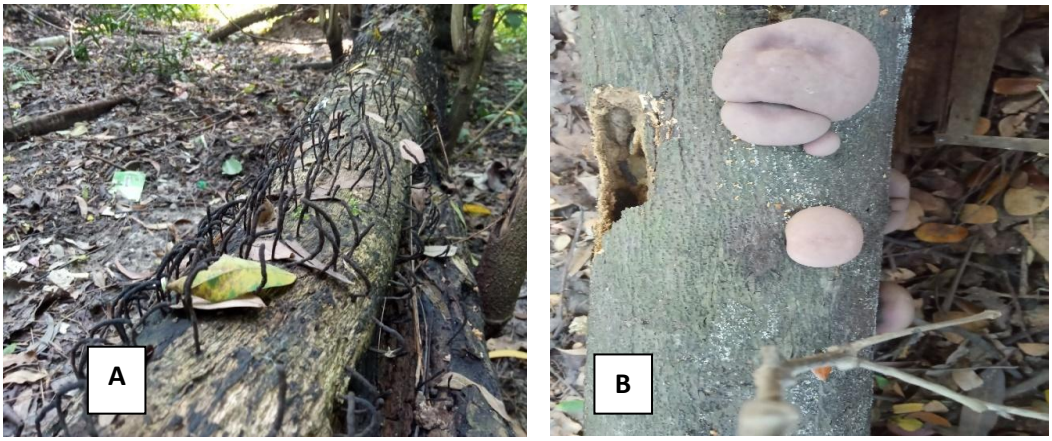

Fig. 6. Fruiting body of *Xylaria hypoxylon* (A); *Daldinia concentric* (B)

VI. Order, Dacrymycetales: *Dacryopinax spathularia* under dacrymycetales order was seen during the assessment. The density and frequency of the species were 55% and 16.67%.
Habitat and biodiversity: *Dacryopinax spathularia* was found in the Botanical garden of Jahangirnagar University. It was seen to grow on dead plants or rotting wood.
Morphology: The species was orange in color, with spatula shaped fruiting body. It was seen scattered.

Fig. 7. Fruiting body of *Dacryopinax spathularia*

VII. Order, Geastrales: During the survey, a species e.g. *Geastrum fimbriatum* under geastrales order was observed. This species frequency and density were 16.67%, 2.5%.
Habitat and biodiversity: The species was seen on the hardwood tree. Some were also found on the ground.
Morphology: The species was yellowish flower shaped and 5 to 8 rays curve downward.

Fig. 8. Fruiting body of *Geastrum fimbriatum*

VIII. Order, Auriculariales: In the time of survey, *Auricularia auricula-judae* under auriculariales was found. 16.67% and 25% were the frequency and density of this species.
Habitat and biodiversity: The species was observed on dying branches or distorting logs trees. It was also found in older living branches trees which grow as a saprophyte. It was found in the social forest of Jahangirnagar University.
Morphology: *Auricularia auricula-judae* was found solitary and brown in color. The surface of the species was covered with very small hair.

Fig. 9. Fruiting body *Auricularia auricula-judae*

IX. Order, Thelephorales: A species, *Thelephora dominicana* under the lephorales order was found at Jahangirnagar University. The frequency and density of species were 33.33% and 35%.

Habitat and biodiversity: The species was found in the botanical garden and natural forest of Jahangirnagar University. The species are mostly found in a moist place. It has been seen in the base of the bamboo and ground.

Morphology: *Thelephora dominicana* was black with a white margin and radially wrinkled. It was found on the solitary and smooth surface.

Fig. 10. Fruiting body of the *Thelephora dominicana*

X. Order, Hymenochaetales: One species, *Hymenochaete rubiginosa* was found on the Jahangirnagar University campus which belongs to the Hymenochaetales order. The frequency and density of the order were 16.67% and 25%.

Habitat and biodiversity: The species was found in the social forest of Jahangirnagar University. It was seen on the fallen kindling of a dead hardwood tree.

Morphology: *Hymenochaete rubiginosa* was brown in color. It was attached to the surface like a carpet.

Fig. 11. Fruiting body of *Hymenochaete rubiginosa*

For centuries, mushrooms have been eaten and valued for their taste, economic and environmental values, and medicinal purpose. In modern research, the mushroom is a subject of curiosity and speculation as it has been important to the ecosystem since the dawn of nature. Mushroom show mycorrhizal symbiosis as well as parasitic association with substrates such as wood, litter and soil, which plays an important role for mushrooms in these microhabitats. (Lakhanpal, 1996). The most productive seasons are the rainy season for mushroom growth. Therefore, during the rainy season and just after the rainy season (June-October), a survey was conducted on the campus of Jahangirnagar University. During this study, 60 samples were collected from the different locations of the campus grounds, from which 40 species belonging to 10 orders, 33 genera and 26 families were identified.

A total of 24 (25%) species were distributed in the natural forest area of the campus, 22 (22.34%) in the reserve forest, 20 (21.27%) in the social forest, 14 (14.89%) in the forest with academic buildings, 12 (12 .76%) in the forest with resident and 4 (4.25%) species were recorded in the lakeside area of the JU campus shown in Table 1 and Figure 12.

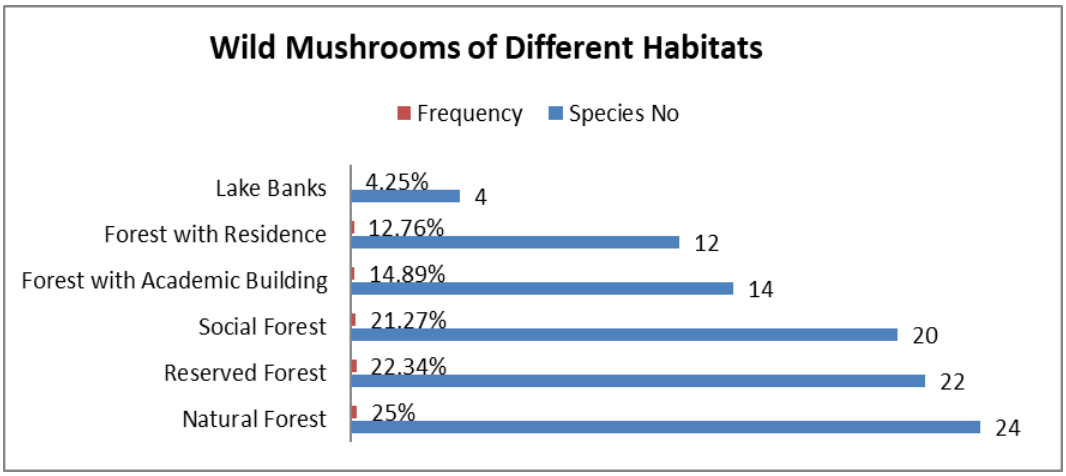

Fig. 12. Distribution of wild mushrooms in different habitats in the JU campus area

A 5-month study was conducted from June to October 2021, Figure 13 depicts the number of recorded mushroom orders during the study period. Abundant growth ofin mushroom orders was noted in August and September, with September having a maximum growth rate and a minimum growth rate in July exhibited Polyporales and Agaricales were recorded from 10 mushroom orders from all months examined. Xylariales and Dacrymycetales were not found until August. Hymenochaetales, Cantharellales, Russulales, and Thelephorales were found from September. Geastrales were recorded from August to October. Auriculariales was found in October.

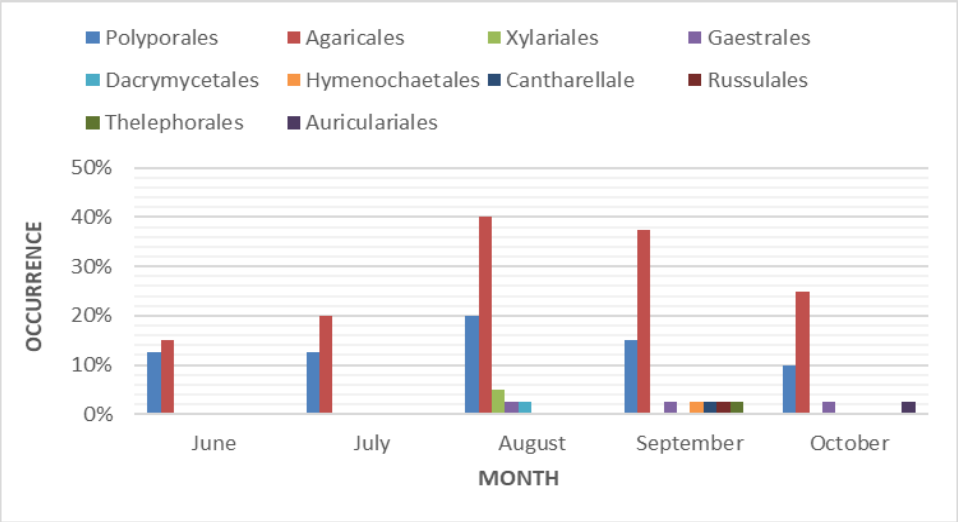

Fig. 13. Occurrence of the mushroom orders from June to October

This observation indicates that wild mushrooms have a relationship with different substratum, most of them depending on that substrate. Different wild mushrooms were noticed on substrates like decaying plant parts (dead leaf, root, bark; deadwood), living plants, and soil. The maximum number of wild mushrooms in our studies were documented from dead materials (47%).

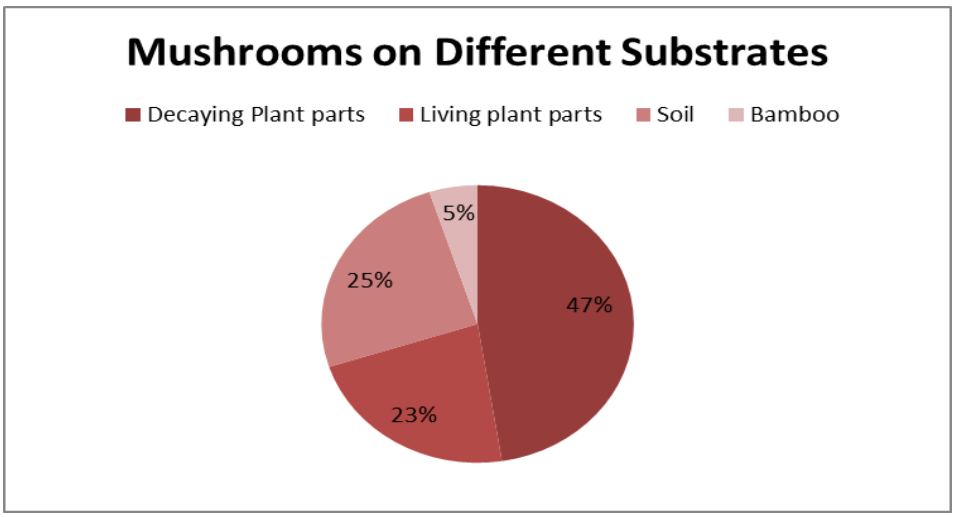

Fig. 14. Different substratum of wild mushrooms

Among them, 9 species were recorded under Polyporales from all sites of the campus area except lake-bank. The frequency of Polyporales was 83.33%. Four species of Ganoderma are found under this order – *Ganoderma lucidum*, *Ganoderma sessile*, *Ganoderma lingzhi*, *Ganoderma applanatum*. The *Ganoderma* sp. was also reported in India (Bhosle

et al., 2010; Thiribhuvanamala *et al*., 2011; Dwivedi *et al*., 2012), China (Wang *et al*., 2012), and also other areas in Bangladesh (Das and Aminuzzaman , 2017; Aminuzzaman & Das, 2016). *Daedaleopsis confragosa, Microporus xanthopus, Merulius tremellosus, Trametes gibbosa, Stereum ostrea* are also under this order. *Daedaleopsis* sp., *Trametes* sp. was reported by (Tanjim *et al*., 2019).

From the checklist, 21 species were belongings to the order Agaricales from natural, social, reserve forest, forest with academic and resident and also from lake bank of the campus area and was distributed in solitary to dispersed. The frequency of the presence of this order was 83.33%. Among 21 species, one species were- *Leucoagaricus americanus, Coprinus disseminates, Agaricus campestris, Schizophyllum commune, Inocyberimosa, Amanita melleiceps, Lyophyllum connatum, Clitocybe nebularis, Mycenarosea, Strobilurus esculentus, Clitocybula lacerate, Leucocoprinus cygneus, Clitopilus prunulus, Panaeolus foenisecii* and two species of Gymnopus- *Gymnopus* sp., *Gymnopus peronatus*, and genus *Crepidotus- Crepidotus applanatus, Crepidotus mollis*, and three species of genus *Marasmius –Marasmius pulcherripes, Marasmius siccus, Marasmiellus candidus*. These findings were also investigated by (Tanjim *et al*., 2019; Rahaman *et al*., 2016; Marzana *et al*., 2018).

A species of Russualales was recorded from a natural forest with a clustered distribution called *Clavicorona pyxidata*. The frequency of the occurrence of the order Russualales was 16.66%. One species *(Calvulina coralloides)* was identified as Cantharellales was found in the natural and social forest of the campus area at a frequency of 16.66%. These results are confirmed by (Marzana *et al*., 2018).

Two species from the Xylariales were identified, namely- *Daldinia concentrica* from the forest with residents and *Xylaria hypoxylon* from the reserve forest. The frequency of the order was recorded as 33.33%. These results were also mentioned by (Das & Aminuzzaman, 2017; Marzana *et al*., 2018).

One species of Dacrymycetales and Geastrales namely- *Dacryopinax spathularia* and *Geastrum fimbriatum* have been recorded from the reserve forest area of the campus. The frequency of these two orders was 16.66%. These studies were supported by (Das & Aminuzzaman, 2017).

A species of Auriculariales was found from the frothy social forest area is solitary and not abundantly distributed namely- *Auricularia auricula-judae*. This species was also identified by (Marzana *et al*., 2018) from the mangrove forest of Bangladesh. In addition, 1 species recorded belongs to Thelephorales - *Thelephora dominicana* from the reserve forest area and was abundant in the recorded area. The frequency of the presence of the orders Auriculariales and Thelephorales was 16.66%.
From the find, one species was identified belonging to the order Hymenochaetales, called *Pseudo chaetetabacina* in a solitary form from the social forest area of the campus. The frequency of this order was 16.66%.

Studies on fungal diversity show their role in plant performance and soil nutrient cycling (Muneer *et al*., 2021). A high diversity of wild mushrooms is an important prerequisite for a healthy forest (Egli, 2011). Fungal diversity surveys can be a significant source of knowledge about climate change such as global warming (Vitousek, 1994). By understanding fungal diversity and how its changes, better strategies for conservation and management of the ecosystem can be prepared (Hawksworth, 1991; Molina *et al*., 2001), especially in the semi-natural area that face the greatest threat.

Conclusion: During this study, 40 species were identified from 60 samples with 40 species belonging to 10 genera, 33 genera, and 25 families. Most of species were identified from Agaricales with the highest frequency along with Polyporales (83.33%). The highest species abundance was 83.33% for *Ganoderma spp., Crepidotus applanatus* and the density was 70% *for Marasmiellus candidus*. The predominant species were *Ganoderma* spp., *Coprinus disseminates, Marasmius* spp., *Schizophyllum commune, Calvulina coralloides*. Best of our knowledge, this survey is the first-ever report on the distribution diversity of wild mushrooms on the campus of Jahangirnagar University that shows the campus has a distinct diversity of wild mushrooms and prepared a macrofungi checklist that provides basic information to assess the biological diversity of the different vegetation areas of the JU. This research may be helpful for further studies on wild mushrooms in this area.

REFERENCE

Akter, S., Rahman, F. and Aziz, M.A. 2013. Investigating the least known small mammals of Jahangirnagar University campus, Bangladesh. *Small Mammal Mail*, **5**: 4.

Alam, N., Amin, S.M.R. and Sarker, N.C. 2007. Efficacy of five different growth regulators on the yield and yield contributing attributes of *Pleurotusostreatus* (Jacquin ex Fr.) Kummer. Bangladesh J. Mushroom, **1**(1): 51-55.

Alam, N., Cha, Y.J., Shim, M.J.,Lee, T.S. and Lee, U.Y. 2010. Cultural conditions for mycelial growth and molecular phylogenetic relationship in different wild strains of *Schizophyllum commune*. Mycobiology, **38**(1): 17-25.

Alam, N., Sikder, M.M., Karim, M.A. and Amin, S.M.R. 2019. Antioxidant and antityosinase activities of milky white mushroom. Bangladesh Journal of Botany, **48**(4): 1065-1037.

Aminuzzaman, F.M. and Das, K. 2016. Morphological characterization of polypore macrofungi associated with Dalbergiasissoo collected from Bogra district under social forest region of Bangladesh. *Journal of Biology and Nature*, **6**(4):199-212.

Barros, L., Venturini, B.A., Baptista, P., Estevinho, L.M. and Ferreira, I.C. 2008. Chemical composition and biological properties of Portuguese wild mushrooms: a comprehensive study. *Journal of agricultural and food chemistry*, **56**(10):3856-3862.

Bhosle, S., Ranadive, K., Bapat, G., Garad, S., Deshpande, G. and Vaidya, J. 2010. Taxonomy and diversity of Ganoderma from the Western parts of Maharashtra (India). *Mycosphere*, **1**(3):249-262.

Chang, S.T. 1999. Global impact of edible and medicinal mushrooms on human welfare in the 21st century: nongreen revolution. *International journal of medicinal mushrooms*, **1**(1).

Das, K. and Aminuzzaman, M. 2017. Morphological and ecological characterization of xylotrophic fungi in mangrove forest regions of Bangladesh. *Journal of Advances in Biology and Biotechnology*, **11**(4):1-15.

Das, K. 2010. Diversity and conservation of wild mushrooms in Sikkim with special reference to Barsey Rhododendron Sanctuary. *NeBIO*, **1**(2):pp.1-13.

Das, K., Aminuzzaman, F.M. and Akhtar, N. 2016. Diversity of fleshy macro fungi in Mangrove forest regions of Bangladesh. *Journal of Biology and Nature*, **6**(4):218-241.

Deshmukh, S.K. 2004. Biodiversity of tropical basidiomycetes as sources of novel secondary metabolites. In 'Microbiology and biotechnology for sustainable development', Ed Jain PC.

Dwivedi, S., Tiwari, M.K., Chauhan, U.K. and Pandey, A.K. 2012. Biodiversity of mushrooms of Amarkantak Biosphere Reserve forest of Central India. *International Journal of Pharmacy & Life Sciences*, **3**(1).

Egli, S. 2011. Mycorrhizal mushroom diversity and productivity—an indicator of forest health. *Annals of forest science*, **68**(1):81-88.

Hailing, R.E. 1996. **Recommendations for collecting mushrooms for scientific study. Selected Guidelines for Ethnobotanical Research: A Field Manual**. *The New York Botanical Garden Press*, Bronx: 135-141.

Hawksworth, D.L. 1991. The fungal dimension of biodiversity: magnitude, significance, and conservation. *Mycological research*, **95**(6):641-655.

Hunter, P. 2007. The human impact on biological diversity: How species adapt to urban challenges sheds light on evolution and provides clues about conservation. *EMBO reports*, **8**(4):316-318.

Jahan, I., Begum, S., Feeroz, M.M., Das, D.K. and Datta, A.K. 2018. Nesting pattern of birds in Jahangirnagar University Campus, Bangladesh. *Journal of Threatened Taxa*, **10**(5):11618-11635.

Karavani, A., De Cáceres, M., de Aragón, J.M., Bonet, J.A. and de-Miguel, S. 2018. Effect of climatic and soil moisture conditions on mushroom productivity and related ecosystem services in Mediterranean pine stands facing climate change. *Agricultural and Forest Meteorology*, **248**:432-440.

Khan, S.A., Sultana, S., Hossain, G.M., Shetu, S.S. and Rahim, M.A. 2021. Floristic composition of Jahangirnagar University Campus-A semi-natural area of Bangladesh. *Bangladesh Journal of Plant Taxonomy*, **28**(1):27-60.

Lakhanpal, T.N. 1996. **Mushrooms of India, Boletaceae**. *APH Pub. Corp*.

Marzana, A., Aminuzzaman, F.M., Chowdhury, M.S.M., Mohsin, S.M. and Das, K. 2018. Diversity and ecology of macrofungi in Rangamati of Chittagong Hill Tracts under tropical evergreen and semi-evergreen forest of Bangladesh. *Advances in Research*, **13**(5):1-17.

Molina, R., Pilz, D. and Smith, J. 2001. Conservation and management of forest fungi in the Pacific Northwestern. *Fungal Conserv Issues Solut*, **22**:19.

Mondol, M.A.H., Kazi, M.S.I., Rahman, M.F. and Rakib, M.R. 2019. Microclimatic study using temperature data of Jahangirnagar University of Bangladesh. *Discovery Journals*, **5**.

Moore, S. and O'Sullivan, P. 2013. **A guide to common fungi of the Hunter-Central Rivers region. Hunter-Central Rivers Catchment Management Authority**.

Muneer, M.A., Huang, X., Hou, W., Zhang, Y., Cai, Y., Munir, M.Z., Wu, L. and Zheng, C. 2021. Response of Fungal Diversity, Community Composition, and Functions to Nutrients Management in Red Soil. *Journal of Fungi*, **7**(7):554.

Rahaman, M., Aminuzzaman, F.M., Hossain, M.B., Rashid, S.N. and Rumainul, M.I. 2016. Biodiversity, distribution and morphological characterization of mushrooms in the south western region of Bangladesh. *International Journal of Advanced Research*, **4**(3):60-79.

Rai, *M.*,Tidke, G. and Wasser, S.P. 2005. **Therapeutic potential of mushrooms**.

Ramsbottom J. 1989. **Mushrooms and toadstools**. London. Blomsbury Books.

Rashid, M.H., Akhter, K., Chowdhury, M.S.M. and Aminuzzaman, F.M. 2017. Biodiversity, habitat and morphology of mushroom of different forest regions of Bangladesh. *International Journal of Advanced Research*, **5**(9):945-957.

Read, D.J. and Perez-Moreno, J. 2003. Mycorrhizas and nutrient cycling in ecosystems–a journey towards relevance. *New phytologist*, **157**(3):475-492.

Srivastava, B., Dwivedi, A.K. and Pandey, V.N. 2011. Morphological characterization and yield potential of *Termitomyces* spp. mushroom in Gorakhpur forest division. *Bulletin of environment, pharmacology & life Sciences*, **1**(1):54-56.

Tanjim, A., Aminuzzaman, F.M., Rahaman, M. and Tanni, J.F. 2019. Biodiversity, distribution and morphological characterization of macro fungi in Sylhet and Moulvibazar under Tropical Evergreen and Semi-evergreen Forest Regions of Bangladesh. *Int J Adv Res*, **7**(11):567-589.

Thiribhuvanamala, G.U.R., Prakasam, V., Chandrasekar, G., Sakthivel, K., Veeralakshmi, S., Velazhahan, R. and Kalaiselvi, G. 2011, October. Biodiversity, conservation and utilization of mushroom flora from the Western Ghats region of India. In Proceedings of the 7th International Conference on Mushroom Biology and Mushroom Products (ICMBMP7), Tamil Nadu, India: 155-164.

Thormann, M.N. 2006. Diversity and function of fungi in peatlands: a carbon cycling perspective. *Canadian journal of soil science*, **86**(Special Issue):281-293.

Vitousek, P.M. 1994. Beyond global warming: ecology and global change. *Ecology*, **75**(7):1861-1876.

Wang, X.C., Xi, R.J., Li, Y., Wang, D.M. and Yao, Y.J. 2012. The species identity of the widely cultivated Ganoderma,'G. lucidum'(Ling-zhi), in China. *PLoS One*, **7**(7):40857.

Wani, H., Pala, S.A., Boda, R.H. and Mir, R.A. 2010. Morels in southern Kashmir Himalya. *Journal of Mycology and Plant Pathology*, **40**(4):540.

Yoon, K.N., Alam, N., Lee, J.S., Cho, H.J., Kim, H.Y., Shim, M.J., Lee, M.W. and Lee, T.S. 2011. Antihyperlipidemic effects of *Lentinus edodes* on plasma, feces, and hepatic tissues in hypercholesterolemic rats. Mycobiology, **39**(2): 96-102.

Yoon, K.N., Alam, N., Shim, M.J. and Lee, T.S. 2012. Hypolipidemic and antiatherogenesis effect of culinary-medicinal pink oyster mushroom, Pleurotussalmoneostramineus L. Vass. (Higher Basidiomycetes), in hypercholesterolemic rats. International Journal of Medicinal Mushrooms, **14**(1): 27-36.

Zoberi, M.H. 1973. **Some edible mushrooms from Nigeria**. Nigerian Field.