

FANTASTIC FUNGI AROUND US : A CASE STUDY OF IPB UNIVERSITY CAMPUS FOREST

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ABSTRACT

Campus forest is the area of education and conservation at IPB University. The preliminary study proved that the area stores high biodiversity, including macroscopic fungi, which have not been well recorded. This study aimed to inventory the diversity of macroscopic fungi in the IPB University campus forest (IPBUCF) to be used as media for mycology course practice and optimize the future's mushroom potential. The results showed 18 mushroom species divided into two divisions, namely Basidiomycota and Ascomycota. Basidiomycota consist of: Agaricus sp., Amanita sp., Amauroderma sp., Conocybe sp., Crinipellis sp., Gymnopus sp., Hypholoma sp., Marasmius sp.1, Marasmius sp.2, Naucoria sp., Pluteus sp. 1, Pluteus sp. 2, Pholiota sp., Ramaria sp., Rigidoporus sp., and Russula sp. Ascomycota members were divided into two classes, namely Pezizomycetes and Eurotiomycetes. The identification results confirmed the existence of Cookeina cf. tricholoma and Onygena sp. In this paper, we explained how to describe mushrooms for identification using macroscopic features.

Keywords: *Ascomycota, Basidiomycota, Macroscopic Fungi, IPBUCF*

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Introduction

Macroscopic fungi or mushrooms have a paramount role in the ecosystem as mighty decomposers and support plant species' diversity in the ecosystem. The presence of macrofungi is one of the important indicators of the dynamic forests. In fact, mushrooms play a key role in the food chain, survival or germination of tree seedlings, tree growth, and overall forest health (Nasution et al., 2018). Macrofungi are a group of fungi visible enough to the unaided eye and picked up by hand (Anon, 2002; Chang & Miles, 2004). Mushrooms are included in the phylum of Basidiomycota and Ascomycota (Alexopoulos et al., 1979).

Macrofungi are known as cosmopolitan organism which are able to grow from natural to man-made areas (Putra et al., 2017; 2018; 2019a; 2019b; Putra, 2020a; 2020b; 2020c; 2020d). It is estimated that only around 140,000 mushroom species exist, with only about one-tenth which taxonomically identified (Hawksworth, 2001; Shelley & Geoffrey 2004). The information about the number of macrofungi diversity is close to 712,000 species (Mueller et al., 2007). However, most of the information is provided by the author in temperate regions. The tropical region posing high mushroom diversity has been inadequately observed and scarcely documented (Hawksworth, 2001), and Indonesia is no exception.

As the initial step to optimize mushroom utilization, exploration and identification of fungi obtained around us are needed, and campus forest is no exception. In Indonesia, some mycologists have assisted significant contributions in the study of macrofungi diversity both in natural or tourism area (Retnowati, 2004; 2007; 2011; 2015; Susan and Retnowati, 2018; Putra et al., 2017; 2018; 2019a; 2019b; Putra, 2020a; 2020b; 2020c; 2020d). However, the limited information provided regarding mushroom diversity in the campus forest. IPBUCF lies in the high rainfall area in Bogor, West Java, Indonesia, which providing suitable conditions for mushroom development. Till the time, there is no comprehensive information about mushroom diversity and potency around IPBUCF. Thus, this study aimed to observe macrofungi diversity and provide information regarding mushroom diversity around IPBUCF.

Research Methods

The study was conducted at IPBUCF (Figure 1) in April-May 2019. Data collection was done by an opportunistic sampling method.

Macrofungi identification has been based mainly on examine the morphology features. The mushroom description was carried out by macroscopic characters referring to Putra et al. (2018). Macroscopic identification parameters including the information of mushroom: how mushroom grows, fruit body shape, hygrophnous, cap color when young and mature, cap diameter, the upper and lower shape of the cap, cap surface, cap edge, cap margin, wetness level, hymenophore type (lamella, pores, teeth), how to attach to the stipe, length, distance between rows, and margins.

Other characters observed were stipe shape, stipe color (young and mature stage), stipe diameter and length, stipe surface, attachment position, stipe attachment type on the substrate, stipe cross-section, partial veil, and universal veil, fruit body texture, odor, and taste. Mushroom samples identified using several identification references, including Largent (1973), Arora (1986), Rokuya et al. (2011), and Desjardin et al. (2016).

Result and Discussion

A total of 18 mushrooms were identified and described in this study. The macrofungi were divided into six orders and consisted of 13 families (Table 1). The mushrooms which identified as Basidiomycota, namely: *Agaricus* sp., *Amanita* sp., *Amauroderma* sp., *Conocybe* sp., *Crinipellis* sp., *Gymnopus* sp., *Hypholoma* sp., *Marasmius* sp.1, *Marasmius* sp.2, *Naucoria* sp., *Pluteus* sp. 1, *Pluteus* sp. 2, *Pholiota* sp., *Ramaria* sp., *Rigidoporus* sp., and *Russula* sp. All Basidiomycota found in this study were Agaricomycetes. Those groups were divided into the order of Agaricales (6 families), Polyporales (2 families), Russulales (1 family), and the Gomphales order (1 family). Ascomycota members were divided into two classes: Pezizomycetes and Eurotiomycetes, consisting of *Cookeina* cf. *tricholoma* and *Onygena* sp. Each mushroom found in this research has different characteristics and will be used as part of mycology course materials in the future. The following are a description of the mushroom of IPBUCF and its characters.

Table 1 Mushroom Diversity Around IPBUCF

Phylum	Class	Order	Family	Species	
Basidiomycota	Agaricomycetes	Agaricales	Marasmiaceae	<i>Crinipellis sp.</i> <i>Marasmius sp. 1</i> <i>Marasmius sp. 2</i> <i>Gymnopus sp.</i>	
			Bolbitiaceae	<i>Conocybesp.</i>	
			Agaricaceae	<i>Agaricus sp.</i>	
			Pluteaceae	<i>Pluteus sp. 1</i> <i>Pluteus sp. 2</i>	
				Amanitaceae	<i>Amanita sp.</i>
			Strophariaceae	<i>Pholiota sp.</i> <i>Hypholoma sp.</i>	
				Hymenogastraceae	<i>Naucoria sp.</i>
			Polyporales	Meripilaceae	<i>Rigidoporus sp.</i>
				Ganodermataceae	<i>Amauroderma sp.</i>
				Russulales	Russulaceae
			Gomphales	Gomphaceae	<i>Ramaria sp.</i>
			Ascomycota	Pezizomycetes	Pezizales
Eurotiomycetes	Onygenales	Onygenaceae		<i>Onygena sp.</i>	

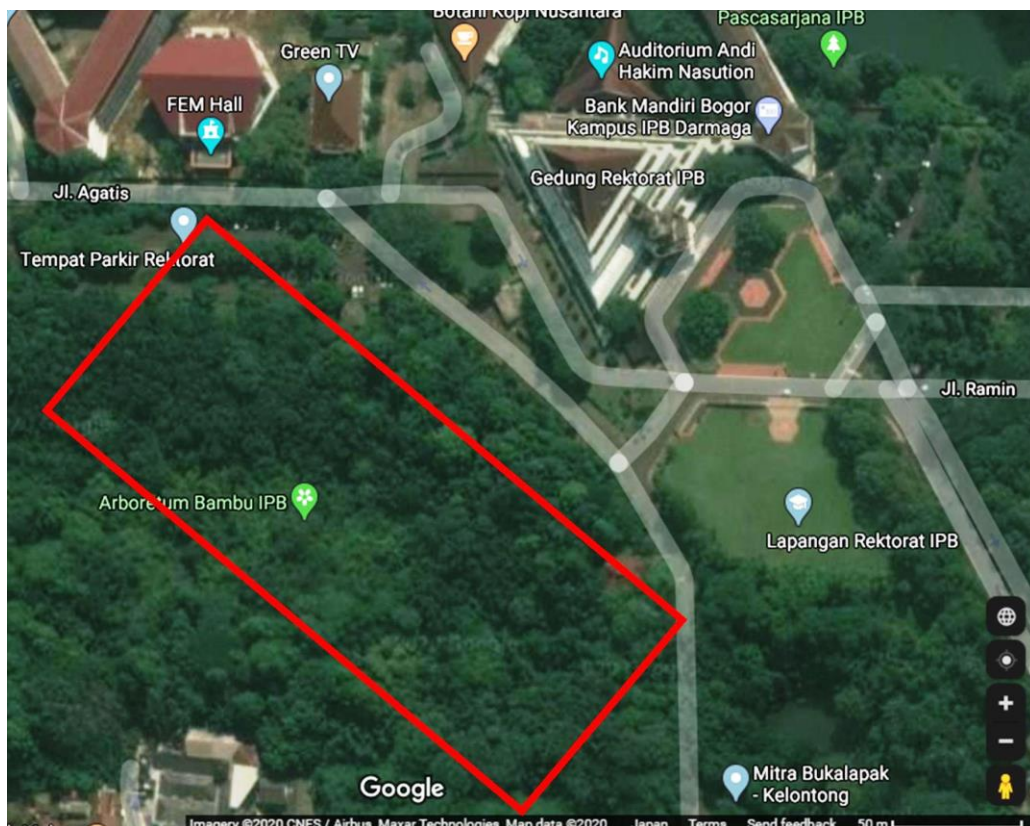


Figure 1 Sampling site of macroscopic fungi around IPBUCF

Agaricus sp.

Agaricus sp. found solitary growing in soil (Figure 2a). This mushroom has a fruit body shape with lamella (cap gills with stipe). The brown cap is darker in the middle and whiter on the cap's edge with a diameter of 9 cm (Figure 2b). The pileus did not change in color (hygrophanous) after time. The cap's surface has a powdery texture, flat edges (entire), and margins are slightly raised (upturned). The lower part of the cap (hymenophore) is lamella, brown in color, the distance between narrow lines (crowded), lamella sticks to the stipe freely (free), and has a smooth margin (Figure 2c). The stipe has a white cylindrical shape, smooth surface, length of 10 cm, the position of the stipe attachment in the middle (central), the stipe directly embedded in the substrate (basal tomentum), and hollow stipe texture (Figure 2d). The stem has a ring (annular) in the superior stipe position (Figure 2e). The fruit body has a soft texture, smells like wood, and moist in wetness level.



Figure 2 Characteristics of macroscopic identification of *Agaricus* sp.

Amauroderma sp.

Amauroderma sp. found solitary growing in rotted plant root (Figure 4a). This mushroom has the shape of a fruiting body with pores (pores with stipe). The cap is black, 4.5 cm in diameter (Figure 4b), and undergoes a color change (hygrophanous) from white to reddish in the hymenophore section after being taken from the substrate. The cap's surface has a fan-like shape, smooth texture, flat edges, and a straight margin. This fungus has a pore type of hymenophore with detachable and cream pore adhesions (Figure 4c). The cylindrical-shaped stipe is black with a length ranging from 13-15 cm. The stipe surface is smooth with a

Amanita sp.

Amanita sp. found growing in groups with scattered fruit bodies near the plant root system (Figure 3a). This mushroom has a fruit body shape with lamella (cap gills with stipe). The cap is yellow to orange, 3-4 cm in diameter (Figure 3b). The pileus did not change in color (hygrophanous) after time. The surface of the cap has a velvety texture (scaly), arched to semiglobose shape, small jagged edges (crisp), and margins are slightly curved (incurved) (Figure 3c). The lower part of the cap (hymenophore) is lamella shaped, white in color, the spacing between rows is crowded, lamellae attach to the stipe freely (free), and has margin smooth (Figure 3d). The cylindrical stipe is white, smooth surface, 2-3 cm in length, attach in the middle (central) of the cap, the stipe is directly embedded in the substrate (basal tomentum), hollow stipe texture, and rhizomorph was spotted. In addition, there is also a bulbous volva on the club-type stalk (Figure 3e). The fruit body is soft, smell like wood, and moist in wetness level.



Figure 3 Characteristics of macroscopic identification of *Amanita* sp.

sticking position on the edge (terminal) of the cap. The stipe is directly embedded in the substrate (basal tomentum) and has a solid stipe texture. The fruit body has a hard texture, smells like wood, dry in wetness level.

Cookeina cf. tricholoma.

Cookeina found growing in groups with gregarious fruit bodies on tree trunks (Figure 5a). This mushroom has a cup-shaped fruit body with a diameter ranging from 0.5-3 cm and light pink (Figure 5b). The pileus did not change color (hygrophanous) after time. Present *Cookeina*

studied indicated that this macro fungus is closely related to *Cookeina tricholoma*. The characteristic of *Cookeina tricholoma* lies in transparent hairs on the apothecium (Figure 5c). However, further observation is needed using microscopic characters. Stipe has a cylindrical shape, pale

orange in color, smooth surface, 0.5-1 cm in length, the position of the stipe attachment in the middle (central), directly embedded in the substrate (basal tomentum) (Figure 5d), and has hollow texture. The fruit's body has a soft texture, smells like wood, and moist in wetness level.

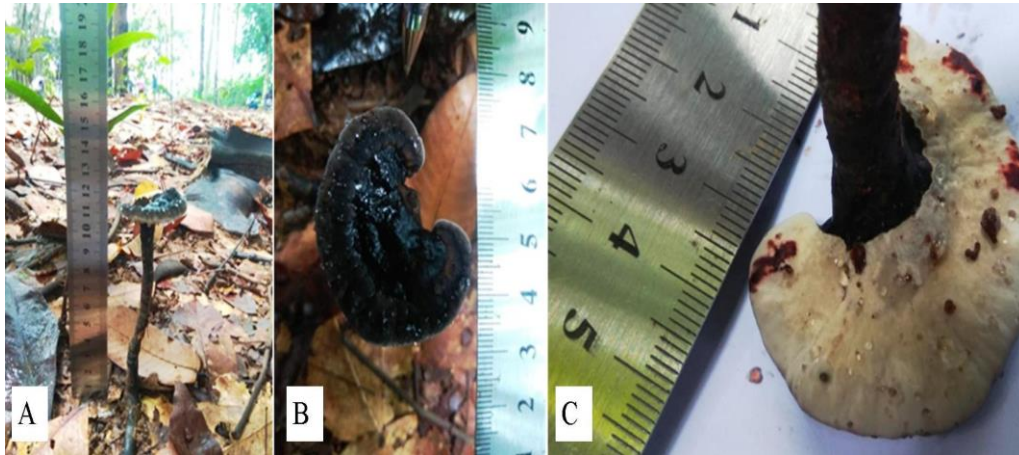


Figure 4 Characteristics of macroscopic identification of *Amauroderma* sp.



Figure 5 Characteristics of macroscopic identification of *Cookeina* cf. *tricholoma*

Conocybe sp.

Conocybe sp. found growing in groups with very close fruiting body distance (caespitose) on the ground (Figure 6a). This fungus has a fruit body shape with lamella (cap gills with stipe). The cap is gray to black and darker in the center of the cap. The cap is 1-2.5 cm in diameter (Figure 6b) and did not change color (hygrophanous) after time. The pileus has a conical shape, smooth texture, smooth edges, and straight margins. The lamella (hymenophore) underside is attached to the stipe with a free type, the distance between the lines is crowded, and smooth margin of the lamella (Figure 6c). Stipe characters are cylindrical shaped, white in color, and the stipe's length ranges from 1-1.5 cm (Figure 6d). The surface of the stipe is smooth with a central position. The stipe is directly embedded in the substrate (basal tomentum). The inside of the stipe is hollow. The fruit's body has a soft texture, easily broken, smells like litter, and moist in wetness level.

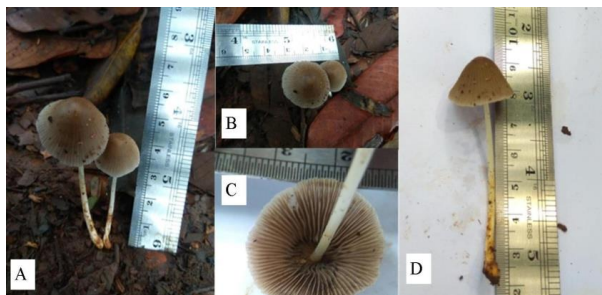


Figure 6 Characteristics of macroscopic identification of

Gymnopus sp.

Gymnopus sp. found growing close together (gregarious) on logs (Figure 8a). This mushroom has a fruit body shape with lamella (cap gills with stipe). The cap is dark brown in the middle and light brown on edge (Figure 8b). The cap did not change in color (hygrophanous) after time. The cap is about 5-7 cm in diameter. The pileus's surface has a pattern of lines leading to the center, large wavy edges (indented), and the margin of the cap is flat (straight). The lower part of the cap (hymenophore) is lamella shaped, white in color, the distance between wide rows (subsistent), lamellae attaches to the stipe freely (free), and smooth margin (Figure 8c). The cylindrical-shaped stipe is dark brown, fibrillose surface, the average length is 3-4 cm, middle

Crinipellis sp.

Crinipellis sp. found growing close to each other (gregarious) on decayed bamboo culms (Figure 7a). This mushroom has a fruit body shape with lamella (cap gills with stipe). The hood is brown to black in the middle and light brown on edge (Figure 7b). The cap did not change in color (hygrophanous) after time. The cap diameter is ranging from 0.7-1 cm. The cap's surface has a prominent stripe pattern, small jagged edges (crisp), and straight margins (decurved). The lower part of the cap (hymenophore) is white, the distance between the lines of the lamella is crowded, and the margin of the hood is smooth (Figure 7c). Stipe with cylindrical shaped, light brown, with a length of 1 cm. Rough stipe surface with a central attachment position (Figure 7d). Stipe is embedded directly on the substrate (basal tomentum). The inside of the stipe is hollow. The fruit body has a soft texture, smells like wood, and moist in wetness level.



Figure 7 Characteristics of macroscopic identification of *Crinipellis* sp.

(central) in pileus attachment, the stipe is directly embedded in the substrate (basal tomentum) (Figure 8d). The inside of the stipe is hollow. The fruit body has a soft texture, smells like wood, and moist in wetness level.

Hypholoma sp.

Hypholoma sp. found growing close to each other (gregarious) in decayed logs (Figure 9a). This mushroom has a fruit body shape with lamella (cap gills with stipe). The Cap color is light brown and dark brown on the center (Figure 9b). The cap did not change in color (hygrophanous) after time, cap diameter 1-2 cm, smooth texture at the surface, large corrugated edges (indented), and straight margins. The lower part of the cap (hymenophore) is lamella shape, white in color, the distance between rows is dense. Lamella attaches

to the stipe in free type with a smooth margin (Figure 9c). Stipe is cylindric and dark brown, soft on the surface, 1-2.5 cm in length, and central attachment position. The stipe attaches directly to the substrate (basal tomentum). The inside of the stipe is hollow. The fruit body has a soft texture, smells like wood, and moist at wetness level.

Marasmius sp. 1

Marasmius sp. one found growing in groups with gregarious spacing in leaf litter (Figure 10a). This fungus has a fruit body shape with lamella (cap gills with stipe). The cap is white and brown at the center of the cap. The cap has a diameter of 0.2-1 cm (Figure 10b) and did not change in color (hygrophnous) after time. The surface of the pileus has a smooth texture, smooth edges, and straight margins. The underside of the cap (hymenophore) is in the form of the lamella, which attaches to the stipe in a free type, brown in color, the distance between crowded lines, and the lamela smooth margin (Figure 10c). Stipe is cylindric in shape, white in color, with a length from 0.5-1 cm. Smooth stipe surface with attaching position in the middle part of the cap. The stipe is

directly embedded in the substrate (basal tomentum). The inside of the stipe is solid, has a fleshy texture, litter odor, and moist at wetness level.

Marasmius sp. 2

Marasmius sp.2 found growing solitary. The fruit body is shaped as a cap with a stipe. Cap is light brown with a diameter of 2.3 cm (Figure 11a). The top shape of the cap is parabolic while the bottom is orbicular. The surface of the cap is radially fibrillose. The edges of the cap are crisped (Figure 11c-d). Pileus margin is recurved with moisture in the wetness level. Lamella is adnexed to the stipe with a length of 1.1 cm (Figure 11 b). The distance between lamella is medium with a smooth margin. The stipe is cylindric in shape and brown in color. Stipe has a diameter of about 0.1 cm and a length of 4.5 cm. Stipe attachment position to the pileus in the middle part. The stipe attache directly to the substrate. The inside of the stipe is hollow. Stipe and cap have a soft texture. The fruit body has the smell and taste of *Pleurotus ostreatus*.



Figure 8 Characteristics of macroscopic identification of *Gymnopus* sp.

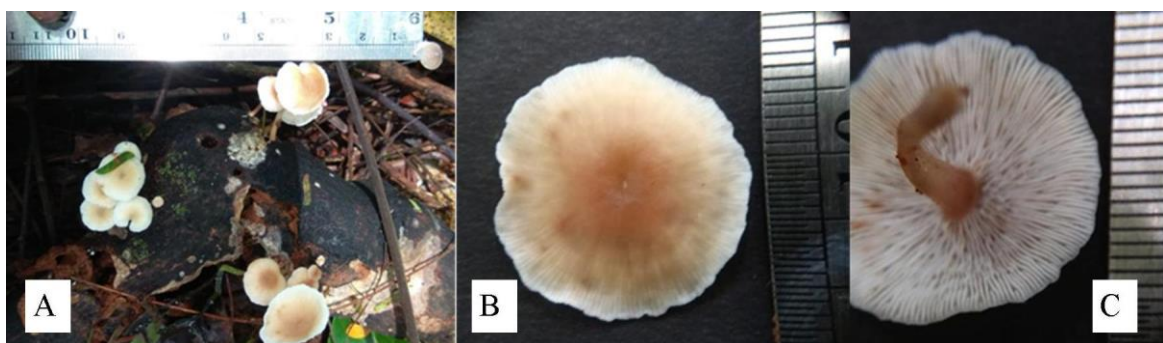


Figure 9 Characteristics of macroscopic identification of *Hypholoma* sp.

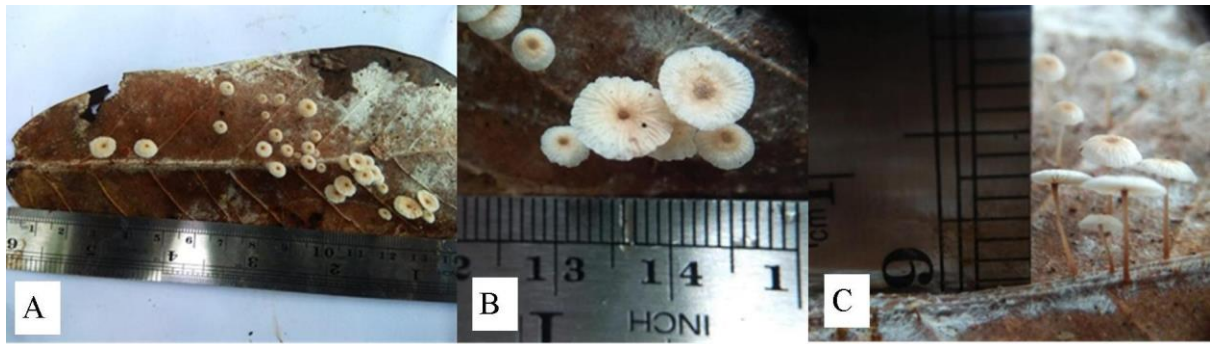


Figure 10 Characteristics of macroscopic identification of *Marasmius* sp.1



Figure 11 Characteristics of macroscopic identification of *Marasmius* sp.2

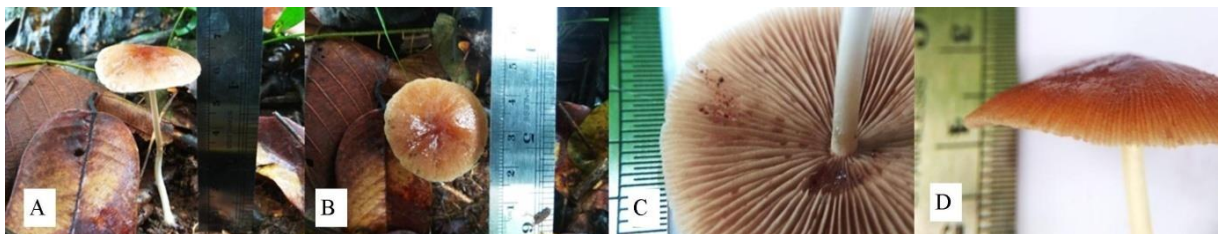


Figure 12 Characteristics of macroscopic identification of *Naucoria* sp.

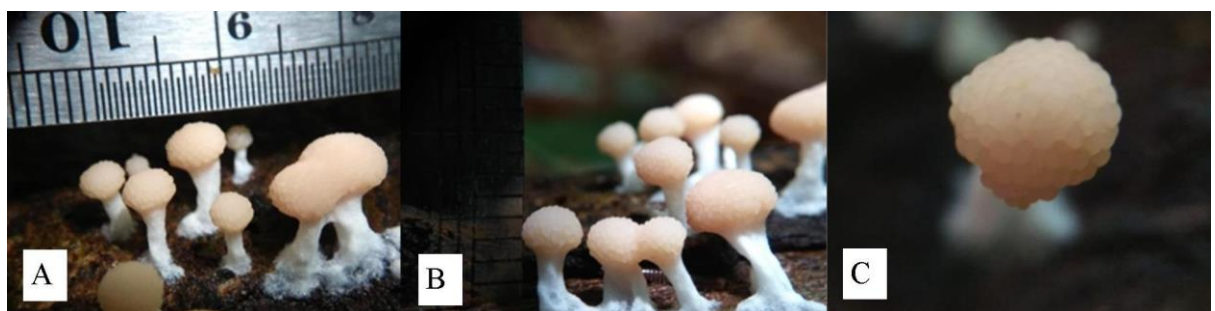


Figure 13 Characteristics of macroscopic identification of *Onygena* sp.

***Naucoria* sp.**

Naucoria sp. found solitary growing in the soil (Figure 12a). This mushroom has a fruit body shape with lamella (cap gills with stipe). The cap color is brown, with a diameter of 3 cm (Figure 12b). The cap did not change in color (hygrophanous) after time. The surface of the pileus is smooth, the edges are straight, and the margins are straight. The lower part of the cap (hymenophore) is lamella-shaped, which attaches to the stipe in a free type, brown to cream in color, crowded in lines, and smooth in the margin (Figure 12c). Stipe cylindrical in shape, white in color, with a length of 6.5 cm. The surface of the stipe is a smooth central position of attachment to the cap. The stipe is directly embedded in the substrate (basal tomentum). The inside of the stipe is hollow. The fruit body has a soft texture, smells like wood, and slimy at wetness level.

***Onygena* sp.**

Onygena sp. found growing in groups very close to each other (caespitose) in wood (Figure 13a). This fungus has a hymenophore type of gleba with a creamy 'cap.' The fruit body is 0.5-0.8 cm in diameter and did not change in color (hygrophanous) after time. The surface of the fruit body has a structure like fish eggs (Figure 13b-c). Stipe is cylindrical shaped white with a length ranging from 0.5-1 cm. Stipe is smooth at the surface with the central position of attachment to the 'cap.' Stipe is embedded directly on the substrate (basal tomentum) with a solid inner texture. The fruit body has a soft texture, easily broken, with a smell like wood, and moist at wetness level.

***Pholiota* sp.**

Pholiota sp. found solitary growing in the litter. This mushroom has a fruit body shape with lamella (cap gills with stipe). The cap color is dark brown in the middle and cream on the cap's edge, with a diameter of 2.5 cm (Figure 14a). The cap did not change in color (hygrophanous) after time. A conical cap presents a scaly surface texture in the middle, a small wavy edge (crenate), and a straight margin (Figure 14b). The lower part of the cap (hymenophore) is lamella, white in color, the crowded in lines, lamellae stick to the stipe in decurrent type, and decreased margin (Figure 14c). Stipe has a cylindrical shape, white in color, rough surface, 3 cm in length, central position of attachment to the stipe. The stipe is directly embedded in the substrate (basal tomentum) and has a hollow stipe texture. The fruit body has a soft

texture, smells like wood, and moist at wetness level.

***Pluteus* sp. 1**

Pluteus sp.1 was found to grow solitary in the soil (Figure 15a). This mushroom has a fruit body shape with lamella (cap gills with stipe). Cap is brown and 3 cm in diameter (Figure 15b). The cap did not change in color (hygrophanous) after time. The surface of the cap is smooth, with striped patterns, flat edges, and straight margins. The lower part of the cap (hymenophore) is lamella, brown in color, crowded in lines. Lamella attaches to the stipe in a free type, with a smooth margin (Figure 15c). Stipe cylindrical in shape, light brown, rough surface, 7.5 cm in length, central attachment to the cap position, and stipe directly embedded in the substrate (basal tomentum). The stipe texture is hollow. The fruit body has a soft texture, smells like wood, and moist at wetness level.

***Pluteus* sp. 2**

Pluteus sp.2 was found to grow solitary on tree trunks (Figure 16a). This mushroom has a fruit body shape with lamella (cap gills with stipe). Purplish cap in color with a diameter of about 5 cm (Figure 16b). The cap did not change in color (hygrophanous) after time. The cap's surface is transparent with a pattern of lines leading to the center (Figure 16c), and the cap margin is straight. The lower part of the cap (hymenophore) is lamella, purplish-brown in color, distant in lines, free type of attachment to the stipe, and smooth margin. Stipe has a cylindrical shape, brown in color, smooth surface, 3 cm in length, central position of attachment to the cap, directly embedded in the substrate (basal tomentum), and hollow stipe texture. The fruit body has a soft texture, smells like wood, and moist at wetness level.

***Ramaria* sp.**

Ramaria sp. was found to grow in groups colonizing on the same basalt on decayed bamboo stems (Figure 17a). This mushroom has the shape of a fruiting body resembling a coral reef. The fruit body is branching, milky brown, with a length of 6 cm (Figure 17b). The fruit body did not change in color (hygrophanous) after time. The stipe is directly embedded in the substrate (basal tomentum). The fruit body has a soft texture, flexible, smells like rotten wood, very pungent, and moist at wetness level.

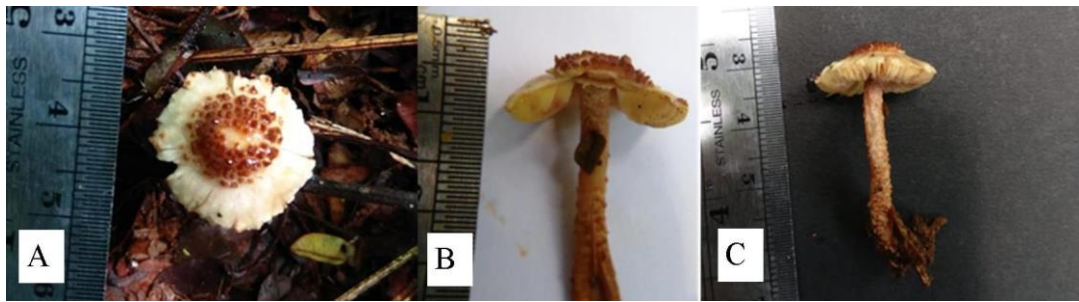


Figure 14 Characteristics of macroscopic identification of *Pholiota* sp.



Figure 15 Characteristics of macroscopic identification of *Pluteus* sp. 1

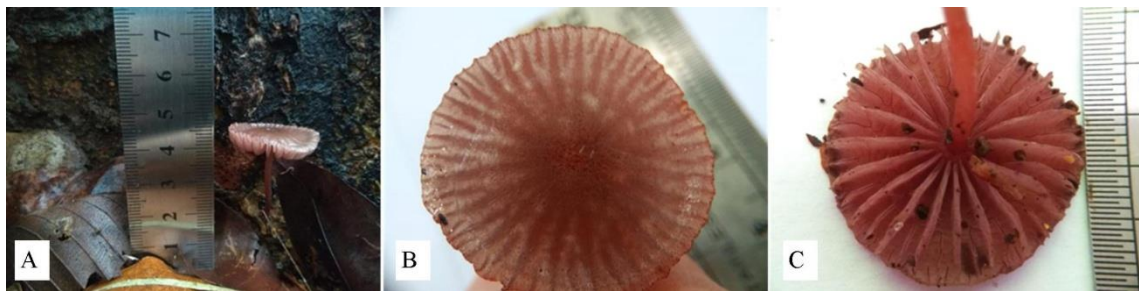


Figure 16 Characteristics of macroscopic identification of *Pluteus* sp. 2



Figure 17 Characteristics of macroscopic identification of *Ramaria* sp.

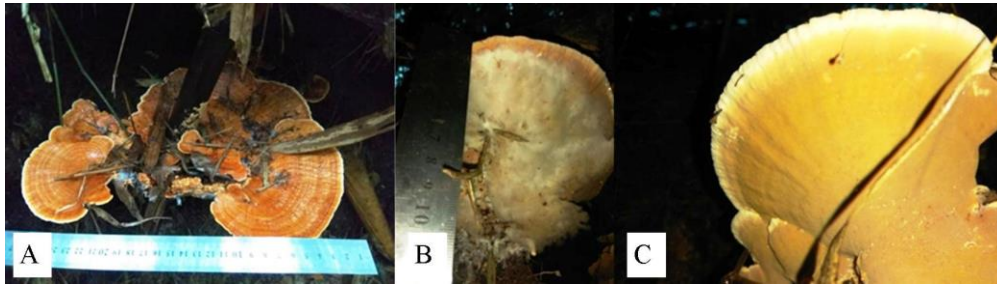


Figure 18 Characteristics of macroscopic identification *Rigidoporus* sp.



Figure 19 Characteristics of macroscopic identification *Russula* sp.

Rigidoporus sp.

Rigidoporus sp. found growing in groups with fruiting bodies growing on the same basal (connate) on tree trunks (Figure 18a). This mushroom has a fruit body shape with pores. The fruit body is brown to orange and 8-10 cm in diameter (Figure 18b). The mushroom did not change in color (hygrophanous) after time. The fruit body has a fan-like shape, smooth texture, undulated edges, and straight margins. The lower part of the fruit body (hymenophores) is pore-shaped with detachable pore attachment and brown color with white at the edge (Figure 18c). This mushroom does not have a stipe (sessile). The fruit body is directly embedded in the substrate. The fruit body has a hard texture, smells like wood, dry at wetness level.

Russula sp.

Russula sp. found solitary growing in the soil (Figure 19a). This mushroom has a fruit body shape with lamella (cap gills with stipe). The cap

Color is dark brown in the middle and pale on edge; the cap is 4.5 cm in diameter (Figure 19b). Cap did not change in color (hygrophanous) after time. The cap has a thread-like structure, large wavy edges (indented), and a flat margin. The lower part of the cap (hymenophore) is lamella, white in color, crowded in lines. The lamella attaches to the stipe in decurrent type and smooth margins (Figure 19c). The stipe has a white cylindrical shape, smooth surface with a slight curve, 4 cm in length, central position to the cap, the stipe is directly embedded in the substrate (basal tomentum), and semi-hollow stipe texture (Figure 19d). The fruit body has a soft texture, smells like wood, and moist at wetness level.

Discussion

Agaricales were the most dominant mushroom found in this research, which in order with the previous report in the near sampling site (Putra 2020a; 2020b; 2020c). This is also in line with Al-Ulya et al. (2017), who reported that

Agaricales is also the most common fungus found in Lebak Regency, Banten. In ecosystems, Agaricales is cosmopolitan macroscopic fungi. In addition, most of these fungi are saprophytes, which most of the members can grow on soil, dead higher plants (Gymnosperms and Angiosperms), and litter. Agaricales can colonize the environment is likely supported by several factors: the ability to produce enzymes that degrade organic matter, environmental factors condition such as temperature and humidity, and the availability of organic material that will support the growth of mushroom.

A total of 11 Family of the Order Agaricales was successfully described in this study. The group of Marasmiaceae found were four species, namely *Crinipellis* sp., *Marasmius* sp. 1, *Marasmius* sp. 2, and *Gymnopus* sp. The fruit body of Marasmiaceae is found in large numbers due to they tend to live in a group. *Crinipellis* sp. found in this study colonize bamboo stems on the forest floor. According to Vizzini et al. (2007), most *Crinipellis* species are saprotrophic in wood or rotted leaves. The next species was *Marasmius* spp. which is also commonly found in decaying leaves. *Marasmius* sp. is a good decomposer because it has a high ability to produce enzymes that can degrade lignin and cellulose (Ferreira-Gregorio et al., 2006). Two species of *Marasmius* were found in this study. Both species exhibit very different characters in cap color and stipe size. *Marasmius* is a diverse and taxonomic complex group of fungi (Desjardin et al., 2000). The last group of the Marasmiaceae Family is *Gymnopus* sp., which live in groups and utilize organic material from the deadwood. These results confirm that Marasmiaceae has a very important role as a litter decomposer to support the ecological function of the forest by recycling carbon stocks.

The Agaricaceae found in this study was *Agaricus* sp. This mushroom has a large size of the fruit body, ringed, and solitary life in the soil. Distinctive character in *Agaricus*'s is the color of lamella, which is pinkish white at the young stage and then turns to purplish-brown at the mature stage (Largent, 1977). *Conocybe* is the only Bolbitiaceae found in this study. This Macro fungus has brown lamella. The *Conocybe* cap has a range of colors from white to dark brown. In addition, the stems are white and break easily. *Conocybe* obtained in this study has a grayish-brown cap and small in size. The variation in size and color of the mushroom is likely affected by environmental factors in each ecosystem. The next Family was Pluteaceae, represented by two species, namely *Pluteus* sp. one and *Pluteus* sp.2.

The distinctive characteristic of this mushroom group is the color of the lamella. The difference between the two species found is that the fruit body color is quite different. *Pluteus* is known to have a wide distribution area (Menolli et al., 2010).

The Amanitaceae collected in this study was *Amanita* sp. and closely elated to *Amanita* cf. *muscaria* only by macroscopic characters. The macrofungi found in groups on the forest floor. *Amanita* sp. has bright yellow with white scales, remnants of universal veils covering its cap. *Amanita* sp. is a mushroom associated with plant roots to form ectomycorrhizae (Pala et al., 2012). Some of the genera of *Amanita* are edible, and some are poisonous. However, there is no specific information about this fungus' edibility in the area of research conducted.

Another family found during exploration was Strophariaceae, which was obtained by two species, namely *Pholiota* sp. and *Hypholoma* sp. *Pholiota* sp. has a scalding surface that resembles a scales and found lives solitary on the soil. According to Siegel et al. (2015), the description of fresh fruit body characteristics for morphological identification of *Pholiota* species has several obstacles due to environmental changes such as weather changes. However, the weather in the research period is relatively stable, so that there was no serious constraint in identifying *Pholiota*. The next member was *Hypholoma* sp., which found living in decayed wood. This indicates that *Hypholoma* sp. utilizes the source of organic material and acts as a decomposer. The last family member of the Agaricales collected was Hymenogastraceae, represented by one species, *Naucoria* sp. The mushroom has a brownish cap, lives solitary on the ground, with a dense lamella distance. This mushroom can be found in various conditions of wild forest ecosystems and tourism area (Putra et al., 2017; 2018; 2019a).

The Order of Poryporales obtained was divided into two families, namely Meripilaceae and Ganodermataceae. Poryporales members are both saprophytes and parasites which live in groups on living plant or fallen tree trunks. A common characteristic of this Order is a fan-shaped fruit body shape with pore as the hymenophore type (Arora, 1986). The Meripilaceae found was *Rigidoporus* sp. These macrofungi found as a parasite in a living tree. The next Family of the Order Polyporales is Ganodermataceae, represented by *Amauroderma* sp. The color of its hymenophore can turn red when it's touched or broken. Most of *Amauroderma* sp. grows in soil from buried roots or wood (Hapuarachchi, 2018). In IPBUCF,

Amauroderma sp. at first glance grew at the ground, but when the soil was dug until the base, the stipe colonizes plant roots buried in the soil. According to Glen et al. (2009), the association of *Amauroderma* sp. with plant roots can cause root rot symptoms in many tropical plants.

The next order of Basidiomycota obtained was Gomphales, which is represented by Gomphaceae. Gomphaceae members found it was *Ramaria* sp. This mushroom has a basidiome character that resembles a coral reef (coral-like). The Russulales is the last Order of Basidiomycota successfully recorded in this study and represented by one species, namely *Russula* sp. *Russula* sp. lives solitary on the ground. According to Verma et al. (2018a), *Russula*'s genus has the characteristics of a fleshy fruit body with a lamella, sometimes brightly in color, and included in the ectomycorrhizal fungi.

The Ascomycota identified in this study were suspect as *Cookeina tricholoma* (order: Pezizomycetes, Family: Pezizales) and *Onygena* sp. (Order: Onygenales, Family: Onygenaceae). *C. tricholoma* has a bowl-shaped fruit body known as apothecium-shaped ascoma and bright red. Fine hairs in the apothecium of *C. tricholoma* are called fasciculate (Verma et al., 2018b). Putra and Khafazallah (2020) reported that some species of *Cookeina* are edible mushrooms and consume by local people in Indonesia. *Onygena* sp. found has unique fruit body shape and color, and live in large number in rotted wood.

Conclusion

A total of 18 macrofungi were identified and described in this study. The macrofungi were divided into 6 Order, 13 Family, and 18 Species. Mushroom identification was carried out using a variety of macroscopic characters. The mushrooms were identified such as *Agaricus* sp., *Amanita* sp., *Amauroderma* sp., *Conocybe* sp., *Crinipellis* sp., *Gymnopus* sp., *Hypholoma* sp., *Marasmius* sp.1, *Marasmius* sp.2, *Naucoria* sp., *Pluteus* sp. 1, *Pluteus* sp. 2, *Pholiota* sp., *Ramaria* sp., *Rigidoporus* sp., and *Russula* sp., *Cookeina* sp., and *Onygena* sp. This result provided macrofungi information and characterization around campus forests in Indonesia.

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References

- Alexopoulos, C. J., & Mims, C. W. (1979). *Introductory mycology*. New York: Wiley.
- Al Ulya, A. N., Leksono, S. M., & Khastini, R. O. (2017). *Biodiversitas Dan Potensi Jamur Basidiomycota Di Kawasan Kasepuhan Cisungsang, Kabupaten Lebak, Banten*. *Al-Kauniah: Jurnal Biologi*, 10(1). doi:10.15408/kauniah.v10i1.4513
- Anon, (2002). *Termitomyces* mushrooms: a tropical delicacy. *Mycologist*, 16(1), p.9.
- Arora, D. (1986). *Mushrooms Demystified*. USA, Teen Speed Press.
- Chang, S.T., Miles, P. (2004). *Cultivation techniques*. In: Chang, S.T., Miles, P. (Eds.), *Mushroom, Cultivation, Nutritional Value, and medicinal Effect and Environmental Impact*. CRS Press, New York, pp. 85–87.
- Desjardin, D.E., Retnowati, A., Horak, E. (2000). *Agaricales of Indonesia. 2. A preliminary monograph of Marasmius from Java and Bali*. *Sydowia*, 52(2),92-194.
- Desjardin, D. E., Wood, M., & Stevens, F. A. (2016). *California mushrooms: The comprehensive identification guide*. Portland, Oregon.
- Glen, M., Bougher, N. L., Francis, A. A., Nigg, S. Q., Lee, S. S., Irianto, R., Mohammed, C. L. (2009). *Ganoderma* and *Amauroderma* species are associated with root-rot disease of *Acacia mangium* plantation trees in Indonesia and Malaysia. *Australasian Plant Pathology*, 38(4), 345. DOI:10.1071/ap09008
- Ferreira Gregorio, A. P., Da Silva, I. R., Sedarati, M. R., & Hedger, J. N. (2006). *Changes in production of lignin-degrading enzymes during interactions between mycelia of the tropical decomposer basidiomycetes Marasmiellus troyanus and Marasmius*

- pallescens*. Mycological Research, 110(2), 161–168.
DOI:10.1016/j.mycres.2005.10.002
- Hapuarachchi, K. (2018). *Amauroderma* (Ganodermataceae, Polyporales) – bioactive compounds, beneficial properties, and two new records from Laos. Asian Journal of Mycology, 1(1), 121–136.
DOI:10.5943/ajom/1/1/10
- Hawksworth, D. L. (2001). The magnitude of fungal diversity: the 1.5 million species estimate revisited. Mycological Research, 105(12), 1422–1432.
DOI:10.1017/s0953756201004725
- Largent, D.L. (1977). How to Identify Mushrooms to Genus I: Macroscopic Features. Eureka (CA), Mad River Press Inc.
- Menolli, N., Asai, T., & Capelari, M. (2010). Records and new species of *Pluteus* from Brazil based on morphological and molecular data. Mycology, 1(2), 130–153.
DOI:10.1080/21501203.2010.493531
- Mueller, G. M., Schmit, J. P., Leacock, P. R., Buyck, B., Cifuentes, J., Desjardin, D. E., Wu, Q. (2006). Global diversity and distribution of macrofungi. Biodiversity and Conservation, 16(1), 37–48.
DOI:10.1007/s10531-006-9108-8.
- Nasution, F., Rahayu Prasetyaningsih, S., & Ikhwan, M. (2018). Identifikasi Jenis Dan Habitat Jamur Makroskopis Di Hutan Larangan Adat Rumbio Kabupaten Kampar Provinsi Riau. Wahana Forestra: Jurnal Kehutanan, 13(1), 64–76.
doi:10.31849/forestra.v13i1.1556
- Pala, S. A. (2012). Diversity of macrofungal genus *Russula* and *Amanita* in Hirpora Wildlife Sanctuary, Southern Kashmir Himalayas. Biodiversitas, Journal of Biological Diversity, 13(2), 65–71.
DOI:10.13057/biodiv/d130203
- Putra, I.P., Mardiyah, E., Amalia, N.S., Mountara, A. (2017). Ragam jamur asal serasah dan tanah di Taman Nasional Ujung Kulon Indonesia. Jurnal Sumberdaya Hayati, 3(1), 1-7.
- Putra, I.P., Sitompul, R., Chalisya, N. (2018). Ragam Dan Potensi Jamur Makro Asal Taman Wisata Mekarsari Jawa Barat. Al-Kaunyah: Jurnal Biologi, 11(2), 133–150.
<http://dx.doi.org/10.15408/kaunyah.v11i2.6729>.
- Putra, I.P., Nasrullah, M.A., Dinindaputri, T.A. (2019a). Study on Diversity and Potency of Some Macro Mushroom at Gunung Gede Pangrango National Park. Buletin Plasma Nutfah, 25(2), 1-14.
<http://dx.doi.org/10.21082/blpn.v25n2.2019.p1-14>.
- Putra, I.P., Amelya, M.P., Nugara, N.H., Zamia, H.Z. (2019b). Notes of Some Macroscopic Fungi at IPB University Campus Forest: Diversity and Potency. Biota, 12(2), 57-71.
<https://doi.org/10.20414/jb.v12i2.192>.
- Putra, I.P. (2020a). Record On Macroscopic Fungi At IPB University Campus Forest: Description And Potential Utilization. IJOSE, 4(1):1-11.
- Putra, I.P. (2020b). Catatan Beberapa Jamur Makro di Pulau Belitung : Deskripsi dan Potensinya Note on Macro Fungi on Belitung Island : Description and Potential. Bioeduscience, 4(1), 11–20.
<https://doi.org/10.29405/j.bes/4111-204416>.
- Putra, I.P. (2020c). Diversity And Potential Utilization Of Some Wild Macroscopic Fungi Around IPB University Campus Building. Jurnal Pendidikan Matematika dan IPA, 11(2), 257-270.
<http://dx.doi.org/10.26418/jpmipa.v11i2.39138>.
- Putra, I.P. (2020d). Kasus keracunan *Inocybe* sp. di Indonesia. *Prosiding Seminar Nasional Biologi Di Era Pandemi Covid 19*. Jurusan Biologi, Fakultas Sains dan Teknologi, Universitas Islam Negeri (UIN) Alauddin Makassar.
- Putra, I.P., & Hafazallah, K. (2020). Catatan Komunitas Pemburu Jamur Indonesia : Kolaborasi Lintas Profesi dan Generasi Mengenai Etnomikologi Jamur-Jamur Indonesia. Sukabumi : Haura Publishing.
- Retnowati, A. (2004). Notes On Diversity Of Agaricales In Gunung Halimun National Park. Berita Biologi, 7(1): 51-55.
- Retnowati, A. (2007). Dua jamur *Russula* (Agaricales: Russulaceae) yang dapat

- dimakan dari Kalimantan Timur. Floribunda, 3(4): 109-112.
- Retnowati, A. (2011). On collections of garlic odorous *Marasmiellus ignobilis* (berk. & br.) Singer from Indonesia. Floribunda, 4(2): 57-61.
- Retnowati, A. (2015). *Lepiota viriditincta* (berk. & broome) sacc.: a species from Bali with grey-green color changing when dried. Floribunda, 5(3): 111-113.
- Rokuya, I., Yoshio, O., Tsugia, H. (2011). *Fungi of Japan*. Japan, Yama-Kei Publishers.
- Shelley, E., Geoffrey, K. (2004). Pocket nature: Fungi. Dorling Shelley Evans and Geoffrey Kindersley Limited, London.
- Siegel, N., Nguyen, N. H., & Vellinga, E. C. (2015). *Pholiota olivaceophylla*, a forgotten name for a common snowbank fungus, and notes on *Pholiota nubigena*. Mycotaxon, 130(2), 517–532. DOI:10.5248/130.517
- Susan, D., & Retnowati, A. (2018). Catatan Beberapa Jamur Makro Dari Pulau Enggano: Diversitas Dan Potensinya. BERITA BIOLOGI, 16(3). doi:10.14203/beritabiologi.v16i3.2939
- Verma, R.K., Asaiya, A.J.K., Pandro, V., Raj, D., Patel, D. 2018– Diversity of macro-fungi in Central India-XVIII: *Cookeina tricholoma*, a cup fungus from Maharashtra. Van Sangyan 5, 25-29.
- Verma, R. K., Pandro, V., & Pyasi, A. (2018). Diversity and Distribution of *Russula* in India with Reference to Central Indian species. International Journal of Current Microbiology and Applied Sciences, 7(10), 3078–3103. DOI:10.20546/ijcmas.2018.710.359
- Vizzini, A., Antonin, V., & Noordeloos, M. E. (2007). *Crinipellis pedemontana* sp. nov. (Agaricomycetes), a new basidiomycete from Italy. Mycologia, 99(5), 786–791. DOI:10.3852/mycologia.99.5.786