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Record on Macroscopic Fungi at IPB University Campus Forest : Description and Potential Utilization

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ABSTRACT

Fungi are ubiquitous and worldwide in distribution. It is estimated that tropical region such as Indonesia has high diversity of macrofungi. Studies on the diversity and potential utilization of macrofungi have gained significance during the recent years in Indonesia. However, information provide in the term of institutional area are still limited, and campus forest is no exception. The aim of this study was to collect information of mushroom diversity at IPB Unversity Campus Forest as inital step to maximize the potential utilization in the future. Macrofungi collection was done by opportunistic sampling method. All mushrooms found were Basidiomycota which dominated by the order of Agaricales. A total of 11 mushroom were identified and described in this study, namely: *Crinipellis* sp., *Marasmius* sp.1, *Marasmius* sp.2, *Termitomyces* sp., *Cortinarius* sp., *Coprinellus* sp., *Pluteus* sp., *Gymnopus* sp., *Schizophyllum* sp., *Lentinus* sp.1 and *Lentinus* sp.2. Some wild macroscopic fungi found to be potentially used as food source, secondary metabolites source, medicine, and also decomposer in sampling site.

Keywords: Macro fungi, diversity, potency, IPB university.

INTRODUCTION

Macrofungi were long appraised as unique group of organisms, poorly understood, and complicated to study due to their constantly sporadic and short-lived basidiocarps. Macrofungi are heterotrophic organisms with variety of form, size, physiology and reproduction style. The term macrofungi or mushroom has been variously defined by several authors. All the definitions lay attention on the fruiting body which are visible enough to the unaided eye and to be picked up by hand (Chang & Miles, 2004; Anon, 2005). Taxonomically, macro fungi are the members of Ascomycetes and Basidiomycetes (Mueller *et al*., 2007).

Even though macrofungi hold the fundamental role, we are still far away from understanding its biodiversity (Mueller *et al*., 2007; Lonsdale *et al*., 2007; Peay *et al*., 2008). This is due to that fungi are one of the most species-abundant taxonomic groups (Hawksworth, 2001). Mushroom is belong to the kingdom of Fungi, which comprise diverse group of organisms on earth. The known number of fungi species up to time is approximately 70,000 of the estimated 1,500,000 species in the world (Blackwell, 2011). In addition, information about macro fungi diversity and its use by people is close to 712,000 species (Mueller *et al*., 2007). Most of the information are provide by author in temperate regions.

In contrast to what is data available in the temperate regions, mushroom in the tropical area are more diverse and are distributed over geographical area (Tedersoo *et al*., 2014). From mycological science perspective, the diversity of Indonesian macro fungi is widely unknown and poorly understood. Only fraction of total mushroom

diversity has been subjected to scientific inquiry and mycologists continue to unravel the unexplored, hidden, and fascinating macro fungi biodiversity. Till date, there is no systematic Indonesian checklist of mushroom ever found, contrary to Malaysia and Vietnam which has checklist of literature macro fungi (Lee *et al*., 2008; Kiet, 2008).

Most mushroom species are occure seasonally and occupy diverse niches in ecosystem. In the term of utilization, fungi has been widely carried out in the fields of industry, agriculture, medicine, food, textiles, and bioremediation (Manzi *et al.*, 2004; Krzywinski *et al.*, 2009; Angelini *et al*., 2012; Pagiotti *et al*., 2010, Picco *et al.*, 2011, Perotto *et al.*, 2013).

As the initial step to optimize mushroom utilization, exploration and identification of fungi obtained around us is needed, and campus forest is no exception. it is crucial to record the diversity, distribution, and abundance of these macro fungi in Indonesia. Some mycologists have given significant contributions in study of macrofungal diversity both in natural or man-made area (Retnowati, 2004; 2007; 2011; 2015; Susan and Retnowati, 2018; Putra *et al.*, 2017; 2018; 2019a; 2019b), however limited information provided regarding to mushroom diversity in campus forest (Putra *et al*., 2019b). IPB University Campus Forest (IPBUCF) lies in the high rainfall area in West Java, which providing suitable for mushroom development. Till time, there is only limited comprehensive information about the mushroom diversity and potency available around IPBUCF. Thus, the goal of this study was to observe macrofungi diversity and their potential utilization in IPBUCF.

RESEARCH METHODE

The study was conducted at IPBUCF (Figure 1) in April-May 2018. Data collection was done by opportunistic sampling method as described by O'Dell *et al*. (2004). Macro fungi identification has been based mainly on examine the morphology structure. Often, this is a tedious, ambiguous, and time consuming method as many diverse fungi may have similar. In this study, mushroom identification was carried out using some simple macroscopic characters refferring to Putra *et al*., (2018). Macroscopic identification parameters including how mushroom grow, fruit body shape, hygrophnous, cap color when young and mature, cap diameter, upper and lower shape of cap, cap surface, cap edge, cap margin, wetness level, hymenophore type (lamellae, pores, teeth) including: 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, taste, and information on its use as food (edible or non edible) through literature studies to obtain data related to the use of fungi. Mushroom samples identified using several identification references including Arora (1986), McKnight & Vera (1998), Largent (1973), and Desjardin *et al*. (2016).

RESULT AND DISCUSSION

A total of 11 mushroom samples were identified and described in this study. The macro fungi is divided into 2 Order and consists of 8 Family (Table 1). All mushroom identified as Basidiomycota, namely: *Crinipellis* sp., *Marasmius* sp.1, *Marasmius* sp.2, *Termitomyces* sp., *Cortinarius* sp., *Coprinellus* sp., *Pluteus* sp., *Gymnopus* sp., *Schizophyllum* sp., *Lentinus* sp.1, *Lentinus* sp.2. The macro fungi found was dominated by the order of Agaricales. Agaricales are considered cosmopolitan macro fungi. They grow easily in broad range of habitats (Vellinga, 2004). Many Agaricales also play vital roles in biodegradation and biodeterioration and are thus important ecosystem engineers (Vellinga, 2004).

Each mushroom found in this research has different characteristics. The following are description of mushroom of IPBUCB and their characters.

***Crinipellis* sp.**

Crinipellis sp. found grow in gregarious type on wood. Pileus are semi conical, dominat brown in colour and dark brown in central part (Figure 2.A), changed after time (hygrophnous) and 11mm in diameter. Cap are radially fibrillose at surface, incurved edge, and dry at wetness level. The hymenophore is lamella with

Table 1. Mushroom Diversity Around IPB University Campus Forest

Phylum	Class	Order	Family	Species
Basidiomycota	Agaricomycetes	Agaricales	Marasmiaceae	*Crinipellis* sp.
				Marasmius sp.1
				Marasmius sp.2
			Lyophyllaceae	*Termitomyces* sp.
			Cortinariaceae	*Cortinarius* sp.
			Psathyrellaceae	*Coprinellus* sp.
			Pluteaceae	*Pluteus* sp.
			Omphalotaceae	*Gymnopus* sp.
			Schizophyllaceae	*Schizophyllum* sp.
		Polyporales	Polyporaceae	*Lentinus* sp.1
				Lentinus sp.2

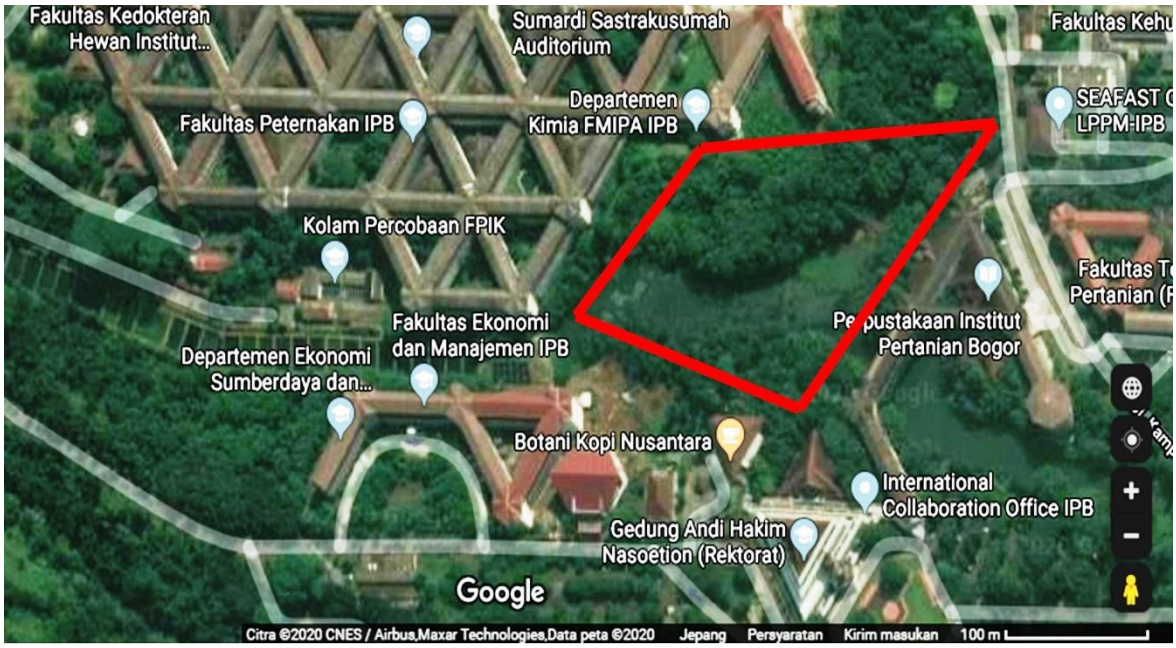

Figure 1. Sampling site (red line) of macroscopic fungi around IPB University Campus Forest.

adnexed style. Lamella (Figure 2B) are 4mm in length and medium rows. The cylindyc stipe are 15 mm in length, 1mm in diameter, and scaly at surfcae. Stipe attach to the substrate in an inserted type, hollow in cross section, without partial veil. The fruit body texture is tough and has bland taste. *Crinipellis* reported as potential natural fungicides (Han *et al*. 2018) and improving the nutritive value of poor quality straw and do not posses any threat for their subsequent use as ruminant feed (Mahesh and Mohini, 2013; Sharma *et al*., 2011).

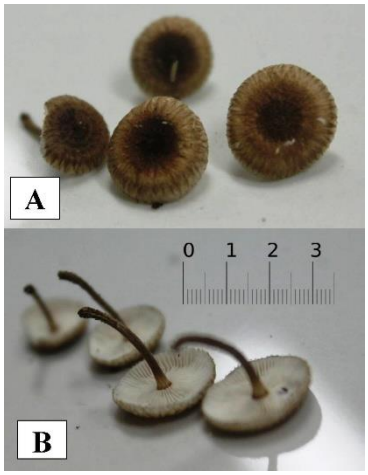

Figure 2. Characteristics of macroscopic identification of

***Marasmius* sp.1**

Marasmius sp.1 grow solitary on wood (Figure 3.A). Pileus are convex in shape, white in colour, 35mm in diameter, smooth surface, crisped edge, incurved margin, without change in color after time (hygrophnous), and has a dry wetness level. The hymenophore characters are lamella in type, ednexed in attachment to the, distant in rows, and entire margin (Figure 3.B).

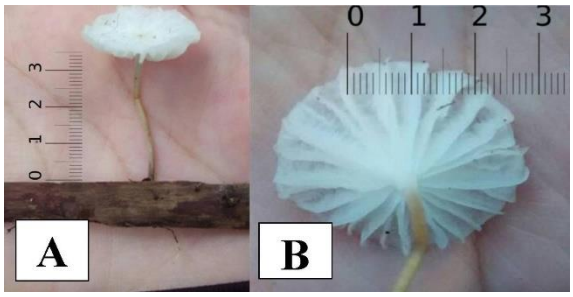

Figure 3. Characteristics of macroscopic identification of *Marasmius* sp.1

The stipe are tapered downward, brown in colour, 3 mm in diameter, 29 mm in length, and smooth surface without partial veil. This mushroom has soft texture of the fruit body, distinctive peanuts odor, and acidic taste.

***Marasmius* sp.2**

Marasmius sp.2 grow in colonies (Figure 4.A). Pilues are arched to semi globose, brown in colour, crisped edge, 30mm in diameter, and incurved margin. The hymenophore is lamella with free type of attachment (Figure 4C), 20 mm in length, distant rows, and entire margin. The stipe has a cylindrical shape (Figure 4.B), brown colour and dark in center, 5 mm in diameter, 30 mm in length, solid cross section, and without partial veil. Fruit body texture is tough without specific odor and taste.

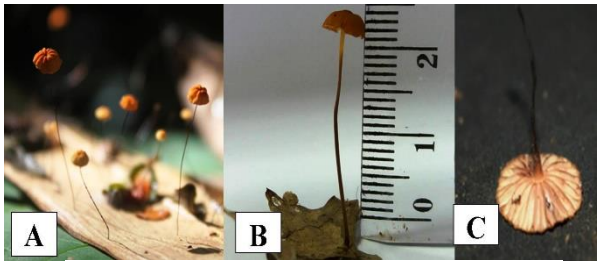

Figure 4. Characteristics of macroscopic identification of *Marasmius* sp.2

The genus of *Marasmius* known as important decomposer in many ecosystem. Both *Marasmius* which found in this study were different from those as decribed by Putra *et al*. (2019b), especially in the term of macroscopic description. *Marasmius* is complex group and emerge to more than 600 species in the world. Desjardin *et al*. (2000) described 37 species of *Marasmius* from Java island and Bali, which 12 of them were new species. Chance for describing the new species of *Marasmius* in Indonesia is extremely high considering the vast tropical forest area. *Marasmius* is easily found in both wild forest areas and tourism areas (Putra *et al*., 2017; 2018).

Vantamuri and Kaliwal (2016) proved that *Marasmius* produce laccase which can be used for decolorization of selected textile dyes. Putir *et al*. (2008) reported that several types of *Masrasmius* sp. can be used as medicine. Furthermore, Shomali *et al.*

(2019) reported that *Marasmius oreades* has the properties of antioxidant, anticancer, antimicrobial and antibiofilm.

***Termitomyces* sp.**

Termitomyces sp. found grow solitary on the soil. Pileus are dominant white in colour, has umbo in the middle, moist in wetness level, and colour changed after time (hygrophnous). The cap are flat in shape, 48 mm in diameter, smooth surface, uplifted margin, and entire edge (Figure 5.A). Hymenophore is lamella, free in attachment, 20 mm in length, crowded in rows, and entire margin (Figure 5.B). The stipe are cream in clour, 10 mm in diameter, smooth surface, and unknown length because it extends into the ground (determined by the depth of the termite nest). The stipe attaches to the center of the cap, no partial veil found, and with a solid cross section. This mushroom has a soft and fleshy fruit body texture with a distinctive aroma of fungi and has a bland taste. *Termitomyces* known as edible mushroom in many area in Indonesia. This mushroom known as 'supa bulan' in West Java, 'jamur barat' in most of Java Island area, or 'jamur rayap' in many Island in Indonesia. The *Termitomyces* sp. found in this study, slightly similar with *Termitomyces* sp.1 which described by Putra *et al*. (2019). However, since DNA data is required to effectively distinguish both species, author consider to treat those as different species for the time being.

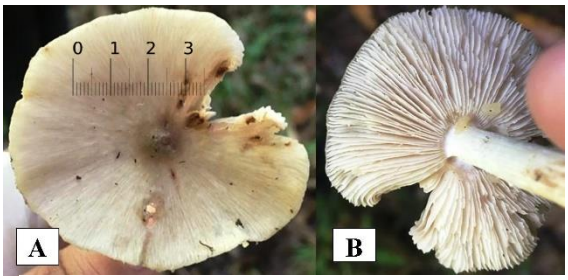

Figure 5. Characteristics of macroscopic identification of *Termitomyces* sp.

Anon (2002) described that *Termitomyces* as tropical delicacy mushroom. *Termitomyces* is a genus of edible mushrooms commonly consumed in Africa and Asia among the mushrooms collected from the wild. *Termitomyces* mushrooms contain have potential uses as antioxidants, immunomodulators, antitumors, and antimicrobials (Hsieh *et al*., 2018). *Termitomyces clypeatus* is another important source of β-glucan that can be extracted using the hot alkaline method (Banik *et al*., 2012).

***Cortinarius* sp.**

Cortinarius sp. found grow solitary on soil near the trees (Figure 6.A). The pileus are semiglobose, brown in colour, 40 mm in diameter, and colour not changed after time (hygrophnous). Cap surface is smooth, entire edge, inrolled margin, and white cortina (Figure 6.B). The hymenophore type is lamella, attached in free style, entire margin, 15 mm in length, and crowded rows (Figure 6.C). The cylindrical stipe are yellow to brown in colour, 7 mm in diameter, 70 mm in length, and smooth surface. Stipe attach to pileus in the central part, rhizoid type to the substrate, no partial veil found, and has hollow cross section. Fruit body texture is soft without specific odor and taste. The genus *Cortinarius* reported as antimicrobial metabolites source (Beattie *et al*., 2010), but some species also poses cytotoxic activity (Torres *et al*., 2016).

Figure 6. Characteristics of macroscopic identification of *Cortinarius* sp.

***Coprinellus* sp.**

Coprinellus sp. found grow on humus soil with caespitose pattern (Figure 7.A). Pileus are high conical, white to cream in colour, colour not changed after time (hygrophnous). Cap chraracteristics are 3-6 mm in diameter, radially thread like surface, entire edge, and decurved margin, and moist at wetness level. The hymenophore is lamella (Figure 7.B), 5 mm in length, crowded rows, and entire margins. The stipe

are white in colour, rooting in form, 12 mm in length, and smooth surface (Figure 7.C). The stipe has hollow stipe cross section without partial veil. This mushroom has a soft and fleshy fruit body texture and has distinctive odor like the smell of vegetables with butter taste. *Coprinellus* sp. is closely related to *Coprinellus disseminatus* (Pers.) J.E. Lange, but further observation is nededed. *Coprinellus* reported as edible saprotrophic fungal species with bioactive potential (Novakovic *et al*., 2016) and agent for damaging nematode cuticles mechanically with spiny balls and produces potent toxins to immobilize nematodes in Agriculture (Luo *et al*., 2007).

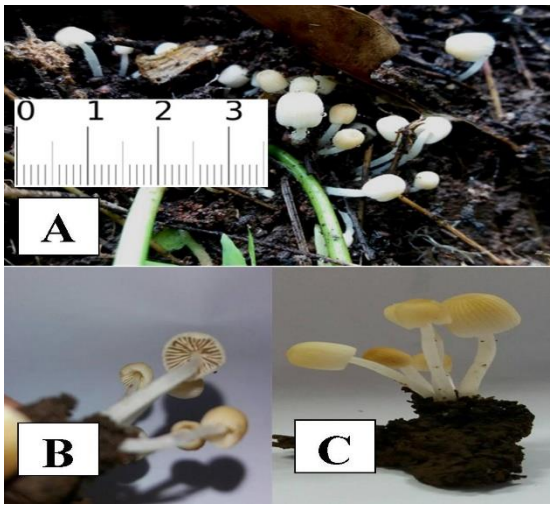

Figure 7. Characteristics of macroscopic identification of *Coprinellus* sp.

***Pluteus* sp.**

Pluteus sp found grow in branch litter (Figure 8A). Pileus are convex in shape, light brown in colour, 24 mm in diameter, smooth surface, entire edge, and moist at wetness level. The hymenophore is lamella (Figure 8B), attach in frre type, entire margin, and medium rows. The stipe are cylindrical in form (Figure 8C), light brown, 30 mm in length, and smooth at surface. The stipe attach in center part of pileus, without partial veil, and solid in cross section. The texture of the fruit body is soft and has bland taste. Few reports found on the role of *Pluteus* both in ecosystem and human life. Rivera-Mariani *et al*. (2013) reported the potential of *Pluteus* to affect human health as allergens. In this study, *Pluteus* found as decomposer on branch litter.

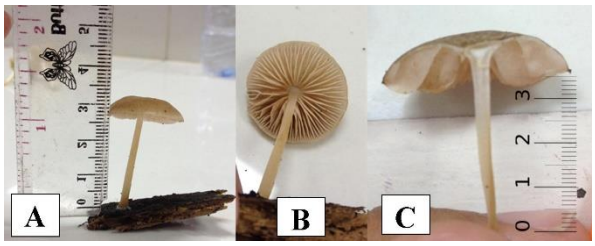

Figure 8. Characteristics of macroscopic identification of *Pluteus* sp.

***Gymnopus* sp.**

Gymnopus sp. found grow solitary or in small group in IPBUCF (Figure 9.A). Pileus are flat with umbo inthe center, light brown in colour, 17 mm in diameter, smooth surfce, crisped edge, decurved margin, without change in color after time (hygrophnous), and moist at wetness level. The hymenophore is lamella, short decurrent in attachment to the stipe, medium rows, and crenete margin (Figure 9.B). Stipe are cylindrical-shaped, light brown in colour, 2 mm in diameter, 19-20 mm in length, and smooth surface. The stipe has hollow cross section without partial veil. This mushroom has soft and fleshy fruit body texture and does not have a distinctive odor.

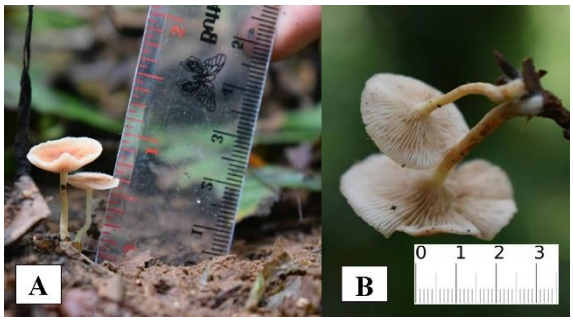

Figure 9. Characteristics of macroscopic identification of *Gymnopus* sp.

Mycochemical study of the mushroom *Gymnopus fusipes* led to the discovery of two new cyclopeptides (Vanyolos *et al*., 2016; Wang *et al*., 2017). *Gymnopus* also reported as potential mycoremediation agent (Falandysz *et al*., 2014). Gamboa-Trujillo *et al.* (2014) reported that local communities of Kichwa nationality, that inhabit vegetal formations called "páramos" of the Ecuadorian Andes, call it kallambas or

kallambitas and use the mushrooms for direct alimentation. Sporadically it is sold in popular markets close to the communities. They claimed that *Gymnopus nubicola* is hereby reported for the first time as an edible mushroom in the world.

***Schizophyllum* sp.**

Schizophyllum sp. found grow both solitary and in groups (Figure 10A;B). Pileus are brown to gray in colour, 5- 7 in diameter, crenate edge, incurved margin, and without change in color after time (hygrophnous). The surface is hairy and dry in wetness level. The hymnophore type is lamellaa, 8- 11 mm in length, crowded rows, and undulate margin. The pesudostipe attach in terminal (side) posisition of pileus, and attach in sessile to the substrate. This mushroom has soft and fleshy fruit body texture and does not have a distinctive odor and tasteless. *Schizophyllum* known as 'jamur gerigit'in many places in Indonesia. This genus has the potential as food source. Darwis *et al*. (2011) reported that *Schizophyllum* sp is consumed by local people in Bengkulu province.

Figure 10. Characteristics of macroscopic identification of

***Lentinus* sp. 1**

Lentinus sp.1 found grow in groups with the distance between fruit bodies (scattered) on tree branch (Figure 11.A). Pileus are depressed (Figure 11.B), 10- 20 mm in diameter, orbicular at bottom shape, colour not changed after time (hygrophnous). Pileus are radially fribrillose in surface, crisped edge, incurved margin, and dry in wetness level. The hymenophore type is lamela with decurrent attachment in a stipe (Figure 11.C), crowded in rows, and serrulate margin. The stipe are rooted in type, 2 mm in diameter, 10-12 mm in length, and thread like structure at surface. Stipe attach in the middle of the cap (central), solid type of stipe section, and has no partial veil. This fungi has tough texture without distinctive odor and taste.

Figure 11. Characteristics of macroscopic identification of *Lentinus* sp.1

***Lentinus* sp. 2**

Lentinus sp. found grow in gregarious pattern (Figure 12.A). Pileus are flat and depressed at the center (Figure 12.B), white in colour, 40 mm in diameter, colour not changed after time (hygrophnous). The pileus is smooth, entire edge, incurved margin, moist at wetness level. The hymenophore is lamella, decurrent in attachment, 20 mm in length, crowded in rows, and entire margin (Figure 12.C). The stipe are rooting in form, cream in colour, 4 mm in diameter, 18 mm in length, and smooth surface. Fruit body is fleshy, has distinctive odor, with vegetables taste. *Lentinus* sp. 2 closely related to *Lentinus sajor-caju* but further observation is needed.

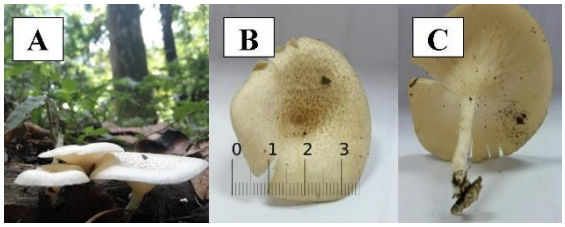

Figure 12. Characteristics of macroscopic identification of *Lentinus* sp.2

Both *Lentinus* found in this study, have different characterictics, especially in the term of macroscopis description. Many

Lentinus considered as nutraceutical and functional food and be used in human diet (Singdevsachan *et al*., 2013; Hussein *et al*., 2017). Fruiting bodies of *Lentinus* species contained abundant nutritional substances such as monosodium glutamate-like, β-glucan, and sweet amino acids (Zhou *et al*., 2015). In addition, Manjunathan and Venkatesan (2010) reported that this macrofungi has potential for food industry, medical application, enzyme production and effluent treatment.

CONCLUSION

A total of 11 mushrooms were identified and described in this study. The macrofungi are divided into 2 Order and consists of 8 Family. All mushrooms identified as Basidiomycota, namely: *Crinipellis* sp., *Marasmius* sp.1, *Marasmius* sp.2, *Termitomyces* sp., *Cortinarius* sp., *Coprinellus* sp., *Pluteus* sp., *Gymnopus* sp., *Schizophyllum* sp., *Lentinus* sp.1, *Lentinus* sp.2. The macrofungi found was dominated by the order of Agaricales. All macrofungi played an important role as decomposes either on litter, soil, or termite comb. Some wild macroscopic fungi found to be potentially used as food source (*Termitomyces*, *Lentinus*, *Schizophyllum*), secondary metabolites source (*Crinipellis*, *Cortinarius*), and medicine (*Gymnopus*, *Marasmius*).

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