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Inventory of macrofungi at peat swamp forest area, Kapuas Hulu, West Kalimantan

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Abstract

The areas surrounding peat swamp forest at Dusun Meliau and Bukit Peninjau, Kapuas Hulu, West Kalimantan host a diverse species of flora and fauna, including macrofungi. However, the information on the macrofungal diversity in this area has not been reported. The goal of this study was to obtain information on the diversity of macrofungi that can be used as food and medicine. Data was collected by direct modified collection method using plot (10 × 20 m) with interval 10 m along the transect line. A total of 79 specimens of macrofungi discovered from the two locations, of which 23 and 66 specimens were collected from Dusun Meliau and Bukit Peninjau, respectively. Of the 79 macrofungi specimens, 16 specimens were potential as a food source, and 41 as medicine. The macrofungi in this study was dominated by members of Ordo Aphyllophorales.

Keywords: biodiversity, macrofungi, peat swamp forest, West Kalimantan

Introduction

As a tropical country, Indonesia hosts a high diversity of flora and fauna, including macrofungi. Hilman & Romadoni (2001) reported that of a total of 1.5 million fungal species worldwide, half of those species exist in tropical areas such as Indonesia. However, the information on the fungal biodiversity in Indonesia is scattered. This is evidenced by the available literatures regarding the Indonesian fungal diversity. Previous studies from several protected forestry officials in Indonesia showed no adequate information about Indonesian macrofungal diversity and their potential as food or medicine sources.

Indonesia is now facing a rapid loss of biodiversity due to climate change and human activities. According to Alikodra & Syaukani (2004), the destruction of the forest area in Indonesia reached 2.5 million hectares per year. Millions of species of macrofungi will remain unknown if no attempt is made on the inventory of fungal biodiversity in the Indonesian forest area.

In this study, we conducted macrofungi inventory in the peat swamp forest area in Dusun Meliau and Bukit Peninjau, West Kalimantan province, Indonesia. Interviews were conducted with the surrounding residents to find out the potential of macrofungi collected in these areas.

Materials and methods

Specimen collection

This study was conducted from March 2015 to August 2015. Specimens were collected from Dusun Meliau and Bukit Peninjau, Kecamatan Batang Lupar, Kabupaten

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Kapuas Hulu, West Kalimantan province, Indonesia (Table 1). Identification was conducted at Microbiology and Genetics Laboratory, Nasional University of Jakarta. A modified direct collection method was used to collect the macrofungal specimens. Several 20 × 10 m plots were made along the transect line where the distance between the plots was 10 m.

Table 1. Peat swamp forest condition at Dusun Meliau and Bukit Peninjau, Kapuas Hulu, West Kalimantan

Location	Environmental condition		
	pH Soil	Humidity (%)	Temp (ºC)
Dusun Meliau	6,3 - 6,7	52 - 61	30 - 33
Bukit Peninjau	6,3 - 6,9	59 - 67	29 - 32

Identification

Identification of macrofungal specimens was carried out using the morphological based method. The morphological characters such as the shape, size, color, and texture of cap; position of stalk, ornamentation of stalk, gill, lamella, pores; size, color and ornaments of basidiospores; nature of living (individually or in groups), number of individuals in the colony, growing substrates (trees or trunks or twigs, dead trees or branches, soil, litter, or other substrates). The obtained data was further matched with several macrofungi identification books such as *Guide to Mushrooms* (Pacioni 1994), *How to Identify Mushrooms to Genus I* (Largent 1973), *Agaric Flora of the Lesser Antilles* (Pegler 1983), and *A Preliminary Polypore Flora of East Africa* (Ryvardern & Johansen 1980).

Results

A total of 87 specimens of macrofungi was collected of which 23 specimens were collected from Dusun Meliau and 64 specimens were collected from Malemba Village (Fig. 1). The macrofungal taxa were listed in the tables 2 and 3.

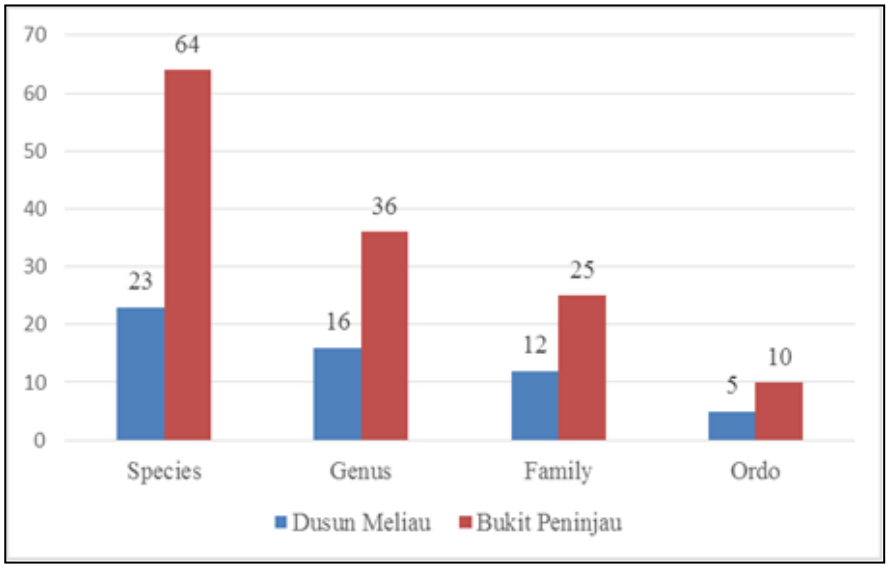

Figure 1. Composition of macrofungi found from Dusun Meliau and Bukit Peninjau, Kapuas Hulu, West Kalimantan

Table 2. Macrofungi species found at peat swamp forest Dusun Meliau, Kapuas Hulu, West Kalimantan

No	Phylum	Ordo	Family	Species
1	Basidiomycota	Agaricales	Cortinariaceae	*Gymnopilus sapineus*
2			Hygrophoraceae	*Hygrocybe cuspidata*
3			Physalacriaceae	*Mucidula mucida*
4			Pleurotaceae	*Pleurotus ostreatus*
5			Schizophyllaceae	*Schizophyllum commune*
6		Aphyllophorales	Ganodermataceae	*Ganoderma lucidum*
7			Lentinaceae	*Lentinus levis*
8			Polyporaceae	*Lenzites* sp.
9				*Microporus xanthopus*
10				*Microporus* sp. 1
11				*Microporus* sp. 2
12				*Microporus* sp. 3
13				*Polyporus alveolaris*
14				*Rigidoporus microporus*
15				*Trametes gibbosa*
16				*T. orientalis*
17				*T. hirsuta*
18				*Trametes* sp. 1
19		Auriculariales	Auriculariaceae	*Auricularia delicata*
20				*A. auricula-judae*
21		Russulales	Bondarzewiaceae	*Heterobasidion annosum*
22			Stereaceae	*Stereum* sp.
23		Hymenochaetales	Schizophoraceae	*Hyphodontia spathulata*

Table 3. Macrofungal species found at peat swamp forest, Bukit Peninjau, Kabupaten Kapuas Hulu, West Kalimantan

No	Phylum	Ordo	Family	Species
1	Basidiomycota	Agaricales	Clavariaceae	*Clavulinopsis corallinorosacea*
2			Coprinaceae	*Panaeolina foenisecii*
3			Hymenogastraceae	*Gymnopilus sapineus*
4			Hygrophoraceae	*Hygrocybe cuspidata*

No	Phylum	Ordo	Family	Species
5				*H. russocoriacea*
6				*Hygrocybe* sp. 1
7				*Hygrocybe* sp. 2
8			Marasmiaceae	*Clitocybula* sp.
9				*Marasmius capillaris*
10				*M. calhouniae*
11				*Marasmius* sp. 1
12				*Marasmius* sp. 2
13				*Marasmius* sp. 3
14				*Marasmius* sp. 4
15				*Trogia straminea*
16			Physalacriaceae	*Strobilurus* sp.
17			Tricholomataceae	*Clitocybe* sp.
18		Aphyllophorales	Ganodermataceae	*Amauroderma* sp. 1
19				*Amauroderma* sp. 2
20				*A. rugosum*
21				*Ganoderma orbiforme*
22				*G. lucidum*
23				*G. neo-japonicum*
24			Fomitopsidaceae	*Fomitopsis* sp.
25			Lentinaceae	*Lentinus levis*
26			Meruliaceae	*Cymatoderma caperatum*
27			Polyporaceae	*Lenzites* sp.
28				*Microporus affinis*
29				*M. vernicipes*
30				*M. xanthopus*
31				*Microporus* sp. 3
32				*Microporus* sp. 4
33				*Microporus* sp. 5
34				*Picipes badius*
35				*Polyporus arcularius*
36				*Polyporus* sp. 1
37				*Polyporus* sp. 2

No	Phylum	Ordo	Family	Species
38				*Pycnoporus cinnabarinus*
39				*Trametes coccinea*
40				*T. gibbosa*
41				*T. ochracea*
42				*T. versicolor*
43				*T. pubescens*
44				*Trametes* sp. 2
45		Thelephorales	Thelephoraceae	*Thelephora anthocephala*
46		Auriculariales	Auriculariaceae	*Auricularia delicata*
47				*A. auricula-judae*
48		Boletales	Boletaceae	*Aureoboletus longicollis*
49				*Imleria badia*
50				*Boletellus* sp.
51				*Tylopilus* sp.
52			Calostomataceae	*Calostoma sarasinii*
53			Suillaceae	*Suillus* sp. 1
54				*Suillus* sp. 2
55				*Suillus* sp. 3
56		Dacrymycetales	Dacrymycetaceae	*Calocera viscosa*
57		Gomphales	Gomphaceae	*Ramaria stricta*
58		Hymenochaetales	Hymenochaetaceae	*Hymenochaete rubiginosa*
59		Russulales	Bondarzewiaceae	*Heterobasidion annosum*
60			Hericiaceae	*Hericium* sp.
61			Russulaceae	*Lactarius* sp.
62			Stereaceae	*Stereum ostrea*
63				*S, subtomentosum*
64	Ascomycota	Pezizales	Sarcoscyphaceae	*Cookeina speciosa*

Of the 79 macrofungal specimens, 16 specimens were found as food, 41 specimens as medicine, and the potential of the remaining specimens was unknown (Fig. 4, Table 4).

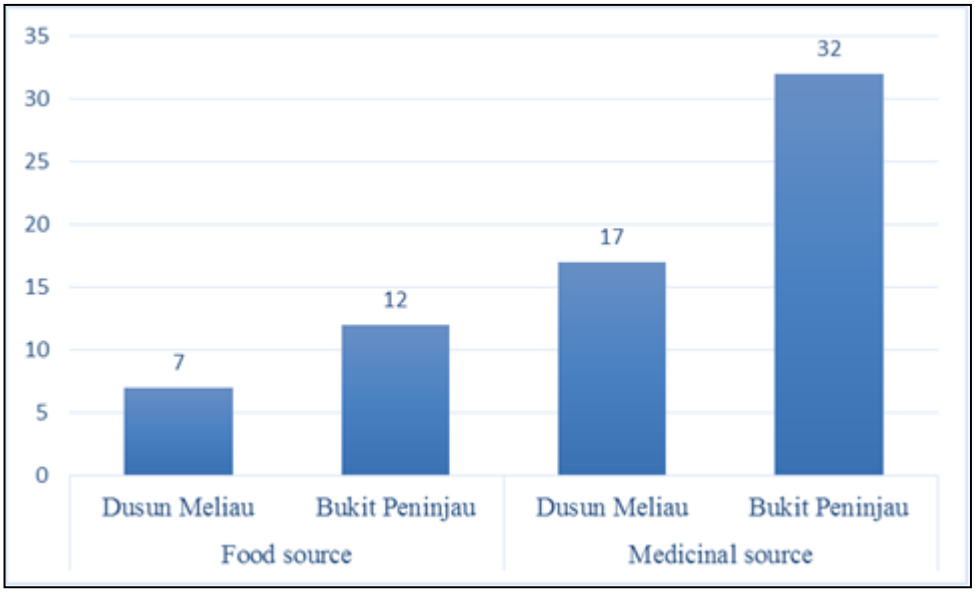

Figure 4. Number of potential macrofungi as food and medicinal resources from two study sites

Table 4 List of macrofungi that have the potential to be food and medicine

Food source		**Medicinal source**	
Dusun Meliau	**Bukit Peninjau**	**Dusun Meliau**	**Bukit Peninjau**
A. delicata	*A. delicata*	-	*Amauroderma* sp. 1
A. auricula-judae	*A. auricula-judae*	-	*Amauroderma* sp. 2
-	*Aureoboletus longicollis*	-	*A. rugosum*
-	*Imleria badia*	*A. delicata*	*A. delicata*
-	*Boletellus* sp.	*A. auricula-judae*	*A. auricula-judae*
-	*Cookeina speciosa*	-	*Calostoma sarasinii*
H. cuspidata	*H. cuspidata*	-	*Cookeina speciosa*
-	*H. russocoriacea*	-	*Cymatoderma caperatum*
-	*Hygrocybe* sp. 1	-	*Fomitopsis* sp.
-	*Hygrocybe* sp. 2	-	*G. orbiforme*
L. levis	*L. levis*	*G. lucidum*	*G. lucidum*
Mucidula mucida	-	-	*G. neo-japonicum*
P. ostreatus	-	*H. annosum*	*H. annosum*
S. commune	-	*L. levis*	*L. levis*
-		*Lenzites* sp.	*Lenzites* sp.
	R. stricta	-	*Pycnoporus cinnabarinus*
			M. affinis

Food source		Medicinal source	
Dusun Meliau	**Bukit Peninjau**	**Dusun Meliau**	**Bukit Peninjau**
			M. vernicipes
		M. xanthopus	*M. xanthopus*
		Microporus sp. 1	-
		Microporus sp. 2	-
		Microporus sp. 3	*Microporus* sp. 3
		-	*Microporus* sp. 4
		-	*Microporus* sp. 5
		R. microporus	-
		S. commune	-
		T. gibbosa	*T. gibbosa*
		-	*T. ochracea*
		-	*T. versicolor*
		-	*T. pubescens*
		T. hirsuta	-
		T. orientalis	-
		-	*T. coccinea*
		Trametes sp. 1	-
		-	*Trametes* sp. 2
		P. alveolaris	-
		-	*P. arcularius*
		-	*Polyporus* sp. 1
		-	*Polyporus* sp. 2
		-	*Picipes badius*

Discussion

Although the environmental conditions in Dusun Meliau and Bukit Peninjau were not distinctively different, both locations were suitable for the macrofungal growth (Table 2). However, this study found that higher diversity of macrofungal species was found in Bukit Peninjau than that in the Dusun Meliau (Fig.1, Tables 2-3). The optimal conditions for the macrofungal growth in nature include a temperature between 22ºC - 35ºC (Arif *et al.* 2007), moisture about 50-70% (Chang & Milles 2004), and pH between 4-9 (optimum at 5-6) (Barnes 1998). Lamrood & Jitendra (2000) noted that the growing substrate, light, moisture, temperature, environmental pH, and aeration greatly influence the growth of macrofungi. Alamsiah & Husin (2010) noted that most of the plants in the forest ecosystems are naturally associated with ectomycorrhizal fungi. The ectomycorrhizal fungi protect plants from disease attacks and environmental stresses as well as contribute to the degradation of organic

compounds in the soil so plant roots can absorb them, and plants provide a carbon source for the fungi from photosynthesis. The significant difference between the two location was probably due to vegetation types in both locations. Bukit Peninjau is a hilly are covered with various kinds of plants, moist and has a low light intensity as a dense plant canopy covered it. The vegetation floor in this area was filled with many plant litters and parts of plants that have decayed, while Dusun Meliau was more open where large plants were hardly found, the vegetation was almost uniform, less moist, and not many decayed twigs and branches found.

The macrofungi found in the Dusun Meliau were commonly found on the stems or branches as saprobes, a few species live as parasites in living plants such as *G. lucidum, R. microporus,* and *M. mucida*, and only one species is found to grow in the soil as mycorrhiza, namely, *H. cuspidata* (Table 1). In this area, many macrofungal species belong to those that well-adapted to the open and hot environments, such as Aphyllophorales (13 species, 56.5%) (Table 1). Members of Aphyllophorales is characterized by having pores, hard texture, and clay. At the Bukit Paninjau, the members of Aphyllophorales were also found dominant with 27 species found (40.91%), followed by Agaricales (15 species, 22.73%), Boletales (9 species, 13.64%). A member of Aphylloporales and Agaricales was also reported commonly found in the Lembah Anai Nature Reserve and Batang Palupuah Nature Reserve area of West Sumatera (Noverita *et al.* 2017). This study was in line with Tampubolon *et al.* (2012) who suggested that Aphyllophorales is a group of macrofungi that can be found in a vast range of habitats, and has a high ability to adapt to various environmental conditions that less supportive for macrofungal growth.

Besides taxa composition, this study also found that 16 species (6 species from Dusun Meliau and 10 species from Bukit Paninjau) have potential as a food source, and 41 species (15 species from Dusun Meliau and 31 species from Bukit Paninjau) have potential as medicinal source (table 4). Our observation found that the many medicinal macrofungal taxa were found on more extensive substrates and extreme environmental conditions for macrofungi, while macrofungi that potential as a food source was mainly found in more suitable environmental conditions for fungal growth. According to Suriawiria (2000) and Chang & Miles (2004), the macrofungi can be used as medicine because they contain several chemical compounds such as polysaccharides, glycoproteins (lectin), triterpenoids, and immunomodulatory proteins. In East Asian countries, the use of macrofungi as a drug has long been known, such as *L. edodes* and *G. lucidum* (Hudler 1998).

Conflict of interest

The authors state no conflict of interest from this manuscript.

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