Inventory of edible and inedible macro fungi on sago bark waste

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Abstract. Macro fungi plays important role in ecosystems, one of them as edible food. This study aim was to determine the species of macro fungi that observed on sago bark waste. This research was conducted in January-February 2020 at Tondok Alla village, Telluwanua district, Palopo city (as location I) and Kalotok village, South Sabbang district, North Luwu regency (as location II). Purposive sampling method was used in collecting samples. Each species that found on sago bark waste was identified and analysed based on stalk and cap structure, and also the presence of gills. As the results, there were six species of edible macro fungi that observed on sago waste bark, namely *Marasmius* sp., *Marasmiellus* sp1., *Marasmiellus* sp2., *Schizophyllum commune*; also, there were two species of inedible macro fungi observed on sago waste bark, namely *Gymnopus* sp and *Ganoderma* sp. Besides, we found two unidentified macro fungi but were suspected to be edible fungi

1. Introduction

Sago (*Metroxylon sago*) is one of plantation product in South Sulawesi with high production during 2016 to 2018, approximately more than 2 tons. Smallholder plantations play an important role in sago productivity. The highest sago production in South Sulawesi came from East Luwu, North Luwu, and Luwu distrct with smallholders' sago productivity of 2,261 kg/Ha/year, 1,793 kg/Ha/year and 929 kg/Ha/year in 2016, respectively [1]. The processing of sago in smallholder plantations was done traditionally. Sago flour was extracted from the pith of the sago stems, and washed with water. Processing of sago into sago flour can produce by-products in the form of bark around 17-25% which contains lignin (38%) and cellulose (57%) [2] [3] [4]. Macro fungi only grow at certain times with conditions and the ability to live is also limited. Generally, many macro fungi were found during the rainy season on weathered wood, litter and still growing trees [5]. The content of lignin and cellulose in the waste of sago stem bark allows the growth of wood rot macro fungi, such as Basidiomycota [2][6][7].

Macro fungi or mushrooms commonly found in nature, so that have been used as the main consumption ingredient (edible). Mushrooms contain 19-35% protein, 9 types of amino acids, 72% unsaturated fatty acids, fiber, vitamins B1, B2, and D, as well as minerals K, P, Ca, Na, Mg, and Cu. One type of amino acid found in mushrooms is glutamic acid which provides a savory taste in food, so it has the potential to be a flavor enhancer [8]. Apart from being consumed, some mushrooms in nature also cannot be consumed (inedible) because they are poisonous or toxic. Poisonous mushrooms are

usually very striking in color, do not have bites from other organisms and usually smell bad because they contain sulfide compounds [9].

The waste of sago stem bark which is not utilized generally becomes a growing place for macro fungi. However, inventory research of edible and inedible macro fungi on sago bark waste is still very rare. Therefore, this study aims to identify the types of macro fungi that can be consumed (edible) and cannot be consumed (inedible) on the sago bark waste.

2. Experimental Method

This research was a survey of macro fungi species in sago bark waste combined with literature studies. This research was conducted during January-February 2020 in two locations, namely Tondok Alla Village, Telluwanua District, Palopo City and Kalotok Village, South Sabbang District, North Luwu Regency. Species identification and determination of edible and inedible were carried out by comparing the morphology of fungi found at each location with the guidebook for the *Common Edible Mushroom* [10]and the book *Edible and Poisonous Mushrooms* [11]. The morphology of the fungi observed were based on stalk and cap structure, and also the presence of gills. After determining the types of macro fungi, a literature study was conducted to determine whether these macro fungi could be consumed or not.

3. Result and Discussion

The results showed that there were 8 species of macro fungi that found on sago bark waste. Six of the 8 species identified were identified as *Gymnopus* sp., *Marasmius* sp., *Marasamiellus* sp. 1, *Marasmiellus* sp. 2, *Schizophyllum commune*, and *Ganoderma* sp. While the other two species are not recognized. The morphology of the eight species of fungi found is presented in Table 1.

Table 1. Morphological identification based on stalk and cap structure

Species	Stalk	Cap structure
Gymnopus sp	Orange, height 6.7 cm, diameter 0.5 cm	Brownish, thick and round, diameter 6 cm
Marasmius sp	white with a little brown on the tip, height 1.3 cm, diameter 1.2 cm	Pale white, thin and slippery surface, diameter 2.9 cm
Marasmiellus sp.1	brown with a little white spot on the tip, height 1.2 cm, diameter 0.1 cm	Yellowish white, thin, striped and wavy at the edges, diameter 3.64 cm
Marasmiellus sp.2	White, height 2.5 cm, diameter 0.2 cm	White, rough cap, slightly curved and wavy at the edges, diameter 3 cm
Schizophyllum commune	height 0.9 cm, diameter 0.1 cm	White, fan shaped with white serrated tip, diameter 1.61 cm
Ganoderma sp	-	Bright orange, thick and hard with fan shaped and wavy edges, diameter 3.2 cm
Species A	brownish white, height 3.3 cm, diameter 0.8 cm	Brownish white, thin, hard, paddle-like shape, wavy edges, diameter 3.27 cm
Species B	Pink, height 0.6 cm, diameter 0.01 cm	Yellowish white, thin, coral-like shape, slippery surface, jagged edges, diameter 0.6 cm

Six species of macro fungi that have been identified are known as wood rot fungi because they can degrade lignin, cellulose, and hemicellulose in wood [12] [13] [14]. *Marasmius* sp.was reported as lignin-degrading fungus on biopulping of oil palm empty fruit bunches [15], *Schizophyllum commune*

encodes a diverse repertoire of lignocellulose-degrading enzyme systems for plant cell wall breakdown [16].

Based on the identification results and the morphological characteristics of macro fungi, in location I, there were eight species of fungi found, there are four species of fungi were edible, namely *Marasmius* sp., *Marasmiellus* sp.1, *Marasmiellus* sp.2, and *Schizophyllum commune*. Besides, there were two inedible species namely *Ganoderma* sp. and *Gymnopus* sp. At location II, there were four species found were edible, namely *Marasmiellus* sp. 1, *Schizophyllum commune*, and probably two unidentified species A, and species B (Table 2). *Marasmiellus* sp. and *Schizophyllum commune* are generally used as a food source by the community [14] [17] [18] [19], while several *Gymnopus* species are reported also as food sources [18] [20]. Several species of genus *Gymnopus* are also reported to be poisonous and inedible [9] [21]. Meanwhile, the genus *Ganoderma* was reported as an inedible macro fungi [22].

Table 2. Edible and poisonous macro fungi were found at two locations

No	Species	Location I		Location II	
		Edible	Inedible	Edible	Inedible
1.	*Gymnopus* sp	-	√	-	-
2.	*Marasmius* sp	√	-	-	-
3.	*Marasmiellus* sp	√	-	√	-
4.	*Marasmiellus* sp1	√	-	-	-
5.	*Schizophyllum commune*	√	-	√	-
6.	*Ganoderma* sp	-	√	-	-
7.	Species A	-	-	√	-
8.	Species B	-	-	√	-
Total		**4**	**2**	**4**	**0**

Apart from being consumed or not consumed, *Marasmiellus* and *Ganoderma* are reported to have xylanase enzymes. The xylanase enzyme is used as a catalyst in the production of xylose sugar and in refining it in the production of fruit juices and grapes. In addition, the xylanase enzyme also plays a role in improving the nutrition of animal feed and paper bleach [13].

Another benefit of the macro fungi on sago bark waste is that can be used as medicinal compounds. Several species of *Gymnopus* are used as anti-bacterial and anti-fungal in China [21]. Several species of *Marasmius* have also been reported to be used in the treatment of arthritis, anti-tumour [21], antibacterial, antioxidant [18] [21], anticancer [23], and antibiofilm [24]. The genus *Marasmius*, *Marasmiellus*, and *Ganoderma* have the laccase enzyme which can inhibit cancer cell proliferation [14] [22] [23]. *Marasmiellus ramealis* is used as an ingredient in the manufacture of anti-bacterial and anti-tumour drugs in China. *Schizophyllum commune* are also reported to be used as neurasthenia, anti-inflammatory, anti-tumour drugs [21].

Based on the results obtained from this study, it's possible that there are still a lot of species that haven't been recorded. Genetic characterization and identification of active compounds in each species also need to be further analysed.

4. Coclusion

Based on the results of research and discussion, it can be concluded that there were six species of edible macro fungi that were observed on sago waste bark, namely *Marasmius* sp., *Marasmiellus* sp1., *Marasmiellus* sp2. and *Schizophyllum commune*; also two species of inedible macro fungi observed on sago waste bark, namely *Ganoderma* sp and *Gymnopus* sp. Besides, two unidentified macro fungi were found but were suspected of being edible fungi based on morphological characters.

5. References

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