Ethnomicology of Basidiomycota fungus species in Central Kalimantan open forests

N Hujjatusnaini1,*, D Erawati2, M Melisa1, F Nor1, D F Shartono1, Y Harlyani1 and M Zulham1

1 Department of Biology Education Program, Faculty of Teacher Training and Education, State Islamic Institute of Religion, Jalan Obos G., Palangkaraya, Central Kalimantan 73112, Indonesia
2 Faculty of Ushuluddin, Adab and Da’wah, State Islamic Institute of Religion, Jalan Obos G., Palangkaraya, Central Kalimantan 731112, Indonesia

*noor.hujjatusnaini@gmail.com

Abstract. The role of fungus Basidiomycota can be used as an indicator of wisdom and the level of maturity forest ecosystems, both as decomposers, symbionts, and pathogens. The existence of several species of edible mushrooms is also used by local communities as food and medicine. This study aims to identify the diversity of fungus species in Central Kalimantan’s open forests, as part of ethnomicological information. The method used was the purposive sampling technique. The results showed 3,715 fruiting bodies of mushroom from 120 species and 41 genera were found at the study site with moderate levels of biodiversity ($R' = 3.51; H' = 2.14; D' = 0.68$). Based on the study of ethnomicology information obtained 5 species of edible mushrooms that are commonly consumed by local communities, such as, cloud ear fungus ($Auricularia polytricha$), Oyster Mushroom ($Pleurotus ostreatus$), Hygrocybeal calc., Cantharellos, and Common Puffball ($Lycoperdon pertatum$). For the type of fungus that is used as an ingredient for disease treatment, 2 types are found, namely $polyporus cinnabarius$, and $ganoderma$. The research findings found that Central Kalimantan’s open forest biodiversity is still quite good, with a moderate level of diversity. Besides, ethnomicology can be developed as local wisdom in Central Kalimantan.

1. Introduction

Central Kalimantan is one of the provinces which has a unique type of tropical rain forest because it is located at the latitude of the equator. Tropical rain forests in Kalimantan are known as forest types that have high biodiversity diversity [1]. The percentage of biological natural wealth especially for mushroom species in the tropical rain forests of Central Kalimantan has not been documented as a whole. It is estimated that 1,500,000 species of fungi exist throughout the world, of which 200,000 of them are in Indonesia. The exploration data includes microfungi and macrofungi, including those that can be consumed as a source of food or medicine, and also mushrooms that cannot be consumed (poisonous). But for specific biodiversity in the basidiomycetes group, especially in the open forest area of Central Kalimantan, it has not been documented accumulatively.

Basidiomycetes are part of the Basidiomycota phylum, in which this group of fungi has a microscopic sexual structure shaped like a club or basidium [2]. The word "basidio" means "small foundation," which refers to how basidium holds spores. Spores based on this basidium are called basidiospores, which are
formed during sexual reproduction [3]. Basidiomycota is a filamentous fungus composed of mycelium and hyphal hyphae. This group of Basidiomycota fungi is known as an important decomposer for wood or other material, and in certain species is a decomposition of complex lignin polymers. Therefore, the existence and abundance of this phylum can be a natural or unnatural indicator of the forest condition [4].

As 300,000 species of Basidiomycota mushrooms have been known [5]. Similar research results found 17 species of macrofungi in the Arboretum protected forest area and 12 species found in the open forest area of the former burning forest of Kalampangan, Central Kalimantan [6]. Based on the role of the Basidiomycota mushroom as an indicator of forest wisdom, the exploratory dominance of the ethnomicology of the Basidiomycota fungus in Central Kalimantan needs to be done, with the purpose to document the biodiversity of open forests in Central Kalimantan.

2. Methods

The study was conducted in May to October 2019 in four open forest locations, namely the Tanjung Sanggalang Katingan forest area, the North Barito Lahei forest area, the South Sanggu Barito forest, the East Barulan Sampulan forest area, Central Kalimantan. Data collection was carried out by collecting primary data followed by the identification of samples in the laboratory. The research method used a survey method with a single plot technique measuring 20x20m and the laying of the plot by purposive sampling with following mushrooms. The technique of preparation of mushroom fruit body specimens found was calculated in the total number of fruit bodies, some of them collected by wet preserving technique [7]. Meanwhile, morphological identification of specimens refers to the mushroom identification book [8]. Ethnomicological study data used interview methods with four key informants from the local population, related to the use of mushrooms for consumptive purposes and their use as medicine.

3. Results and discussion

3.1. Description of data

According to data on the village profile that the Tanjung Sanggalang Katingan forest area only has an area of around 5.4 ha. North Lahei Barito forest area is 302.357.62 Ha / Km^2, covering Protection Forest (PF) covering 13,812.38 ha / Km^2, Production Forest (PF) covering 113,232.39 Ha/Km^2, Convertible Production Forest (CPF) covering an area of 31.293.08 Ha/ Km^2 and Limited Production Forest (LPF) covering an area of 144,019.77 Ha/Km^2. South Sanggu Barito forest area 1140 Ha/Km^2, limited forest 1000 ha / Km^2, conservation forest 4668 Ha/Km^2 and small-holder private forest 2000 Ha/Km^2, production forest 500 Ha in good condition and 100 ha of damaged condition. East Sampulan Barito forest area only has an area of around 5 hectares, because settlements dominate it.

The description of the identification data in the field showed that the Basidiomycota mushroom fruit body was quite varied, namely from the morphology of the fruit body stalk length, the color and thickness of the gleba, and the shape and color of the spores both when young and old. Tanjung Sanggalang Katingan forest area found 14 species with 318 fruit bodies, North Lahei Barito forest found 54 species with 1471 fruit bodies, South Sanggu Barito forest area 1140 Ha/Km^2, limited forest 1000 ha / Km^2, conservation forest 4668 Ha/Km^2 and small-holder private forest 2000 Ha/Km^2, production forest 500 Ha in good condition and 100 ha of damaged condition. East Sampulan Barito forest area found 25 species with 682 fruit bodies. The details are presented in Table 1 below:

| No. | Species / Genus     | Habitus | Number of Individuals | Type Habitus |
|-----|---------------------|---------|-----------------------|--------------|
| 1.  | *Coltricia cinnamomea* | Plant   | 27                    | Sanggalang Katingan Forest Area |
| 2.  | *Coltricia sp*      | Plant   | 42                    |              |
| 3.  | *Coltricia sp 2*    | Plant   | 17                    |              |
| 4.  | *Coltricia sp 3*    | Plant   | 22                    |              |
| 5.  | *Clitoybe dealbata* | Soil    | 18                    |              |
| 6.  | *Gaereapatum Stereum* | Plant | 25 | |
Table 1. Cont.

|   | Species                        | Habitat  | Quantity |
|---|--------------------------------|----------|----------|
| 7. | *Fomes sp*<sub>1</sub>         | Plant    | 21       |
| 8. | *Fomes sp*<sub>2</sub>         | Plant    | 43       |
| 9. | *Ganoderma sp*<sub>1</sub>     | Soil     | 27       |
| 10.| *Ganoderma sp*<sub>1</sub>     | Soil     | 15       |
| 11.| *Ganoderma sp*<sub>3</sub>     | Soil     | 18       |
| 12.| *Lactarius sp*                 | Soil     | 11       |
| 13.| *Lentinus sp*                  | Plant    | 24       |
| 14.| *Pseudotrametes sp*            | Plant    | 8        |
| 15.| *Auricularia polytricha*       | Plant    | 28       |
| 16.| *Austroboletus mutabilis*      | Plant    | 34       |
| 17.| *Boletus sp*<sub>1</sub>       | Plant    | 36       |
| 18.| *Boletus sp*<sub>2</sub>       | Plant    | 32       |
| 19.| *Boletus sp*<sub>3</sub>       | Plant    | 39       |
| 20.| *Boletus sp*<sub>4</sub>       | Plant    | 29       |
| 21.| *Boletus sp*<sub>5</sub>       | Plant    | 31       |
| 22.| *Boletus sp*<sub>6</sub>       | Plant    | 34       |
| 23.| *Clavulinopsis laeticolor*     | Plant    | 37       |
| 24.| *Collybia cirhata*             | Plant    | 25       |
| 25.| *Daedalea*                     | Plant    | 43       |
| 26.| *Daedanilla*                   | Plant    | 38       |
| 27.| *Ganoderma sp*<sub>1</sub>     | Soil     | 42       |
| 28.| *Ganoderma sp*<sub>2</sub>     | Soil     | 30       |
| 29.| *Ganoderma sp*<sub>3</sub>     | Soil     | 31       |
| 30.| *Hebeloma sp*                  | Plant    | 28       |
| 31.| *Hypholoma sp*                 | Plant    | 25       |
| 32.| *Inocybe sp*                   | Plant    | 44       |
| 33.| *Lactarius sp*<sub>1</sub>     | Soil     | 39       |
| 34.| *Lactarius sp*<sub>2</sub>     | Soil     | 22       |
| 35.| *Lycoperdon perlatum*          | Soil     | 34       |
| 36.| *Marasmius sp*<sub>1</sub>     | Plant    | 27       |
| 37.| *Marasmius sp*<sub>2</sub>     | Plant    | 43       |
| 38.| *Marasmius sp*<sub>3</sub>     | Plant    | 37       |
| 39.| *Marasmius sp*<sub>4</sub>     | Plant    | 28       |
| 40.| *Marasmius sp*<sub>5</sub>     | Plant    | 37       |
| 41.| *Marasmius sp*<sub>6</sub>     | Plant    | 25       |
| 42.| *Marasmius sp*<sub>7</sub>     | Plant    | 49       |
| 43.| *Marasmius sp*<sub>8</sub>     | Plant    | 32       |
| 44.| *Marasmius haematocephalus*    | Plant    | 41       |
| 45.| *Marasmius Oreades*            | Plant    | 42       |
| 46.| *Mycena sp*<sub>1</sub>        | Plant    | 6        |
| 47.| *Mycena sp*<sub>2</sub>        | Plant    | 27       |
| 48.| *Mycena sp*<sub>3</sub>        | Plant    | 32       |
| 49.| *Mycena clavularis*            | Plant    | 34       |
| 50.| *Mycena lilacipolia*           | Plant    | 28       |
| 51.| *Panus sp*<sub>1</sub>         | Plant    | 13       |
| 52.| *Panus sp*<sub>2</sub>         | Plant    | 17       |
| 53.| *Phiolita mutabilis*           | Plant    | 11       |
| 54.| *Phiolita sp*                  | Plant    | 12       |
| 55.| *Pluteus atromarginatus*       | Plant    | 16       |
| 56.| *Polyporus sp*<sub>1</sub>     | Plant    | 32       |
| 57.| *Polyporus sp*<sub>2</sub>     | Plant    | 21       |
| 58.| *Polyporus sp*<sub>3</sub>     | Plant    | 14       |
| 59.| *Polyporus sp*<sub>4</sub>     | Plant    | 12       |
| 60.| *Polyporus sp*<sub>5</sub>     | Plant    | 10       |
| 61.| *Polyporus sp*<sub>6</sub>     | Plant    | 12       |
Table 1. Cont.

|   | Species                          | Plant/Soil  | Location                        |
|---|---------------------------------|-------------|---------------------------------|
| 62.| Pycnoporus sanguinis            | Plant       | Sanggu Barito Selatan Forest Area |
| 63.| Ramaria sp<sub>1</sub>           | Plant       |                                  |
| 64.| Ramaria sp<sub>2</sub>           | Plant       |                                  |
| 65.| Russula sp                      | Plant       |                                  |
| 66.| Russula subniricans             | Plant       |                                  |
| 67.| Thelephora sp                   | Plant       |                                  |
| 68.| Tremella sp                     | Plant       |                                  |
| 69.| Fomes sp<sub>1</sub>             | Plant       |                                  |
| 70.| Fomes sp<sub>2</sub>             | Plant       |                                  |
| 71.| Fomes sp<sub>3</sub>             | Plant       |                                  |
| 72.| Fomes sp<sub>4</sub>             | Plant       |                                  |
| 73.| Fomes sp<sub>5</sub>             | Plant       |                                  |
| 74.| Fomes fentarius                 | Plant       |                                  |
| 75.| Coltricia cinnamomea            | Plant       | Sampulan East Barito Forest Area |
| 76.| Coltricia sp<sub>1</sub>         | Plant       |                                  |
| 77.| Coltricia sp<sub>2</sub>         | Plant       |                                  |
| 78.| Coltricia sp<sub>3</sub>         | Plant       |                                  |
| 79.| Coltricia sp<sub>4</sub>         | Plant       |                                  |
| 80.| Coltricia sp<sub>5</sub>         | Plant       |                                  |
| 81.| Lenzites betulina               | Plant       |                                  |
| 82.| Lenzites sp                     | Plant       |                                  |
| 83.| Ganoderma boninse               | Plant       |                                  |
| 84.| Ganoderma sp<sub>1</sub>        | Plant       |                                  |
| 85.| Ganoderma sp<sub>2</sub>        | Plant       |                                  |
| 86.| Hypholoma marginatum            | Soil        |                                  |
| 87.| Stereum gaupatum                | Plant       |                                  |
| 88.| Stereum sp                      | Plant       |                                  |
| 89.| Clitoybe sp                     | Soil        |                                  |
| 90.| Clitoybe dealbata               | Soil        |                                  |
| 91.| Lactarius sp                    | Soil        |                                  |
| 92.| Boletus sp                      | Plant       |                                  |
| 93.| Pynoporus cinnabarinus          | Plant       |                                  |
| 94.| Rudicidal Panels                | Plant       |                                  |
| 95.| Auricularia polytricha          | Plant       |                                  |
| 96.| Pleurotus ostreatus             | Plant       |                                  |
| 97.| Plateus atromarginatus          | Plant       |                                  |
| 98.| Pleurotus sp                    | Plant       |                                  |
| 99.| Lactarius sp                    | Soil        |                                  |
| 100.| Lactarius corrugis              | Soil        |                                  |
| 101.| Laetiporus sulphureus           | Plant       |                                  |
| 102.| Fomes sp.                       | Plant       |                                  |
| 103.| Lactarius obscuratus            | Soil        |                                  |
| 104.| Russula nobilis                 | Soil        |                                  |
| 105.| Amanita atrodisca               | Soil        |                                  |
| 106.| Amanita citrine                 | Plant       |                                  |
| 107.| Polyporus cinnabarinus          | Plant       |                                  |
| 108.| Poria sp.                       | Plant       |                                  |
| 109.| Fomes sp.                       | Plant       |                                  |
| 110.| Coltricia cinnamomea            | Plant       |                                  |
| 111.| Auricularia polytricha          | Plant       |                                  |
| 112.| Coprinus lagopus                | Plant       |                                  |
| 113.| Lycoperdon perlatum             | Soil        |                                  |
| 114.| Lactarius rubidus               | Soil        |                                  |
| 115.| Polyporus sp                    | Soil        |                                  |
Table 1. Cont.

| No. | Species                  | Habitat        | Count |
|-----|--------------------------|----------------|-------|
| 116 | Hygrocybe calciphila     | Soil           | 27    |
| 117 | Ramaria myceliosa        | Soil           | 38    |
| 118 | Clavaria rosea           | Soil           | 20    |
| 119 | Cantharellus sp.         | Plant          | 14    |
| 120 | Coprinus ephemerus       | Plant          | 27    |

In total, 3,715 mushroom fruit bodies from 120 species and 41 genera were found, of which 94 species were known to have a habitat in other plants as ectomycorrhizae, while 26 species grew above ground level (Table 1).

3.2. Distribution of fungi by genus

The distribution of 41 genera of the Basidiomycota fungus found was dominated by the genus *Coltricia* (67.5%), *Marasmius* (25%) and *Fomes* (25%). While it base the distribution on the number of individual species *Fomes* sp (425 fruit bodies) and *Colricia* (413 fruit bodies) which are more dominant than the others, as the following diagram:

![Figure 1. Distribution of fungi by genus.](image-url)
Distribution data by genus illustrate diversity. Basidiomycota diversity data obtained in this study were higher when compared to previous studies (Figure 1). The number of mushroom species found was 44 species of mushrooms in the seed stand Dipterocarpaeae in Sebangau National Park and Tanjung Puting National Park in Central Kalimantan [9], and 32 species of fungi from 15 families in the Bukit Beluan forest of Kapuas Hulu District, Central Kalimantan [10]. The difference is likely influenced by the area of study, and differences in climatic factors or availability of different substrates and hosts.

Climate factors and the availability of vegetation and human activities as natural users have a great influence on local wisdom and natural resources, including the diversity of fungi [11]. It classified the level of diversity of mushroom species in this study as moderate, with a Margalef species wealth index ($R$) of 3.15, Simpsons Index ($D'$) of 0.68 and the Shannon-Wiener Index ($H'$) of 2.14. Likewise, based on the level of evenness, the species is classified as moderate with an evenness index ($E'$) of 0.73. Human activities in their use of natural resources affect the diversity of species, such as land clearing and burning of forests, cleaning litter under its stand, climatic conditions such as hot temperatures and relatively less rainfall.

Data collection in the form of mushroom fruit body collection in several species could not be done, because it was constrained in the long dry season and rainfall was very lacking. Environmental conditions such as dry and hot, the intensity of rain and the time of observation are very important to consider seeing the diversity of fungi because these external conditions can affect the development of fruit bodies found [12]. This also determines the condition of the habitat [13].

3.3. Ethnomicology
Based on the study of ethnomicology information obtained 5 species of mushrooms that are commonly consumed by local communities, such as, cloud ear fungus (Auricularia polytricha), Oyster Mushroom (Pleurotus ostreatus), Hygrocybeal calc, Cantharellos, and Common Puffball (Lycoperdon pertatum). For the fungus as an ingredient in the treatment of disease, 2 types were found, namely polyporus cinnabarius and ganoderma. It was found that polyporus cinnabarius was used by the community as a drug for ulcers, and ganoderma as a drug for digestive tract infections and coughing. How to use polyporus cinnabarius as a traditional medicine of local people for boil is made by grinding and sticking to the therapeutic object, while ganoderma as a drug for digestive infections and cough is by boiling and then consuming it. Some types of mushrooms that are consumed by the local Dayak community are medicinal plants, as the Kenyah Dayak tribe also uses medicinal local plants, one of which is a reproductive health medicine for women [14].

Based on literature studies, it is known that Pleurotus ostreatus and Ganoderma has β-glucans polysaccharide compounds with long chains that act as food fibers. This compound will interact with blood fat, so it can reduce blood cholesterol levels [15]. Besides, β-glucans can also form viscous substances that prolong gastric emptying, inhibit the transfer of triglycerides and cholesterol in the intestine, and reduce the absorption of LDL (low-density lipoprotein). β-glucan can also bind bile acids, monoglycerides, free fatty acids, and cholesterol [16].

4. Conclusion
The study found 3,715 Basidiomycota mushroom fruit bodies from 120 species, of which 94 species had ectomycorrhizal symbiosis in plants and 26 species grew above ground level, with moderate species diversity. The total genus distribution was 41 genera, where the genus Coltricia (67.5%) was more dominant than the other genera. Individuals are dominated by the species Fomes (425 fruit bodies) and Coltricia (413 fruit bodies). Marasmius (25%), and Fomes (25%) were more dominant than others. Based on the study of ethnomicology information obtained 5 species of mushrooms that are commonly consumed by local communities, such as, cloud ear fungus (Auricularia polytricha), Oyster Mushroom (Pleurotus ostreatus), Hygrocybeal calc, Cantharellos, and Common Puffball (Lycoperdon pertatum). For the fungus that an ingredient in the treatment of disease, 2 types are found, namely Polyporus cinnabarius and Ganoderma. This study was expected to a reference for the development and cultivation of mushrooms, as one source of local wisdom.
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