Wild Edible Mushroom, a Potential and Valuable Source for Food Security

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Abstract. Mushrooms have been consumed as food. Rich in nutrition and as serve an extraordinary benefaction to agricultural biodiversity, fostering local food security and economic sustainability in the community. This review thus gathers the existing literature on edible mushrooms reported from Indonesia. The information offers a thorough and up-to-date overview of the potential and valuable nutritional sources of wild edible mushrooms reported from Indonesia. Furthermore, it identifies research gaps to encourage further investigation and development of edible mushrooms reported from Indonesia. The information will undoubtedly act as a catalyst for advancement in both science and the economy.

Keywords: food security · nutrition · wild edible mushroom

1 Introduction

For more than a thousand years, mushrooms have been consumed as food. As a result, they have become a part of the culture. They have a significant role in history because of their attractive culinary attributes [1]. Mushrooms are heterotrophic organisms associated with dead organic matter, or other living organism such as plants, and animals. It varies in different shapes and sizes and also in physiology and reproduction. The term mushrooms refer to identified fungi that produced a macroscopic fruiting body of sufficient size [2], the size of which is visible and picked up by hand [3]. Evolutionarily, mushrooms belong to two major phyla, Ascomycota and Basidiomycota. A considerable number of mushrooms present in the world. An estimated 6000 of the 100,000 fungal species was described can produce visible fruiting bodies [4]. According to Riaz et al. (2022), there are about 2,000 mushrooms in nature, however only around 25 percent are commonly used as food [5].

Mushrooms serve as a component to agricultural biodiversity, fostering local food security and economic sustainability in the community. However, food insecurity due to unsustainable dietary choices has adversely influenced livelihoods in rural and urban

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communities, especially in Asia [6]. Mushrooms can be added and utilized as natural resources to overcome food problems, which are more nutritious and serve as a solution to the community's food security. Besides, the mushroom can also potentially be essential in future food supplies [7].

Mushrooms are valued foods that are in demand nowadays. Due to their excellent organoleptic qualities, mushrooms make a great complement to many dishes and a great meat substitute for vegetarians [8]. Furthermore, mmushrooms are particularly healthy since they are nutritionally balanced sources of proteins and carbs with low-fat contents that typically range from 0.1 to 16.3 percent [9].

Indigenous communities have used wild edible mushrooms as an additional source of food from plant or animal food supplies [10]. Other than nutritional purpose, wild mushrooms are also provided significantly as nutraceuticals with producing bioactive compounds such as secondary metabolites that have a role in antioxidant and antibacterial functions [11]. This article will summarize and discuss the potential and valuable source of wild edible mushroom for food security.

2 Materials and Methods

Research Design

A literature study analysis was performed in this research. A thorough electronic search of publications and reviews published in peer-reviewed journals was conducted using databases including Scopus, Science Direct, and Google Scholar [12]. The number of yearly publications, publishing journals, citations, international cooperation, and author keywords is the factors that will be considered in this study.

The outcomes of a literature review can serve as a starting point and source of information for future studies of difficulties. The literature used was focused on review scope using locally sourced research inputs. The search term related with edible-mushroom-in-Indonesia." Data that has been organized and classified into manageable, synthesizable, and conclusive components is the basis for data analysis. The emphasis and specialty areas of the material were published and made available significantly varied (e.g., wild mushroom, Indonesia, biodiversity, nutritional property, chemical composition). Even though they were distinct, these niches were occasionally discussed and explained simultaneously, which caused knowledge and interests to overlap. Therefore, to guarantee that the contents of the current evaluation comply with the intended scope, thorough screening and selection were applied when appropriate.

3 Result and Discussion

Basically, a mushroom's consumption depends on factors such as lack of toxicity, flavour, and scent, and unique texture [13, 14]. Ramady et al. (2022) distinguished edible and food species mushrooms, with a distinct category for poisonous species [15]. These classifications represented an effort to recognize the edible one and standardize the process of nutrition and safety reasons.

Table 1. General nutritional information (based on dry weight) for certain wild edible mushrooms from various sources.

Sample of Wild edible mushroom species	Family	Carbohydrate (%)	Protein (%)	Fat (%)	References
Pleurotus sp.	Pleurotaceae	3.37–3.33	1.74–3.4	-	[20]
Auricularia sp.	Auriculariaceae	66.1	12.5	1.7	[21]
Volvariella volvacea	Pluteaceae	2.99	4	0.19	[22]
Agaricus sp.	Agaricaceae	62.97–83.65	8.56–23.8	3.4	[23]
Heimioporus sp.	Boletaceae	49	-	-	[24]
Termitomyces sp.	Lyophyllaceae	2.81–69.13	15.1−19.2	2.5−5.4	[25]

Mushrooms are regarded as a food with nutritional advantages because they contain many nutrients. The components are abundant in their fruit bodies, as well as carbohydrates, protein, essential amino acids, unsaturated fatty acids, vitamins, and minerals [16]. Table 1 shows the general nutritional values (based on dry weight) of some wild edible mushrooms from different sources. Carbohydrate dominates the composition of mushrooms [17, 18]. For example, in the mushroom cell wall, carbohydrate is in the form of digestible (e.g., mannitol, glucose, glycogen, trehalose). Whereas non-digestible one (e.g., chitin as a straight-chain (1 → 4)-β-linked polymer of N-acetyl-glucosamine, (1 → 3)-β-D-glucans, mannans) can be used as a source of some novel fibers that have a good impact on health since they have been linked to a decline in the occurrence of numerous illnesses.

Proteins are crucial nutrients that give the body the vital amino acids it needs for development and maintenance. They also serve as a source of energy. Additionally, proteins have unique biological properties that might affect health and illness prevention in people. According to Qiannan et al. (2020), the protein contents of edible fungi were about 8.5∼36.9 g/100 g [19].

Wild edible mushrooms are a significant source of economy for local economies and nations, and they are particularly vital to rural residents in developing countries [26]. Wild edible mushrooms are one of the natural resources that becomes a part of daily life for different traditional community in Indonesia such as in Banten Province [27], West Papua Province [28] and Belitong Island [29]. Collectively, the knowledge becomes inherited traditionally and passed down from generation to generation. Thus serves as a source of references that must be acknowledged for later generations. Yet the contribution of wild fungi to the modern livelihoods and for industrial implementation has received less attention.

Most of the wild edible mushrooms in Indonesia belong to a species that naturally grows near the residence or in the forests. A deeper understanding of the habitat, niche, and morphology of wild edible mushrooms is necessary for mushroom collection. The local communities in Indonesia had noticed and recognized the mushrooms nearby by

carrying out their daily activities. Species are often identified by examining characteristics like colour, texture, and fragrance, the substrate on which they grow, and even taste. Species are named to help preserve memory and pass on knowledge to the following generation. The same way of identifying edible mushrooms from poisonous was observed by [30] in Nepal. Due to their physical similarity and inability to be distinguished by folk taxonomy, it was determined that most species belonging to the same family were given names by a single traditional (vernacular) name. The traditional community also learned the value of conserving fungi species, their ecological roles, and the consequences of this potential value if it is lost based on traditional knowledge. Revaluing wild mushrooms as resources and promoting their protection can be aided by keeping this information alive. Knowledge of important wild edible mushrooms can also be revived as a significant contribution to food security, and their usage is encouraged [31].

Regarding to the wild edible mushroom collected by the traditional community associated gender, women are more familiar and have a better knowledge to utilize wild mushrooms. According to Garibal-orijey et al. gender is one of the main variables influencing local knowledge distribution [32]. Women are usually responsible for their family, involved in every stage of mushroom utilization from collection to processing the mushroom to finally served as a food on the table.

The ages of the informant also influence on the knowledge. Generational differences influence traditional knowledge on mushroom utilization as the knowledge accumulated with age. The gained information transfers from one generation to the next without any recorded document. It was also pointed by [33] that the knowledge on mushroom edibility depends much on folk taxonomy, that inherited from one generation to another. The knowledge will develop when the parents require children in daily activities to have the chance to observe the mushrooms directly, identify whether it is edible, and find out the significances of their life. The similarity of the methods can be found in a cultural group in Asia [34], Africa [35], and even in America [36]. The informants below the age of 30 have less knowledge of mushroom utilization. Several studies have documented that the lack of traditional knowledge between younger people has been assigned to the expansion of modern education, cultural change, and the influences of modernization [37]. If it is neglected, somehow, the traditional knowledge on mushroom utilization will disappear soon.

Among the wild mushroom grew in nature only a few were reported as edible. The described edible species refer to 3 fungal functional groups. The usually consumed and recognized species belong to the saprobe fungi. The wild edible mushroom species are decomposers, capable of completing their life cycles on dead organic matter. Therefore they usually grew on dead logs and wooden stumps and accounted for a high decomposition degree in forest wood. According to [38], this corresponds with the mushrooms' task to maintain ecosystems balance and stability, being saprophytes that used dead biomaterials for growing substrates. Also, the environmental condition supports the favor of wood-inhabiting mushrooms. For the example of saprophytic wild edible musrooms which are consumed mostly by the villagers of the Ranupani residents' of Tengger tribe, i.e. *Pleurotus* sp., *Clytocybe nebularis* and *Auricularia auricula* [39].

The second group is belong to ectomycorrhizal fungi. Ectomycorrhizal symbiosis is defined as a mutualistic interaction between a fungus, mostly ascomycetes and basidiomycetes, with the fine roots of plants. This connection affects the biology, ecology, and growth of forest trees and shrubs, playing a crucial role in the ecosystems. The fungus affords protection from root infections and aids the plant in absorbing water and nutrients in this partnership with reciprocal advantages for both parties, while the plant gives its fungal companion shelter and carbohydrates. Ectomycorrhizal fungi constitute one of the essential edible fungi groups worldwide [40]. In Indonesia, the species of wild edible mushroom that belong to the ectomycorrhizal group are *Scleroderma* species. *Scleroderma* spp. Has been consumed as food by locals in East Java [41], and *S. sinnamariense* Mont. Has been sold in a number of traditional Indonesian marketplaces, including Bengkulu [42] (Susan and Retnowati, 2017). The mushroom is establish an ectomycorrhizae association with a variety of forestry plants, including melinjo (*Gnetum gnemon* L). The edible ectomycorrhiza known as the pelawan mushroom *(Heimioporus* sp.) has a high commercial value for community in Belitong Island. The mushroom grow in the group on the forest floor near the system the roots of the pelawan tree (*Tristaniopsis merguensis*). The local people uses the mushroom in traditional Belitong cuisine as a result of the unique and distict flavor. Pelawan mushroom sold expensively marketed as its availability depend on the nature [43].

The third group belongs to the termite-associated mushroom. Reference [44] stated that among the edible mushrooms collected from nature, the species Termitomyces is mainly consumed in Africa and Asia. Termitomyces mushroom is a symbiotic fungus associated with termite nests. The mushroom will provide various enzymes to help termites digest lignocellulosic substrates. The local community considered the wild edible mushroom, which belongs to the genus Termitomyces, one of the most delicious foods. The Termitomyces mushroom is known to have a particular life cycle, and in the wild, these fungi are only found in the nests of Macrotermitinae termites [45]. In a unique chamber, the fungus garden, inside the nest, they reside in a habitat known as the fungus comb. To keep the fungal combs alive, the termites gather plant materials from outside the nest, which they subsequently consume. Although several preliminary suggestions have been put out, the purpose of this symbiotic relationship is still unclear. Termitomyces are another protein-rich food source for termites, and it aids in the lignin's breakdown so that the termites may reach the cellulose [46] (Fig. 1).

In addition to increasing the status of the food security of the traditional communities in Indonesia, this technique has enormous potential. Given that they are inexpensive, simple to cultivate, and contain elements like iron and zinc, mushrooms are becoming more and more popular as a meal that can benefit needy people who are suffering from nutritional deficiencies. It is vital to design strategies, food security initiatives, and applied research to evaluate the integration of edible fungus into communities' food cultures while taking their acceptability into account.

Fig. 1. Morphology of some wild edible mushroom fruiting bodies a. *Auricularia* sp. b. *Heimioporus* sp. c. *Scleroderma* sp d. *Termitomyces* sp.

4 Conclusion

Wild edible mushroom diversity utilized by the local community contribute to food security aspect. The described edible species refer to 3 fungal functional groups. The species belong to the saprobe, ectomycorrhyzal and termite associated fungi.

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