The potency of mushrooms as food alternative in the forest park of Pocut Meurah Intan, Saree, Aceh Besar

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Abstract. The research, potential of mushrooms as food alternatives to obtain information about mushrooms species which potentially as food and their nutritional content found in the forest park of pocut meurah intan, Aceh Besar. The research used an exploratory survey method by exploring a lot of mushrooms on each track in the region for collecting mushrooms sample and several physical factors. The nutritional analysis was carried out using Kjeldahl for protein, Luff Schoorl for carbohydrate, soxhlet for fat and gravimetric for fiber, ash and moisture content. Fifteen species of mushrooms were identified as alternative food, but only five species had been examined for nutrition analysis tests, including Lentinus polychrous, Lentinus sajor-caju, Ischnoderma resinosum, Marasmiellus ramealis, and Thelephora ganbanjun. L. polychrous was contain the highest rate of proteins (6.12%), carbohydrates (10.27%), bers (4.73%) and fat (1.26%). M. ramealis contained the highest moisture content (89.01). The highest ash content (1.63%) was in T. ganbanjun. These five species of mushrooms were potentially alternative food because they contained a good level of nutritional content and can be used as a cultivation commodity that can improve the economic level of society.

1. Introduction
Generally, not all mushrooms can be consumed as food sources because of some species contain toxic compounds that are very harmful to health if it is consumed. Usually, the mushrooms that can be consumed have certain characteristics on their fruit body, such as colors that are not varied and intrusive; has no smell; Do not have rings on the stem; And do not change color when cooked [1]. As for the characteristics of mushroom that cannot be consumed due to its toxic properties (non-edible mushroom) color is very varied and striking, such as dark blue, jet black, ocher or orange; There is no bite from other organisms; Caused a piercing odor containing sulfide compounds, Have a cup or ring on the mushroom stalk; Grew up in a dirty place; Cause discoloration in silver metal or stainless-steel blades if scraped; and has a soft texture if cooked [2]. Nowadays, mushrooms have been used as the most widely-liked alternative food in many circles of society. It is influenced by the modern science factor that has allowed people to change their daily consumption patterns, from foodstuffs that are worth high cholesterol to foodstuffs that are worth low cholesterol [3].
Forest park of Pocut Meurah Intan, Saree, Aceh Besar is one of the conservation areas of tropical rainforest Mountains located in Aceh Province [4]. The land surface in this area is generally covered with many leaf litter and weathered twigs. This environmental condition is very suitable in supporting the growth and development of mushroom, therefore highly enabling high diversity of species of food-potentially fungal mushroom. So far there have been no studies on the species of mushroom that could potentially be foodstuffs in the Forest Park of Pocut Meurah Intan, so it is necessary to research the region as one of the efforts to obtain information about mushroom food and nutritional potential for healthy and good nutritional food needs.

2. Materials and methods

2.1. Materials
Mushrooms are documented using a digital camera. Mushroom samples measured the body of the fruit, noted the character of the mushroom, then preserved using alcohol 70%, and labeled. Each species of samples is collected in the collection of approximately 300 grams to continue the nutritional test of mushroom. Sample of mushrooms in nutrition test in the laboratory of Research and Industry Standardization (BARISTAND).

2.2. Survey Explorative
The collection of research data was conducted in the Forest Park of Pocut, Saree, Aceh Besar. This study was conducted for eight months namely from January to August 2019. Data retrieval and samples of all mushrooms species are carried out in an exploratory survey by exploring the existence of mushrooms according to the exploration path. Identification of samples conducted in the Molecular Cell Biology Laboratory of the Faculty of Mathematics and Natural Sciences, Syiah Kuala University.

2.3. Edible Mushroom Identification
Identification of potentially food mushroom species is used by cross-checking on some literature that provides information about food mushrooms, some other literature in the form of representative books, journals, and online libraries.

2.4. Nutrition Test
Nutrition tests conducted to know the nutritional levels contained in the type of mushroom found. Some of the nutritional indicators are observed by protein, carbohydrate, fat, fiber, moisture content and ash content. The methods used are kjheldhal for protein, luff schrool for carbohydrates, soxhlet for fats and gravimetry for fiber, moisture content and ash content.

3. Result and discussion
3.1. Species of Edible Mushrooms in Forest Park of Pocut Meurah Intan, Saree, Aceh Besar
Based on the results of studies that have been done along the observation track, there are 15 species of food-potentially mushroom in the Forest Park of Pocut Meurah Intan, Saree, Aceh Besar. The mushroom was found to be part of 12 families belonging to seven orders and two divisions (Table 1).

Most of the potential food mushroom species in the forest park of Pocut Meurah Intan, Saree, Aceh Besar is a group of order Agaricales. Members of the order Agaricales generally have a morphological structure of the body such as an umbrella with soft meat texture. The soft texture of the esh makes this group of potentially large mushrooms can be consumed [16]. Description of the species of mushroom potentially as foodstuffs found in the Forest Park Conservation Pocut Meurah Intan can be seen in Table 2.

*Cookeina tricholoma* has a soft, thin and not fragile texture of the flesh. *C. tricholoma* was found to grow solitary and flocking on weathered wood at location. *C. tricholoma* is one of the most widely consumed food mushroom by the Patamona tribe of Guyana [6]. In addition, the mushroom is also consumed by most of the Mexican and West African residents because of its savory taste and crispy texture. This mushroom is widely used as a mixed cooking ingredient [17]. *Cookeina sulcipes* was
found to grow solitary and flocking on the four-point weathered timber of the research location. *C. sulcipes* is one of the mildew consumption that is relatively unknown as food mushroom. These mushrooms are only known and consumed in some countries only, such as Malaysia and Mexico [7].

**Table 1. Mushrooms species that food potentially in the area of Forest park of pocut meurah intan, Saree, Aceh Besar.**

| Divisio | Ordo | Family | Species |
|---------|------|--------|---------|
| Ascomycota | Pezizales | Sarcoscyphaceae | *Cookeina tricholoma* [5], [6] |
| | | &nbsp;&nbsp; | *Cookeina sulcipes* [5], [7], [8] |
| Boletales | Boletaceae | | *Boletus edulis* [9], [10] |
| | Suilaceae | | *Suillus luteus* [5], [11] |
| | Physalaciaceae | | *Flammulina* sp. [9] |
| Agaricales | Agaricaceae | | *Lycoperdon perlatum* [5], [12], [13] |
| Basidiomycota | Marasmiaceae | | *Marasmiellus ramealis* [15] |
| Auriculariales | Schizophyllaceae | | *Schizophyllum commune* [14] |
| | Auriculariaceae | &nbsp;&nbsp; | *Auricularia auricula* [12] |
| Tremellales | Tremellaceae | | *Tremella fuciformis* [9], [12] |
| Thelephorales | Thelephoraceae | | *Thelephora ganbajun* [12] |
| Polyporales | Polyporaceae | | *Lentinus polychrous* [12] |
| &nbsp;&nbsp; | &nbsp;&nbsp; | &nbsp;&nbsp; | *Lentinus sajor-caju* [5], [12] |
| &nbsp;&nbsp; | &nbsp;&nbsp; | &nbsp;&nbsp; | *Ischnoderma resinosum* [15] |

*Boletus edulis* is found to grow solitary in the soil covered by leaf litter is at the location. *B. edulis* is generally the most widely known and traded around the world. The mushroom is widespread in Europe, North America, and Asia and has become a popular cooking ingredient in all three regions [18]. According to [10], of some food mushroom genus *Boletus*, only *B. edulis* has the most unique flavor, tasty, savory with thick flesh. *Suillus luteus* was found to grow solitary in the soil to scatter pine leaves at research location. *S. luteus* has thick flesh with a bland flavor. Generally, the genus is a popular food among the southern European nation. *S. luteus* can be processed in several ways, such as marinated, fried and baked. In its processing, the skin parts of the hood and stem of the fruit must be peeled first to clean [11]. *Flammulina* sp. was found to grow on a weathered wood substrate in groups at the location. *Flammulina* sp. is one of the popular mushrooms in various circles of society. This is because this mushroom has a very good nutritional content for health. This mushroom is usually used as a mixture of ingredients in soups, meat dishes and blends in sautéed [9].

*Lycoperdon perlatum* has long been known as a food mushroom and has become one of the favorite culinary in various countries. This mushroom can be consumed when it is young with soft white meat. While if it is ripe and change color to dark brownish then this mushroom could not be consumed [12]. [13] Puffball is one of the mushrooms that has a very high nutritional content compared to some other mushroom [20]. *Calvatia craniiformis* was found to grow in soil/litter leaf at the research area. *C. craniiformis* is a species of the genus *Calvatia* which is most widely consumed in Western Europe and South Africa [5]. This mushroom can only be consumed when young because of its still soft flesh texture, mild aroma and good taste. This mushroom is able to absorb the seasoning dishes very well so it is delicious to eat [21]. *Marasmiellus ramealis* grows in groups of weathered timber with adjacent distances. [5] FAO data has grouped this species into one of the mushroom consumption because it has a high mineral content and has been reported consumed in Hongkong.
Table 2. Diversity of food mushroom found in Forest Park Conservation Pocut Meurah Intan, Saree, Aceh Besar.

| Species name                      | The character of mushroom morphology found in the Tahura Pocut area of Meurah Intan, Saree, Aceh Besar |
|-----------------------------------|------------------------------------------------------------------------------------------------------|
|                                  | **Diameter** | **Colour** | **Shape** | **Height** | **Colour** | **Texture** | **Colour** | **Shape** | **Cap (volva)** | **Ring (annulus)** |
| Cookeina tricholoma              | 1-2 cm       | Pink       | Bowl, has hair, curved edges | 1-3 cm | White | Soft, not fragile | Pink | Small porous | - | - |
| Cookeina sulcipes                | 3-6 cm       | Orange     | Bowl | 1-5 cm | White | Soft | Pink | Small porous | - | - |
| Boletus edulis                   | 1-2 cm       | Dark brown | Narrow convex | 3-6 cm | Faded Brown | Sticky, soft | White brownish | - | - |
| Suillus luteus                   | 2-3 cm       | Reddish brown | Convex | 1-3 cm | Greyish-White | Sticky, hard | Brown | Small porous | - | - |
| Flammulina sp.                   | 2-4 cm       | Bright orange | Convex | 2-7 cm | Orange | Hard covered Rough, soft | White | Multilayered | - | - |
| Lycoperdon perlatum              | 1 cm         | White      | Shaped like a pear Round, like a skull | 1 cm | White | - | Pale brown White | Small porous | - | - |
| Calvatia crassiformis            | 6 cm         | Pale brown | White | - | - | - | Small porous | - | - |
| Marasmiella ramealis             | 1-1,5 cm     | White      | Convex, like an umbrella | 1-2 cm | White | Soft | White | Split brushed | - | - |
| Schizophyllum commune            | 1-5 cm       | Pale brown | White | - | - | - | Light Gray | Split brushed stem, stringed | - | - |
| Auricularia auricula             | 2-3 cm       | Bright Reddish brown | Semi-circular notched bending | - | - | - | Bright Reddish brown | Small porous | - | - |
| Tremella fuciformis              | 2-4 cm       | Transparent, whitish | Soft like gelatin, | - | - | - | Transparent, whitish | Small porous | - | - |
| Thelephora ganbujun              | 2-5 cm       | Pale brown | White | Concave, unaligned edges | 3-6 cm | Dark grey | Hard, rough surface | Dark grey | Small porous | - | - |
| Lentinas polychrous              | 4-10 cm      | White brownish grey | Concave, folded curved edges, thick | 3-7 cm | Faded brown | Hard | White brownish | Split around the trunk | - | - |
| Lentinas sajor-caju              | 3-7 cm       | Young Yellowish beige | Concave in, curved edges out | 4-7 cm | Dark brown | Hard | Young yellowish white | Split around the trunk | - | - |
| Ischnoderma resinosum            | 5-12 cm      | Brown, white loose | Concave, irregular edges | - | - | - | White brownish | Small porous | - | - |

*Schizophyllum commune* is found to grow attached to weathered wood in groups. *Schizophyllum* is food mushroom among many people [22]. *S. commune* is known for its delicious taste that is consumed in many countries, including Cameroon, Mexico and India [23]. *Auricularia auricula* is one of the mushrooms commonly known as consumption mushrooms and has been widely cultivated in several Southeast Asian countries such as China, Taiwan, Thailand, Philippines, Malaysia and Indonesia [24]. This mushroom is used for various provisions, mainly as food ingredients. In China, *A. auricula* has been consumed since 600 AD [25] and has been the second most widely consumed mushroom. *Tremella fuciformis* is known as jelly mushroom or white snow which became one of the
popular mushrooms in China. The genus plays an important role in giving a sweet taste to Chinese delicacies. Although it feels bland, the texture of the mushroom resembling a soft jelly is very appealing to the tongue of Asian residents [19]. In addition to China, T. fuciformis is also widely found in Malaysia and consumed by most of its inhabitants [8]. Thelepora ganbajun is found to grow in groups of litter. T. ganbajun was first discovered in Yunnan province, China. T. ganbajun become the most favorite consumption mushroom in Yunnan because it has a unique flavor and delicious. Nowadays, this ectomycorrhizal mushroom has been widely commercialized in some countries, such as Laos and Thailand.

*Lentinus polychorus* is one of the most commonly consumed foodstuffs in Thailand, particularly in the north and northeast [26]. This mushroom is widely consumed because it tastes good and its nutrient content is good for health. *L. polychrous* contains protein levels, fats, carbohydrates, fibers and important elements needed by the body, such as sodium, potassium, calcium, iron, magnesium and zinc [27]. *Lentinus sajor-caju* is found to grow on weathered timber in groups of adjacent distances. *L. sajor-caju* can be eaten because it has a good nutrient content such as carbohydrates, proteins, fats, mineral macro, and micro, vitamins and fibers [28]. Besides, the mushroom also has a fairly high mineral content needed by the body. This mushroom is also known to have potential high antioxidant activity [29]. *Ischnoderma resinosum* was found to be growing overlapping. I. resinosum usually can only be consumed when young because of the soft, tender and chewy texture of the flesh. When it is ripe, this mushroom is not able to be consumed anymore because its fruit body that has been hardened. It tastes a little sweet bitterness and its distinct smell makes this mushroom as one of the natural flavors in the food industry. In its processing, this mushroom is usually used as a mixture of soup, salad and stir-fry [15].

### 3.2. Nutritional Content of Edible Mushroom

Nutrition analysis is only conducted on five species of food potentially mushroom found in Forest park of Pocut Meurah Intan, Saree, Aceh Besar, among them *Marasmiellus ramealis, Ischnoderma resinosum, Thelephora ganbajun, Lentinus sajor-caju, and Lentinus polychrous*. Nutrient content analysis cannot be done on all food potentially macro mushroom species found. This is only five species of mushrooms that have examined due to sample weight according to the nutritional analysis method. The results of the nutrient content analysis for the five species of potentially food mushroom can be seen in Table 3.

**Table 3.** Nutritional content of the five species of potentially food mushroom (100 g/sample) in the area of Forest park Pocut Meurah Intan, Saree, Aceh Besar.

| No. | Test parameters | Marasmiellus ramealis | Ischnoderma resinosum | Thelephora ganbajun | Lentinus sajor-caju | Lentinus polychrous |
|-----|----------------|-----------------------|----------------------|---------------------|---------------------|---------------------|
| 1.  | Protein        | 4.70                  | 2.50                 | 3.12                | 3.41                | 6.12                |
| 2.  | Carbohydrates  | 1.20                  | 3.10                 | 2.97                | 5.89                | 10.27               |
| 3.  | Crude fiber    | 2.12                  | 3.18                 | 2.12                | 3.46                | 4.73                |
| 4.  | Fat            | 0.77                  | 0.77                 | 1.18                | 0.77                | 1.26                |
| 5.  | Ash content    | 1.12                  | 1.28                 | 1.63                | 1.36                | 1.16                |
| 6.  | Moisture content | 89.01                | 77.64               | 74.97               | 85.59               | 86.39               |

The test results show the protein content of the five species of mushroom is still much lower compared to the common food sources in daily protein needs such as meat, fish, eggs, and milk. [31]. The protein content of meat, fish, eggs and milk respectively 21%, 19%, 3.2% and 1.8% per 100 gr [32]. However, the fat content of this daily food source is quite high that is 3.7% - 5.5% per 100 gr. Fat contained in mushroom it only gives 0.77% - 1.26%. Although the protein content of the five species is lower in the meat protein appeal but the low fat content makes it one of the alternative food sources.
substitute animal proteins are generally high in fat content. *L. sajor-caju* has a protein and fat levels which is ideal as an alternative food which is 3.41% and 0.77% per 100 gr.

Carbohydrate content of spinach, cabbage and cucumber respectively at 1.9%, 4.2%, and 0.4%. The value of carbohydrates in the five species of an analyzed mushroom ranged 1.20% - 10.27%. *L. polychorus* that has the largest content of 10.27%. However, *M. ramealis* has a fairly low carbohydrate content of 1.20%. Low carbohydrate content suitable for use as one of the ideal food for diabetics [31]. The crude fiber contained in the five species is quite high at 2.12% - 4.13%. This is generally due to the carbohydrate contained in the mushrooms is also high. Coarse fiber is another group of undigestible carbohydrates and is found in the body of mushroom [33].

*T. ganbajun* has the highest ash content is 1.63%. Also, the value of the content is not much different than the other four mushroom ranging from 1.12% - 1.36%. The ash content of the five mouldy mushroom species is still better than the ash content found in the 15 species of food mushroom in Thailand ranging from 0.27% - 1.53% [34]. The main element in the ash is K (potassium) and P (phosphorus). Low ash content in some species of mushroom can be attributed to low content of K and P [20], [13]. Moisture content found in the five species of mushroom analyzed is 77.64% - 89%. *M. ramealis* is a species that has the highest water content of 89%. The difference in water content in each mushroom species is usually influenced by environmental conditions [30].

4. Conclusion

Food-potentially mushrooms were found in the Forest park Pocut Meurah Intan. Saree. Aceh was discovered by 15 species included in 12 families, seven orders and two divisions. *Lentinus polychrous* has the highest protein (6.12%), carbohydrate (10.27%), fat (1.26%) and fiber (4.73%) compared to *Marasmiellus ramealis*. *Lentinus sajor-caju*, *Thelephora ganbajun* and *Ischnoderma resinosum*. *Thelephora ganbajun* has the highest ash content compared to another mushrooms species which is 1.63%. *Marasmiellus ramealis* has the highest water content compared to another mushrooms species, which is 89.01%. These five potential mushroom species could be a good food alternatives, because it has good nutrition.

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