Available online at www.derpharmachemica.com

ISSN 0975-413X
CODEN (USA): PCHHAX

Der Pharma Chemica, 2017, 9(15):44-47
(http://www.derpharmachemica.com/archive.html)

The Nutritional Content of the Mushroom *Phallus indusiatus* Vent., which Grows in the Cocoa Plantation, Gaperta-Ujung, Medan

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ABSTRACT

The nutritional content that exists in various types of stinkhorn mushrooms can be beneficial in human life, other than as a source of food, can also be useful to cure certain diseases. This study aims to determine the nutritional content in the fruit bodies of mushrooms Phallus indusiatus Vent. which grows among the decayed cocoa leaves in the cocoa plantation area in Gaperta Ujung, Medan? The method used is description and analysis. This stinkhorn mushroom belongs to a very rare species found, and grows on the ground which is a pile of decaying cacao leaves. Having a fairly short life cycle, and at the stage of adult have a fruit bodies as high as 24 cm, as well as emit an unpleasant odor. The results showed that the fruit bodies of this fungus contained very high water content (90.9%), crude fiber about 6.03%, 4.813% protein, 4.7% fat, 0.064% carbohydrate, ash content 10.4% and 2.286% vitamin C. The fruit bodies of this stinkhorn mushroom also contains some elements of minerals namely Ca, Mg, Fe, Al, Si. The nutrient content and mineral elements contained in the fruit bodies of P. indusiatus may be increased if the fungus is cultivated.

Keywords: *Fruit bodies, Nutrition, Phallus indusiatus* Vent., *Stinkhorn*

INTRODUCTION

In general, live fungi with habitat diversity. There are living saprophytes in nature that inhabit dead stems, leaf litter, compost, etc., there is mycorrhiza with trees, some are parasites, and some are thermitophilic [1]. Mushrooms play an important role in the decay of dead organisms, and are associated in stimulating optimal growth of certain plants [2]. Indonesia is an area suitable for the growth and breeding of microorganisms such as fungi. Of the 1.5 million fungi on earth, only 50% have been characterized, and only about 5-10% of the fungi can be cultivated artificially [3].

Stinkhorn mushroom *Phallus indusiatus* Vent., ordo Phallales, family Phallaceae [4] is a new type of fungus, and belongs to a large group of Basidiomycetes [5]. *P. indusiatus* Vent. has many common names: Bamboo fungus, bamboo pith, Long net Stinkhorn, Crinoline Stinkhorn, Stinkhorn Basket, Veiled lady and Bridal veil lady (English), Kinugasatake (Japanese), Bamboo mushroom (Chinese), Rang hae kra pong yao (Thailand and Laos). This fungus has a large and attractive fruit bodies, making people more interested to know more [6].

In Indonesia, this type of mushroom is still a newly discovered species and its existence is still rare. Around the year 2013 to 2015 this type of fungus is found and researched in the area of cocoa plantations in Gaperta Ujung, Medan. This mushroom fruit bodies reaches a height of ± 19.13 cm, the cap or pileus is a brown cone shape with curved side, which is ±3 cm wide and ±2.6 cm high, creamy yellow gleba, has a circular white ring in the middle of the stem, sticks (stipe) perforated and cylindrical, at the base of the stem there is a gray (volva) cup containing grains like jelly, has a part that resembles a root (mycelium), has a mantle or indusium like a creamy white net that turns golden yellow when it withers. The process of growth and development from the stage of eggs to stage wilt (death) took place quickly. Caps that have gluten emit an unpleasant odor, which attracts several flies [7]. This fungus is also one of the new species identified from the Brazilian Amazon rainforest [8], which is also found in the Atlantic Forests of Misiones-Argentina [9], and at Hollongapar Gibbon Wildlife Sanctuary, Jorhat, Assam, India [4,10], in the State of Paraíba, Brazil, the Basidiomycetes collection was made in the Restinga area of Mataraca, Paraíba, May and September 2009 [11]. This fungus is also found in a collection of Phallus species made in a survey of the subtropical forests of Xishuangbanna in Yunnan Province, China, during the rainy season of 2012 [12].

As a result of the development of science and biotechnology at the present time, from the diversity of mushrooms has been found that in addition to causing harm to human life, mushrooms can also be used as an ingredient to cure various diseases and as a source of delicious and nutritious food. Mushrooms have a vast source, and most of it has not been exploited a powerful new pharmaceutical product. This fungus is a limited source of polysaccharides with antitumor and immunostimulant properties.

Recently, Basidiomycetes has been used for the treatment of cancer. Many types of fungi from Basidiomycetes contain biologically active polysaccharides in fruit bodies, culture mycelium, and broth culture. Polysaccharides and complex protein-polysaccharides of medicinal mushrooms can improve the innate immune response, resulting in antitumor activity [13]. Macro fungal diversity is increasingly important because groups of these organisms function as a source of food and medicine. An estimated 38,000 species of mushrooms present provide a wealth of protein, fiber, vitamins B and C, as well as calcium and other minerals. At least three species have demonstrated the potential for phenomenal healing: Maitake, Shiitake and Reishi. This medicinal mushroom has been proven to improve cardiovascular health; Reduce the risk of cancer; Promotes immune function; Prevent viruses, bacteria, and fungi; Reduce inflammation; Combat allergies; Helps to balance blood sugar levels and supports the body's detoxification mechanism [14]. According to Aziz et al., some fungal species have therapeutic properties such as antioxidants, antimicrobials, anticancer, cholesterol lowering and immuno-stimulatory effects. The consumption of a diet rich in fungi is associated with a reduced risk of cardiovascular disease, and certain types of cancer. Mushrooms have nutraceutical properties such as prevention or treatment of Parkinson's, Alzheimer's, hypertension, and high-risk stroke. From a large number of macro fungal diversity, the Phallceae mushroom group is a type of mushroom *P. indusiatus* Vent, including a very important mushroom because it can be a source of food and medicine [15].

Nowadays there have been many research results showing that mushrooms can be used as a source of delicious food, a source of herbal remedies, and also can improve the lives of people through mushroom cultivation. This is due to the average mushroom has nutrients that can improve the quality of health in the community. Among them are white oyster mushrooms can be consumed and contain high enough carbohydrate, protein, fat, crude fiber, Ca, Fe, thiamin, riboflavin. Similarly, mushroom *Volvariella volvaceae, Auicularia auricular*, *Lentinus edodes* and *Agaricus* sp. [16]. However, some wild mushrooms are considered toxic and there has been some concern about the concentration of metals such as arsenic, cadmium, copper and lead in wild mushrooms. But the normal consumption of wild mushrooms does not pose a significant health risk [17]. Because of the increasing of society requirement to mushroom especially in health world, hence the researcher is encouraged to know the nutrient content in *Phallus indusiatus* mushroom species that have been found planted cocoa in Gaperta-Ujung, Medan, Indonesia.

MATERIALS AND METHODS

This research was conducted in April-December 2016, at Laboratory of Prima University Indonesia and chemistry laboratory of University of Northern Sumatra, Medan. The analyzed material is *P. indusiatus* mushroom obtained from cocoa plantation in Gaperta Ujung, Medan. The method used is description and analytic method. The parameters observed were nutritional content test on mushroom including mineral and vitamin analysis, and test of carbohydrate, protein and fat content. Analysis of nutritional content using Kjeldahl method to analyze protein, Soxhlet method to analyze fat, Lane-eynon method to analyze carbohydrate, and Crude fiber method to analyze fiber. To analyze the mineral elements contained in the fruit bodies of this fungus is used method Gravimetry, Titrimetry and Spectrophotometry [18,19].

RESULTS AND DISCUSSION

P. indusiatus including the Stinkhorn mushrooms group that has a large fruit bodies. In this study, the fungus was found in the cocoa plantation area in Gaperta Ujung Medan, as shown in Figure 1. This fungus lives as a saprophyte, growing among the decaying cocoa leaves, when the beginning of the rainy season or the end of the rainy season. The fruit bodies of this mushroom is clearly visible to the soil surface around 9 am, with an average height of 19.13 cm [7] can even reach up to 24 cm high. The results of the analysis of nutrient content and mineral elements contained in the fruit bodies of *P. indusiatus* can be seen in Table 1.

Figure 1: The fruit bodies of *Phallus indusiatus* growing in the cocoa plantation, Gaperta-Ujung, Medan

Table 1: The content of nutrients and mineral elements in the fruit bodies of mushrooms *Phallus indusiatus* Vent

S. No.	Type of nutrients/mineral elements	Average results (%)
1	Water content	90.9
2	Fat	4.7
3	Crude fiber	6.03
4	Carbohydrate	0.064
5	Protein	4.813
6	Vitamin C	2.286
7	Ash content	10.402
8	Ca	0.099
9	Mg	0.053
10	Fe	0.001
11	Al	1.012
12	Si	1.596

Basically, the fungus consists of hyphae, which together form the mycelium. When two groups of mycelium conjugate under the right conditions, a fruit body will form, which will release the spores [2]. When at the stage of an egg or underground peridium, Stinkhorn Phallus is almost odorless. Peridium can be eaten, but after growing upward as a Phallus, this fungus produces a sticky spore mass at the tip, which has a carcass smell to attract flies [2,20]. The ripe fruit bodies can be smelled from a considerable distance in the forest and from close most people find a nasty smell. Flies settle in the gleba and consume mucus, storing it as dirt elsewhere [20].

Based on the results of laboratory analysis, the fruit bodies of *P. indusiatus* obtained from cocoa plantation area in Gaperta-Ujung, Medan, contained average water content (90.9%) very high, followed by crude fiber about 6.03%, protein 4.813%, fat 4.7%, carbohydrates 0.064%, and vitamin C 2.286%. When compared with ear mushrooms, the fiber content in the ear mushroom is between 7.4-27.6% [16], while the fiber content of *P. indusiatus* in this study is still much lower. Nevertheless, the fibers contained in the fruit bodies of this *P. indusiatus* may include quite high, when compared with mushrooms whose lives have not been cultivated. According to Dunkwal and Jood cultivated oyster mushrooms form an important constituent for balanced foods, and can serve to improve nutritional status, as well as help in reducing protein deficiency especially in children. Then, the *Pleurotus tuberregium* (Fr.) Sing mushroom can be used as a substitute for expensive meat and fish in the developing world, since its protein content is higher than in most legumes and vegetables [21].

Similarly, with this *P. indusiatus* mushroom, if successfully cultivated, as well as a source of delicious food also has the potential to improve the quality of nutrition. Because of its high fiber content, it is possible that the studied *P. indusiatus* mushroom tends to suppress the increase in blood cholesterol levels. Like button mushrooms (*Agaricus bisporus*) can cause a decrease in total cholesterol, Low-density Lipoprotein (LDL) and total triglyceride concentration and a significant increase in High-density Lipoprotein (HDL) plasma concentration and with a high diet with button mushrooms can modulate the activity aromatase and its function in "chemoprevention" in postmenopausal women through decreased in-situ estrogen production [22]. Aziz et al. also argue that mushrooms are easy to digest, cholesterol-free, and provide a source of dietary fiber. Mushroom proteins compete successfully with animal protein foods and healthy alternatives to meat.

If the results of this study were compared with the results of research Jonathan et al. which shows, the *P. indusiatus* (Vent Ex-Pers) high-grade Nigerian mushroom, rich in protein, sugar, crude fiber, and dry matter. The highest crude protein level of 42.63 mg/g was found in vein, egg and pileus stages containing 33.6 mg/g and 25.56 mg/g respectively. The egg stage, containing 1.66 mg/g lipid, while the sugar level on the stipe 6.50 mg/g. Similarly, the mineral elements Ca, Mg, Fe, K, Mn, Zn, and Cu are found in sufficient concentrations in different parts of this fungus. This is probably due to the fungus having different habitats or growth media or other factors that can affect the nutritional content contained in the fruit bodies of the fungus. Similarly, when compared with nutrients (water content, crude protein, fat, and fiber) contained in oyster mushroom, *Pleurotus ostreatus* (Jacq. Fr.) Kumm grown on cotton waste substrate, added with 20% rice bran [23] is much higher than the nutrients contained in the fruit bodies of *P. indusiatus* investigated in this study. This is probably due to the fungus in addition to having different habitats or growth media, also the type of fungus can affect the nutrients contained in the fruit bodies of fungus. The content of nutrients and mineral elements in the fungus can be influenced by several factors, such as storage time [24], type of fungus, growing media or mushroom habitat [23]. It is possible that mushrooms with different media compositions have different physical and nutritional content. Several studies have also shown that variations in mushroom nutritional composition are likely due to variations in substrate composition, such as mushroom *P. ostreatus* cultivated better on cotton waste media than rice straw and wheat straw [25], the growth and nutritional composition of this oyster mushroom also better on a mixed substrate than a pure substrate [26], this fungus also has higher carbohydrate, calcium, and magnesium content, when grown on Mahogany wood powder substrates added with wheat bran and lime [27], and from some of the tested substrate, the mycelial growth of this fungus was highest in the topsoil substrate [28].

Then the mushroom *P. tuberregium* has a very high nutrient content on the substrate of river sand mixture and sawdust fermentation rather than the topsoil soil mixed substrate and sawdust fermentation [21]. Similarly, oyster mushrooms grown on Brassica straw substrate are significantly higher in protein, riboflavin, lysine and methionine, while oyster mushrooms grown on wheat straw substrates are significantly higher in thiamine and dietary fiber [29]. This suggests that the nutrient levels contained in the fruit bodies of the *P. indusiatus* obtained from this cocoa plantation may be enhanced if they can be cultivated. Because natural habitats have less stable properties due to many factors of disruption, including in the abiotic and biotic environment, so that the forest ecosystem (the natural habitat where the fungus grows) further loses its organism's diversity including mushroom species. To preserve genes from in-situ fungi, it is necessary to preserve the primary forest, which is endowed with many diverse quantities of detritus, which are suitable for the presence of fungi and preservation. However, for forest rehabilitation needs to be of sufficient duration as old growth microhabitats, favored by fungi rather than new microhabitats [8]. Like, the existence of micro fungi in zone recovered from the Atlantic Forest (Misiones, Argentina). Atlantic forest is a historically managed ecosystem with no boundaries. Over the years, this situation led to fragmentation of the forest environment with consequent, habitat loss for all organism species in the region [11].

Then according to Naz edible mushrooms have important effects on health or even in treating illness. Mushrooms have health food values: low calorie, high in vegetable protein, chitin, iron, zinc, fiber, essential amino acids, vitamins and minerals. *P. indusiatus* mushrooms can be eaten at the egg stage, and as an ingredient in Chinese haute dishes, used in stir fries and chicken soup. This mushroom has been grown commercially and is usually sold in Asian markets, rich in protein, carbohydrates, dietary fiber, also contains various bioactive compounds, has antimicrobial properties and antioxidants [1]. *P. indusiatus* as a material that can be used to treat various inflammation, stomach and neurological diseases. Sout China's Miao community continues to use it traditionally for a number of sufferings, including injury and pain, cough, dysentery, colitis, leukemia, and weakness, and has been prescribed clinically as a treatment for sore throat, whitish, fever and oliguria (low output urine), diarrhea, hypertension, cough, hyperlipidemia and in anticancer therapy [6]. Naz also argues that the fungus *Dictyophora indusiata* (*P. indusiatus*): Medicine fungsional: antioxidant, antimicrobial, and inflammatory potential, active compounds: Dictyophora A/B, dictyoquinazole B/C, ribonucleases, and tyrosinase. According to Ker et al. [30], the possibility of bioactivity in *D. indusiata* is polysaccharide solution and monosaccharide profiles can act to play an important role in influencing antioxidative ability, which in turn will affect biological activity involving anti-inflammation, boost immunity and anticancer. Retrieved some fraction of polysaccharide solution is galactoglucan, galactan, riboglucan, myoinositol, and mannogalactans. Based on the molecular weight of soluble polysaccharides (SP) fractions it has the ability to resist α, α-diphenyl-β-picrylhydrazyl, •OH-, and $•O_2$- radicals.

This *P. indusiatus* mushroom attracts attention in terms of its unique shape, has a coat and veil with attractive shapes and colors. Makes everyone who sees it want to get close and pick it. However, the unpleasant odor that it spread made people hesitate to approach it. Since this fungus can be used as a food source and even as a source of substances that can cure disease, there is no reason not to obtain this mushroom and cultivate it.

CONCLUSION

Phallus indusiatus Vent. stinkhorn mushroom obtained from the cocoa plantation area in Gaperta Ujung, Medan, contains a very high water content of about 90.9%, followed by fiber with a high of about 6.03%, 4.813% protein, 4.7% fat, 0.064% carbohydrate, ash content 10.4%, and vitamin C 2.286%. This mushroom also contains some mineral elements that are Ca, Mg, Fe, Al, Si. The nutritional content contained in the fruit bodies of this *P. indusiatus* may be increased if this fungus can be cultivated.

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