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Research Article

# Comparative Nutritive Profile Study of Bangladeshi Shiitake Mushroom (Lentinula Edodes)

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## Abstract

Shiitake mushroom (Lentinula edodes) is considered as an edible and medicinal mushroom. Its medical qualities are becoming more and more well-known worldwide. In Bangladeshi mushroom markets, there is an increase in demand for it. However, little study has been done on its nutritional qualities. Thus, the present study has been aimed at determining the comparative nutritional values of two most common strains of Shiitake mushrooms (Lentinula edodes-8 and Lentinula edodes-16) available in Bangladeshi markets. For this purpose, the caps were separated from the stipes. Then proximate nutrient composition of caps, stipes and whole fruiting body were evaluated following standard protocols. Lentinula edodes-8 fruiting body showed higher carbohydrate and protein content than the fruiting body of lentinula edodes-16 strain. Lipid content was higher in the fruiting body of Lentinula edodes-16. Ash and fiber was very much similar in the fruiting body of those two strains. Besides, the caps of Lentinula edodes-8showed higher protein, carbohydrate and ash content than Lentinula edodes-16. The stipes showed higher value of carbohydrate and fiber in both of the strains. Thus, shiitake mushroom could be considered as a rich source of biomolecules and nutraceuticals.

**Keywords:** Ash; Biomolecules; Fiber; Fungi; Food supplement; Mushroom; Nutrients

## Introduction

Mushrooms are the fleshy, edible fruit bodies of many different fungi species and in the modern day, food of fungal origin is consumed in large numbers all over the world, and commercial production is a component of a rapidly expanding industry [1]. Fungi are very important to vegetarians since they are quite nutritious. Edible mushrooms are a good source of fiber, vitamins, and some minerals and have a high protein content [2]. The term "mousseron," which comprised both dangerous and edible species of mushrooms, is supposed to have given rise to the word "mushroom" [3,4]. The term "fruiting body" is now used to describe the above-ground portion of fungus that are edible [3]. Truffles and morels are two examples of particular names for mushrooms that lack the conventional stem and cap [3-5]. Mushrooms can replace fish or meat due to their high protein content and make sauces and soups taste even better [1]. For centuries, people have admired mushrooms for their flavor and texture. They are currently regarded as a wholesome diet and a significant source of physiologically active chemicals with therapeutic significance [6]. One of the most significant culinary and therapeutic mushrooms is the shiitake (Lentinula edodes) [6-8]. In terms of global mushroom production as a whole, it comes in second [6-8]. Only the button mushroom is superior to it in terms of productivity [6-8]. Lentinus edodes's ancient Japanese name, shiitake mushroom, derives from a mushroom associated with the shii tree (Castanopsis cuspidate Schottky) [6-8]. This variety of mushroom is now well recognized by the term "Japanese Mushroom," as Japan ranks first in the world for production of it [6-8].

Antioxidant-rich foods are a useful strategy for managing oxidative stress [9-11]. Consuming grains, vegetables, and fruits has been associated to a lower risk of developing chronic diseases [10,11]. It has been proposed that this is because they contain phytochemicals that assist maintain a balance between oxidants and antioxidants and counteract oxidative stress in the body. Phenolics are naturally occurring secondary metabolites that are formed from plants and are among the most potent plant compounds that act as antioxidants [10,11]. Vegetables, fruits, leaves, nuts, and seeds all contain them [10,11]. The secondary metabolites and nutrients found in mushrooms include phenolic chemicals, polyketides, terpenes, and steroids. Addi-

tionally, phenolic chemicals originating from mushrooms have been shown to be excellent antioxidants and synergists that are not mutagenic [10-14]. There is a dearth of information regarding the proximate nutrient contents of pilei and stipes of commonly consumed shiitake mushrooms in Bangladesh, despite extensive reporting on the nutrient, antinutrient, and mineral makeup of various edible mushrooms in Bangladesh [10,11]. This study, therefore, aimed to determine the distribution of nutrients between the pilei (caps) and stipes (stalks) of two strains of shiitake mushroom in Bangladesh, namely Lentinula edodes-8 and Lentinula edodes-16.

## Materials and Methods

### Location of Experiment

The experiment was carried out at the National Mushroom Development Institute, Savar, Dhaka from July 2021 to June 2022.

### Experiments and Treatments

The experiment was laid out in single factor Completely Randomized Design (CRD). Two different treatments with thirty replications of each strain were conducted to achieve the desired objectives. The experiments were as follows:
Lentinula edodes-8 + sawdust (LE-8 + SD)
Lentinula edodes-16 + sawdust (LE-16 + SD)

### Preparation of Packets

Spawn packets using sawdust were prepared separately. With spawn preparing substrate; different supplements and CaCO3 (1 g per packet) were added. The measured materials were taken in a plastic bowl and mixed thoroughly by hand and moisture was increased by adding water. Moisture was measured by using the moisture meter and adjusted the moisture content at 50%. The mixed substrates were palced into a 9×12-inch polypropylene bag weighting 500 g. The filled polypropylene bags were prepared by using bamboo neck and the necks were plugged with cotton and covered with brown paper placing rubber band to hold it tightly in place.

### Sterilization, Inoculation and Mycelium Running in Spawn Packets

After being sterilized for one hour, the packets were left to cool. When the mother spawn had cooled, 5g of it was inoculated into the packets in the laminar airflow cabinet and kept there at a temperature of 20 to 22 degrees Celsius until the packets became white to indicate the presence of mushroom mycelium. After the mycelium running process was finished, the bamboo neck, cotton plug, brown paper, rubber band, and rubber band were removed from the mouth of the spawn packets. These spawn packets were then moved to the culture building.

### Cultivation of Spawn Packet

The upper position of the plastic bag's two ends that were opposite one another were cut into a "D" shape with a blade and opened by removing the plastic sheet. The substrate's opened surface was then lightly scraped with a tea spoon to remove the thin, whitish mycelial layer. The spawn packets were then submerged in water for 15 minutes, followed by another 15 minutes of investment to drain the excess water. Each type's packets were laid out separately on the culture room's floor and covered with newspaper. By misting the culture room with water three times each day, the relative humidity was kept in the range of 80-85%. The culture house's lighting, which ranged from 300 to 500 lux, and ventilation were kept consistent. The culture house was kept at a temperature of 24 to 27 degrees. After scribing, the first primordia appeared 2–4 days later. Depending on the kind of substrate, different times are required for harvesting.

### Collection of Produced Mushrooms

Both strains of Shiitake mushroom were matured within 2 months after primordia initiation. The matured fruiting body was identified by curial margin of the cap, as described by Amin et al (2002). Mushrooms were harvested by twisting to uproot from the base. It was made sure that every part of the mushrooms including the cap, gills, stem and base are included in the collection.

Small, tiny and delicate mushrooms were collected in suitable plastic container or glass vials with tight lids to prevent damage to these mushrooms besides arresting desiccation during the time of transportation. The time from inoculation to the first harvest and total harvesting time (from the first to the last harvest) were observed and recorded. At every flush, the harvested fruiting bodies were weighed and mushroom size was measured.

### Proximate Analysis of the Mushrooms

The collected Lentinula edodes specimens were divided into little pieces. These little pieces were then properly dried in a hot air oven at a temperature of 55°C after being dried in the sun. The dried chips were pulverized into coarse powders using a blender with a powerful grinding motor after drying. The powder was then put in an airtight container with the requisite identification labels and kept in a cool, dark, and dry location for further research.

### Extraction Procedure

Lentinula edodes fruiting bodies were powered after being initially dried. The powered sample was then maintained in a separate conical flask with 95% ethanol. Here, 5% of the mushroom was extracted (5gm mushroom in 100 ml ethanol). For two days in 40 c, the mushroom conical flask was shaken. The solution was then filtered with whatman filter paper after being filtered through cloth to remove the solvent part. A rotary evaporator was then used to evaporate the solvent, and the solid residue was recovered. 45gm of the extract from 500gm was gathered.

### Determination of carbohydrate, protein, lipid, ash and fiber

Following the previously established method of Rahman et al (2020a; 2020b), content of carbohydrate, protein, lipid, ash and fiber were determined.

### Statistical analyses

Each experiment was carried out in triplicate, and the results will be provided as the mean SEM. Version 20 of the statistical program SPSS will be used. One-way analysis of variance (ANOVA) was used for the analysis, and the differences between the means will then be further examined using the least significant difference (LSD) at the 95% level (P 0.05).

## Results and Discussion

Time required for the completion of mycelium running (Days)
Time required for the completion of mycelium running for Lentinula edodes-8 and Lentinula edodes-16 were 27 and 41 days, respectively **(Table 1)**.

**Time required for bump formation (Days)**
Time required for bump formation for Lentinula edodes-8 and Lentinula edodes-16 were 108 and 94 days, respectively **(Table 1)**.

**Time required from opening to harvest (Days)**
Time required from opening to first harvest for Lentinula edodes-8 and Lentinula edodes-16 were 5 and 6 days, respectively **(Table 1)**.

**Number of total Effective Fruiting body (EFb)**
Number of total effective fruiting body for Lentinula edodes-8 and Lentinula edodes-16 were 37 and 36, respectively (Table 2).

**Length of Stalk (LS)**
Length of stalk for Lentinula edodes-8 and Lentinula edodes-16 were 4.58 and 5.35 cm, respectively **(Table 2)**.

**Diameter of Stalk (DS)**
Diameter of stalk for Lentinula edodes-8 and Lentinula edodes-16 were 1.65 and 1.13 cm, respectively **(Table 2)**.

**Diameter of Pileus (DP)**
Diameter of pileus for Lentinula edodes-8 and Lentinula edodes-16 were 6.40 and 6.45 cm respectively, **(Table 2)**.

**Thickness of Pileus (TP)**
Thickness of pileus for Lentinula edodes-8 and Lentinula edodes-16 were 1.28 and 1.30 cm respectively, **(Table 2).**

*Table 1: Harvest time period of Lentinula edodes-8 and Lentinula edodes-16.*

| Treatments | Time period from inoculation to fully run of mycelium (days) | Time required for bump formation (days) | Time required from opening to first harvest (days) | Time required for harvest (days) |
|---|---|---|---|---|
| Lentinula edodes-8 | 27 | 108 | 5.00 | 113 |
| Lentinula edodes-16 | 41 | 94 | 6.00 | 99 |

*Table 2: Data regarding fruiting body, stalk and pileus of Lentinula edodes-8 and Lentinula edodes-16.*

| Treatments | No. of Fb | No. of EFb | LS (cm) | DS (cm) | DP (cm) | TP (cm) |
|---|---|---|---|---|---|---|
| Lentinula edodes-8 | 16 | 12 | 4.58 | 1.65 | 6.40 | 1.28 |
| Lentinula edodes-16 | 29 | 23 | 5.35 | 1.13 | 6.45 | 1.30 |

**Yield (g)**
Yield of Lentinula edodes-8 and Lentinula edodes-16 were 172 and 175 gm, respectively.

**Biological efficiency (%)**
Biological efficiency of Lentinula edodes-8 and Lentinula edodes-16 were 98 and 100 gm, respectively.

**Nutritional value**
Nutritional value of caps, stipes and whole fruiting body of different strains of Lentinula edodes are discussed below:

**Protein**
The protein content of caps, stipes and whole fruiting body different strains of Lentinula edodes mushrooms is shown in **Table 3**.

All the treatments contain a considerable number of proteins. The content of protein in the cap and stipe of Lentinula edodes-8 were 14.56 % (w/w) and 11.03% (w/w), respectively. Sinilarly, the content of protein in the cap and stipe of Lentinula edodes-16 were 13.3 % (w/w) and 10.09% (w/w) respectively. In case of whole fruiting body shown in **table 4**, the highest content of protein was found in the Lentinula edodes-8(28%) and the lowest protein was found in Lentinula edodes-16 (26.8%). Thus, Lentinula edodes-8 could be a good source of protein for daily intake. People of Bangladesh usually suffer from the lack of proteins. Addition of Lentinula edodes-8 in their diet would definitely help them to overcome the shortage of proteins. These mushroom proteins will also provide essential amino acids.

**Ash**
The ash content of caps, stipes and whole fruiting body different strains of Lentinula edodes mushrooms is shown in **Table 3**. All the treatments contain a considerable number of ashes. The content of ash in the cap and stipe of Lentinula edodes-8were 3.5 % (w/w) and 1.7% (w/w), respectively. Similarly, the content of ash in the cap and stipe of Lentinula edodes-16 were 3.1 % (w/w) and 1.5% (w/w) respectively. In case of whole fruiting body shown in table 4.5, the highest content of ash was found in the Lentinula edodes-8 (5.20%) and the lowest ash was found in Lentinula edodes-16 (5.18%).

**Lipid**
The lipid content of caps, stipes and whole fruiting body different strains of Lentinula edodes mushrooms is shown in Table 3. All the treatments contain a considerable amount of lipids. The content of lipid in the cap and stipe of Lentinula edodes-8 were 2.6 % (w/w) and 1.3 % (w/w) respectively. Similarly, the content of lipid in the cap and stipe of Lentinula edodes-16 were 3.3 % (w/w) and 2.0% (w/w) respectively. In case of whole fruiting body shown in table 4.5, the highest content of lipid wasfoundin the Lentinula edodes-16 (5.3%) and the lowest lipid was found in Lentinula edodes-8 (3.9%).

**Crude fiber**
The fiber content of caps, stipes and whole fruiting body different strains of Lentinula edodes mushrooms is shown in Table 3. All the treatments contain a considerable number of fibers. The content of fiber in the cap and stipe of Lentinula edodes-8 were 12.3 % (w/w) and 15.6% (w/w) respectively. Similarly, the content of fiber in the cap and stipe of Lentinula edodes-16 were 11.43 % (w/w) and 14.19% (w/w) respectively. In case of whole fruiting body shown in table 4.5, the highest content of fiber wasfoundin the Lentinula edodes-8(28.3 %) and the lowest fiber was found in Lentinula edodes-16 (27.9 %).

In the **Table 3**, we can see that the caps of both Lentinula edodes-8 and Lentinula edodes-16 is showing higher protein and ash value. On the other hand, Stipes of both strains is showing higher carbohydrate and fiber value.

*Table 3: Distribution of proximate nutrient composition of caps and stipes in some strains of Shiitake mushrooms (g100 g-1dryweight).*

| Sample | Protein | Ash | Fat | Crudefibre | Carbohydrate |
|---|---|---|---|---|---|
| ***Lentinula edodes -8*** | | | | | |
| **Capes** | 14.56±0.4 | 3.5±0.2 | 2.6±0.2[a] | 12.3±0.6 | 13.3±0.5 |
| **Stipes** | 11.03±0.5 | 1.7±0.2 | 1.3±0.3[b] | 15.6±0.3 | 22.7±0.3 |
| ***Lentinula edodes -16*** | | | | | |
| **Capes** | 13.3±0.5 | 3.1±0.4 | 3.3±0.1 | 11.43±0.5 | 12.0±0.2 |
| **Stipes** | 10.09±0.4 | 1.5±0.2 | 2.0±0.3 | 14.19±0.3 | 20.9±0.3 |

**Carbohydrate**

The carbohydrate content of caps, stipes and whole fruiting body different strains of Lentinula edodes mushrooms is shown in Table 4. All the treatments contain a considerable amount of carbohydrates. The content of carbohydrate in the cap and stipe of Lentinula edodes-8 were 13.3 % (w/w) and 22.7 % (w/w) respectively. Similarly, The content of carbohydrate in the cap and stipe of Lentinula edodes-16 were12.0 % (w/w) and 20.9 % (w/w), respectively. In case of whole fruiting body shown in table 4.5, the highest content of carbohydrate was found in the Lentinula edodes-8 (37.4 %) and the lowest carbohydrate was found in Lentinula edodes-16 (33.9 %).

*Table 4: Distribution of proximate nutrient composition of whole fruiting body in some strains of Shiitake mushrooms (g100 g-1dryweight).*

| Sample | Protein | Ash | Lipid | Crudefibre | Carbohydrate |
|---|---|---|---|---|---|
| ***Lentinula edodes -8*** | 28.0± 1.4 | 5.20±0.8 | 3.9±1.2 | 28.3± 1.5 | 37.4 ± 2.3 |
| ***Lentinula edodes -16*** | 26.8±1.1 | 5.18± 0.6 | 5.3±1.4 | 27.9± 1.6 | 33.9± 1.9 |

As shown in **Table 4**, Lentinula edodes-8 contains higher amount of carbohydrate, protein and ash while Lentinula edodes-16 contains higher amount of total lipid. However, Ash and Fiber content are very much similar in the both strains of Shiitake mushroom.

Shiitake mushrooms are well-known edible ones with a high nutritional content. Shiitake mushrooms are very nutrient-dense. They contain 88–92% water, protein, lipids, carbs, and vitamins and minerals in their uncooked fruit bodies. It should be emphasized that nutritional and physiologically active chemical concentrations vary among strains and are influenced by the substrate, fruiting environment, and growing techniques. When compared to other regularly consumed vegetables, they offer a comparatively high nutritional content on a dry weight basis. According to statistical analysis, protein and ash contents in stipes of both Lentinula edodes-8 and Lentinula edodes-16 were significantly lower than in caps while carbohydrate, lipid and fiber contents in stipes were markedly higher than in caps.

These findings imply that shiitake stipes still contain essential nutrients, should not be ignored or discarded outright, and positively affect other food compositions. These findings may serve as inspiration for the development of novel functional foods (like high-fiber mushroom biscuits or chips) or the creation of new ingredients (such as flavoring agents). The high protein content of the caps contains some crucial amino acids that are vital for our bodies. Shiitake mushrooms are able to contain several important amino acids and have high-quality proteins, which can contribute to human nutrition. These elements in mushrooms were bioavailable in addition to ash contents having an impact on human mineral intake. In order to better utilize caps and stipes, it is vital to assess their distinctions generally. In case of the nutrition of the total fruiting body, L. edodes-8 strain contains slightly higher carbohydrate and protein content than the strain of Lentinula edodes-16. However, the fiber, ash and lipid content are almost similar in both of the strains. Statistical analysis shows higher nutrients value of L. edodes-8 than L. edodes-16. Shiitake mushrooms are believed to be beneficial for a wide range of disorders including different types of cancer, heart disease, hyperlipidemia (including high blood cholesterol), hypertension, infectious disease, and hepatitis due to their high nutritional value, which has led to numerous clinical studies in humans over the past 15-20 years. The mushroom is used medicinally to treat conditions like cancer, allergies to the environment, fungal infections (particularly Candida), recurrent colds and flu, bronchial inflammation, and urine incontinence. Shiitake mushrooms have been in high demand as they are used to boost the nutritional value of functional foods and beverages.

## Conclusion

Both the strains of shiitake mushroom (L. edodes – 8 and L. edodes -16) of the present study had been found as rich source of biomolecules and nutraceuticals. However, content of different biomolecules and nutraceuticals varied from strain to strain and also from part to part of the same strain. Both of these strains of shiitake mushroom would aid highly in fulfilling the nutritive support to the ever-increasing malnourished populace of Bangladesh as well as of the entire world.

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**Conflict of interest:** Authors declare no conflict of interest.

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