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Comparative Study of the Nutritional Composition of Oyster Mushrooms Cultivated in Bangladesh

Md. Asaduzzaman Khan, S.M. Ruhul Amin[1], Md. Nazim Uddin[1], Mousumi Tania and Nuhu Alam[2]*

Department of Biochemistry and Molecular Biology, Jahangirnagar University, Savar, Dhaka, Bangladesh

Abstract

The nutritional composition of six species of oyster mushrooms such as *Pleurotus sajor-caju, P. ostreatus, P. florida, P. cystidiosus, P. highking 51* and *P. geestaranus* was determined. The protein content was found highest in *P. sajor-caju* (24.5g/100g of dry weight) followed by *P. ostreatus, P. highking 51, P. florida, P. geestaranus* and *P. cystidiosus.* The highest lipid content was found in *P. cystidiosus* (5.5g/100g dry sample) followed by *P. highking 51, P. sajor-caju, P. florida, P. geestaranus* and *P. ostreatus.* The carbohydrate content was found highest in *P. geestaranus* (45.9g/100g dry sample) followed by *P. cystidiosus, P. florida, P. ostreatus, P. sajor-caju* and *P. highking 51.* The fiber content was found highest in *P. highking 51* (30.3 g/100g dry sample) followed by *P. ostreatus, P. florida, P. geestaranus, P. sajor-caju* and *P. cystidiosus.* The total ash content was found highest in *P. florida* (8.3 g/100g dry sample) followed by *P. sajor-caju, P. ostreatus, P. cystidiosus, P. highking 51* and *P. geestaranus.* Following these data the highest metabolizable energy was found in *P. cystidiosus* (262.8 kcal/100g dry sample) followed by *P. sajor-caju* (254.1 kcal/100g), *P. geestaranus* (252.7 kcal/100g), *P. florida* (250.1 kcal/100g), *P. highking 51*(249.7 kcal/100g) and *P. ostreatus* (242.6 kcal/100g). The moisture content of fresh oyster mushrooms was found 85-88%.

Key words: Oyster mushrooms, protein, lipid, fiber, carbohydrate, ash and metabolizable energy.

INTRODUCTION

Mushrooms are being recognized as important food items from ancient times. Their usage is being increased day by day for their significant role in human health, nutrition and disease. Although the history of mushroom cultivation is very recent in Bangladesh, its consumption is increasing rapidly in this country. Mushrooms of *Pleurotus* sp. are commonly called 'oyster mushrooms'. They are the second most popular mushrooms after button mushroom all over the world (Adejoye *et al.*, 2006) and the most popular in Bangladesh. Oyster mushrooms grow over a wide range of temperature of 15-30^0 C and hence are ideally suitable for cultivation under both temperate and tropical climatic conditions. In Bangladesh, oyster mushrooms are cultivated and harvested all over the year (Amin *et al.,* 2007). These mushrooms are the most prospective mushrooms of Bangladesh.

[1] National Mushroom Development and Extension Centre, Savar, Dhaka, Bangladesh.
[2] Department of Botany, Jahangirnagar University, Savar, Dhaka, Bangladesh.
* For correspondence: mmabotju@yahoo.com

Several species of oyster mushrooms are of highly medicinal importance. *Pleurotus sajor-caju* inhibits hypertensive effects through its active ingredients, which affect the renin-angiotensin system (Chang, 1996). *Pleurotus ostreatus* ameliorates atherogenic lipid in hypercholesterolaemic rats (Hossain *et al.,* 2003). *P. ostreatus* also possesses antitumor activity (Yoshioka *et al.,* 1985) and it has hypoglycaemic effects in experimentally induced diabetics (Chorvathoba, *et al.,* 1993) and human subjects (Khatun *et al.*, 2007). *Pleurotus florida* has antioxidant and antitumor activities in experimental animals (Manpreet *et al.,* 2004; Nayana & Janardhanan, 2000). Methanol extracts of *P. florida* inhibits inflammation and platelet aggregation (Nayana *et al.,* 2004). Water extracts of the fruiting bodies of *P. sapidus* have antibiotic activity especially on *Staphylococus aureus* (Gunde-Chimerman, 1999). *Pleurotus cystidiosus* is strong antioxidant (Li *et al*., 2007). These medicinal values of *Pleurotus* mushrooms are due to the nutritional or chemical composition of these mushrooms. However nutritional composition is affected by many factors including differences among strains, the composition of growth substrate, the method of cultivation, stage of harvesting, specific portion of the fruiting bodies used for analysis, time interval between harvest and measurement methods (Benjamin, 1995). Although many scientific research works have been conducted to determine the nutritional composition of different mushrooms in different culture conditions, it should require further research works to investigate the nutritional composition of mushrooms cultivated in Bangladesh especially different species of oyster mushrooms (*Pleurotus* sp.). With this aim, this research work has been designed.

MATERIALS AND METHODS

This study was carried out in the 'Quality Control and Quality Assurance' laboratory of National Mushroom Development and Extension Centre, Savar, Dhaka from February to April 2008.

Moisture determination: Moisture of fresh mushrooms was determined by using automatic moisture analyzer (Weighed moisture box. *A&D company ltd. N 92; P1011656; Japan*).

Determination of total protein: Five gram of grinded mushroom was taken with 50ml of 1N NaOH and boiled for 30 minutes. The solution was cooled in room temperature and centrifuged at 1000 × g by a table centrifuge machine (*DIGISYSTEM: DSC-200T; Taiwan*). The supernatant was collected and total protein content was measured according to the Biuret method (Burtis & Ashwood, 2006).

Determination of total lipid: Total lipid was determined by slight modified method of Folch *et al.* (1957). Five gram of grinded mushroom was suspended in 50ml of chloroform: methanol (2:1 v/v) mixture then mixed thoroughly and let stand for 3 days. The solution was filtrated and centrifuged at 1000 × g by a table centrifuge machine. The upper layer of methanol was removed by Pasteur pipette and chloroform was evaporated by heating. The remaining was the crude lipid.

Determination of crude fiber: Moisture and fat free sample was treated with 0.255N H_2SO_4 and 0.313N NaOH and then washed with ethanol and ether. It was then transferred to a crucible, dried overnight at 80-100^{0}C and weighed (W_1) in an electric balance (*KEY1: JY-2003; China*). The crucible was heated in a muffle furnace (*Nebertherm: Mod-L9/11/c6; Germany*) at 600^{0}C for 6 hours, cooled and weighed again (W_2). The difference in the weights (W_1-W_2) represents the weight of crude fiber (Raghuramalu *et al.,* 2003).

$$\text{Crude fiber (g/100g)} = \frac{[100-(\text{moisture} + \text{fat})] \times (W_1-W_2)}{\text{Weight of sample}}$$

Determination of total ash: One gram of the sample was weighed accurately into a crucible. The crucible was placed on a clay pipe triangle and heated first over a low flame till all the material was completely charred, followed by heating in a muffle furnace for about 6 hours at 600^{0}C. It was then cooled in a dessicator and weighed. Then total ash was calculated as following equation (Raghuramalu *et al.,* 2003):

$$\text{Ash content (g/100g)} = \frac{\text{Weight of ash} \times 100}{\text{Weight of sample taken}}$$

Determination of total carbohydrate: The content of the available carbohydrate was determined by the following equation (Raghuramalu *et al.,* 2003):

Carbohydrate (g/100g sample) =

[100 – (Moisture + Fat + Protein + Ash + Crude Fiber)]

Determination of metabolizable energy content: Fat, protein or carbohydrates can supply energy. Metabolizable energy is calculated as the following formula:

$$\text{ME (Kcal /100g)} = [(3.5 \text{ X CP}) + (8.5 \text{ X CF}) + (3.5 \text{ X NFE})]$$

Where, ME = Metabolic Energy; CP = % Crude Protein; CF = % Crude Fat; NFE = % Nitrogen Free Extract (carbohydrate)

RESULTS AND DISCUSSION

The moisture contents of oyster mushroom were found 85-88% (Table 1) with no significant difference at P≤0.05 level. The highest moisture content was found in *P. florida* followed by *P. sajor-caju, P. ostreatus, P. cystidiosus, P. geesteranus* and *P. highking* 51.

The nutritional composition of different oyster mushrooms is shown in Table 2. The protein content was found highest in *P. sajor-caju* (24.5g/100g of dry weight) followed by *P. ostreatus* (23.5g/100g), *P. highking 51* (21.9g/100g), *P. florida* (20.6g/100g), *P. geestaranus* (19.0g/100g) and *P. cystidiosus* (17.7g/100g). The variation in protein content between *P. sajor-caju* and *P. cystidiosus* is significant at P≤0.05.

Table 1. Moisture content of different oyster mushrooms

Mushroom species	Moisture (%)
Pleurotus sajor-caju	87.2 ± 0.5
Pleurotus ostreatus	86.5 ± 0.8
Pleurotus florida	87.4 ± 1.1
Pleurotus cystidiosus	86.5 ± 0.8
Pleurotus highking 51	85.6 ± 0.9
Pleurotus geestaranus	85.9 ± 1.0

Results show mean ± SEM of 5 trials.

Table 2. Nutritional composition of oyster mushrooms (g/100g of dried sample)

Mushroom species	Protein	Lipid	Carbohydrate	Fiber	Ash
P. sajor-caju	24.5±2.9^{a}	4.0±0.6^{a,b}	37.2±4.2	26.2±2.0	8.0±0.3^{a}
P. ostreatus	23.5±2.8^{a,b}	2.6±0.2^{b}	39.4±5.9	27.0±2.2	7.4±0.9^{a}
P. florida	20.6±2.6^{a,b}	3.9±0.2^{a,b}	40.3±4.5	26.8±1.9	8.3±0.2^{a}
P. cystidiosus	17.7±0.6^{b}	5.5±2.0^{a}	44.0±1.6	25.5±1.7	7.4±0.5^{a}
P. highking 51	21.9±0.6^{a,b}	5.2±0.1^{a,b}	36.9±2.2	30.3±1.3	5.7±0.6^{b}
P. geestaranus	19.0±1.2^{a,b}	3.0±0.3^{a,b}	45.9±1.7	26.3±0.5	5.7±0.2^{b}

The results are the mean ± SEM of 5 trials. Values in the same column that do not share a common superscript are significantly different at P≤0.05 (Duncan's multiple range test).

The highest lipid content was found in *P. cystidiosus* (5.5g/100g dry sample) followed by *P. highking* 51 (5.2g/100g), *P. sajor-caju* (4.0g/100g), *P. florida* (3.9g/100g), *P. geestaranus* (3.0g/100g) and *P. ostreatus* (2.6g/100g). The variation in lipid content between *P. cystidiosus* and *P. ostreatus* is significant at P≤0.05.

The carbohydrate content was found highest in *P. geestaranus* (45.9g/100g dry sample) followed by *P. cystidiosus* (44.0g/100g), *P. florida* (40.3g/100g), *P. ostreatus* (39.4g/100g), *P. sajor-caju* (37.2g/100g) and *P. highking 51* (36.9g/100g). The variation in carbohydrate content between different species of mushrooms is not statistically significant at P≤0.05.

The fiber content was found highest in *P. highking 51* (30.3 g/100g dry sample) followed by *P. ostreatus* (27.0g/100g), *P. florida* (26.8g/100g), *P. geestaranus* (26.3g/100g), *P. sajor-caju* (26.2g/100g) and *P. cystidiosus* (25.5g/100g). The variation in fiber content between different species of mushrooms is not statistically significant at P≤0.05.

The total ash content was found highest in *P. florida* (8.3 g/100g dry sample) followed by *P. sajor-caju* (8.0g/100g), *P. ostreatus* (7.4g/100g), *P. cystidiosus* (7.4g/100g), *P. highking 51* (5.7g/100g) and *P. geestaranus* (5.7g/100g). The total ash content of first four types differs with the last two significantly at P≤0.05.

Using these data the highest metabolizable energy was found in *P. cystidiosus* (262.8 kcal/100g dry sample) followed by *P. sajor-caju* (254.1 kcal/100g), *P. geestaranus* (252.7 kcal/100g), *P. florida* (250.1 kcal/100g), *P. highking 51*(249.7 kcal/100g) and *P. ostreatus* (242.6 kcal/100g) [fig 1]. The difference in metabolizable energy content is not statistically significant at P≤0.05.

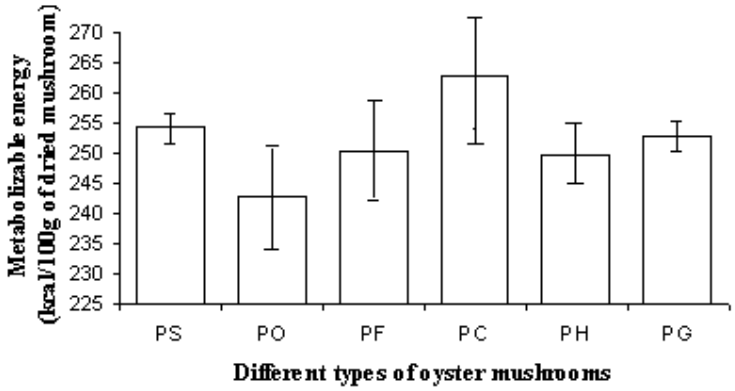

Fig. 1. Metabolizable energy content of different oyster mushrooms (kcal/100g of dried sample). The results are the mean ± SEM of 5 trials

The protein and lipid content of *P. sajor-caju, P. ostreatus, P. florida* found in this study is near about similar to the findings of Rai and Sohi (1988) and Alam *et al.* (2007). But carbohydrate, fiber and ash content are different from the report of Rai and Sohi (1988), however relevant to Alam *et al*. (2007). Protein content in *P. sajor-caju* is also similar to the findings of Banik and Nandi (2004) and protein, carbohydrate, fat and metabolizable energy value of *P. florida* is relevant to the findings of Shashirekha *et al*. (2005).

The present study suggests that oyster mushrooms differ from each other in nutritional composition although they are of same genus, however each species are nutritious with high protein and fiber value with low fat. Hence fruiting bodies of oyster mushrooms can be taken regularly as a protein supplement or as an alternative to fish and meat. Vegetarians could also eat mushrooms because it might serve as alternative protein supplements in their diet. The low lipid and high fiber contents of the oyster mushrooms make it health beneficial food items especially against heart diseases and diabetes.

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