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Nutritional analysis of different *Pleurotus* species grown on wheat straw and finger millet straw

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Oyster mushroom is one of the most important edible mushrooms cultivated in India. The nutritional parameters in present investigationof oyster mushroom species *viz., P. florida, P. flabellatus, P. ostreatus, P. sapidus, P. sajor-caju* and *P. eryngii*were tested. The *Pleurotus* species grown on wheat straw substrate showed maximumamount of moisture (88.73 %)in *P.flabellatus*, ash (1.20 %) in *P. sajor-caju*, protein (3.54 g) in *P. sapidus* and carbohydrates (5.47 g) in*P. flabellatus*. In other way finger millet straw showed maximum amount of moisture (88.25 %) in *P. ostreatus*, ash (1.18 %) in *P. florida*, protein (3.33 g) in *P. ostreatus*and carbohydrates(5.13 g) in *P. ostreatus*.

Key words: Ash, carbohydrate,moisture, oyster mushroom, *Pleurotus* species, protein

INTRODUCTION

Mushrooms are rich in proteins, vitamins, and minerals and popularly called as the vegetarian's meat. *Pleurotus* species are popular and widely cultivated throughout the world mostly in Asia andEurope owing to their simple and low cost production technology and higher biological efficiency (Mane *et al.*2007). Tiwari and Ravi (2020)they haveobserved growth behavior and yield potential of *Pleurotus* species on wheat straw as substrate.Tiwari *et al.* (2019) they have also found the performance of *P.florida* on different substrates.*Pleurotus* mushroom is considered as a good source of nutrition, because of the presence of high amount of proteins, vitamins and minerals. Apart from having high nutritional value, it also possesses medicinal properties because of low fat and cholesterol content Agarwal *et al.* (2017).Oyster mushroom fresh fruiting bodies indicates a high quality of moisture (90.8%), where dry aswell as fresh oyster mushrooms are rich in carbohydrate (57.6%), protein (30.4%), fiber (8.7%), fat (2.2%) and ash (9.8%) with 345 kilocalories energy value on 100g dry weight (Iqbal *et al.* 2016).

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Oyster mushroom contains most of the mineral salts required by human body, such as K, Na, P, Fe and Ca. In the present study *Pleurotus*spp. were cultivated in the mushroom house to determine nutritional parameters (*viz.,*moisture, ash, carbohydrates and protein) separately grown on two substrates *i.e.*wheat straw and finger millet straw substrates.

MATERIALS AND METHODS

The experiment was carried out at Plant Pathology laboratory, Mushroom Research Unitand Food Technology Laboratory, College of Horticulture, VCSG UUHF,Bharsar(Pauri Garhwal) Uttarakhand. Six *Pleurotus* species *viz.,Pleurotus florida, P.flabellatus, P.ostreatus, P. sapidus, P.sajor-caju* and *P.eryngii* were grown firstly on two substrates *viz.,* wheat straw (WS) and finger millet straw (FMS) and after wards further used for nutritional parameters analysis.

Moisture analysis

Moisture content was determined by using air oven official method 925.10 (AOAC, 1995). 5 g of fresh mushroom sample was taken in a clean, pre- dried (at 130ºC for 20 min) and pre- weighed Petri- plate. The samples were then dried in an oven at 130±

2ºC for 2 hours till a constant weight was obtained and cooled in desiccators. After cooling, the loss in weight was taken as moisture content and expressed in terms of percentage.

$$\text{Moisture per cent} = \frac{W_2 - W_3}{W_2 - W_1} \times 100$$

where, W_1 = Weight of empty Petriplate,
W_2 = Weight of Petriplate + sample before drying
W_3 = Weight Petriplate + sample after drying

Estimation of total ash (%)

The ash content was determined using direct official method 923.03 (AOAC, 1995). 5 g sample was weighed in a pre- dried porcelain dish and ignited on flame till the fuming ceased and then it was cooled in the desiccator and weighed soon after reaching room temperature. The dish was then transferred to a muffle furnace at 600ºC for 3 hours and subsequently cooled in a desiccator. The weight of the residue was noted and the per cent ash was calculated as follows.

$$\text{Ash per cent} = \frac{W_2 - W_1}{W} \times 100$$

where, W_1 = Weight of crucible (before incineration), W_2 = Weight of crucible + Weight of sample (after incineration), W = Weight of sample

Estimation of protein

Test sample 5 g of fresh mushroom was weighed and homogenized with 50 mL of phosphate buffer (0.1 M) in mortar pestle. After complete grinding sample was filtered with Whatman filterpaper No.1 and 5 mL of filtered sample was pipette out and mixed with 50 mL of NaOH (0.1 N), then the mixture was boiled for 15-20 min and kept it at room temperature for cooling. 0.2 mL of test protein sample was taken along with 2 mL of alkaline copper sulphate and 0.1 mL of folin reagent (1 N) in a test tube and absorbance was read at 660 nm. Protein content was measured according to the method given by Lowry *et al*. (1951).

Estimation of carbohydrate

The procedure for carbohydrates estimation was carried out according to an experimental biochemistry laboratory manual, Anonymous (2005). Sample 5 g was clarified with 25 mL of 80% ethanol. About 0.5mL of the clarified solution was taken in a 100 mL volumetric flask and diluted till 100 mL mark with distilled water. From the sample solution, 1 mL was taken in a test tube, then 1 mL of 5% phenol solution and 5 mL of 96% H_2SO_4 were added. The sample was cooled to room temperature by keeping in a water bath at 25- 30ºC for 20 min. The absorbance of the prepared sample was observed at 515 nm using a spectrophotometer. The concentration of carbohydrate in the sample was determined using standard graph curve.The data were obtained in crop room condition and analyzed by using simple CRD (Complete Randomized Design) and with the help of OPSTAT software.

RESULTS AND DISCUSSION

Nutritional parameters of mushrooms were measured after being grown on wheat straw and finger millet straw as substrates.The experiment was carried out to check the nutritional parameters *viz.,* moisture, ash, protein and carbohydrates present on different *Pleurotus* spp. grown on wheat straw and finger millet straw substrate, the data presented in (Tables 1 and 2). Earlier found among the *Pleurotus* species, *P. florida* gave higher yield 872.24 with Biological efficiency *i.e.* 87.22% on wheat straw showed in comparison to 802.29 g with B.E. 80.22% on finger millet straw.After the harvesting of the mushroom for the nutritional status of the *Pleurotus* species. On the basis of nutritional value again wheat straw was found most effective for *Pleurotus* species in comparison to finger millet straw and data presented.

Moisture

In present investigation 85-90% moisture content was found in all *Pleurotus* species, the data presented. On wheat straw(WS) among the treatments, highest amount of moisture was found in *P. flabellatus* (88.73 %) which was found statistically at par with *P. ostreatus* (88.55%) while minimum was found in *P. sajor-caju* (87.00%).Infinger millet straw(FMS)maximum amount of moisture was reported in *P. ostreatus* (88.25 %) which was found statistically at par with *P. eryngii* (88.00 %), *P. flabellatus* (87.98 %), *P. sapidus* (87.65 %), with *P. florida* having minimum amount of moisture (86.95%). Moisture is water or other liquid diffused in a small quantity as vapor, within a solid or condensed on a surface. It is a

Table. 1: Nutritional parameters of *Pleurotus* species grown on wheat straw

Treatments	Moisture (%)	Ash (%)	Protein (g/100g)	Carbohydrate (g/100g)
Pleurotus florida	87.50±0.14	1.19±0.01	3.50±0.10	4.11±0.15
Pleurotus flabellatus	88.73±0.24	1.08±0.00	2.33±0.03	5.47±0.02
Pleurotus ostreatus	88.55±0.24	1.09±0.03	2.89±0.34	5.21±0.14
Pleurotus sapidus	87.83±0.06	1.16±0.00	3.54±0.18	4.37±0.06
Pleurotus sajor-caju	87.00±0.41	1.20±0.00	3.28±0.03	3.80±0.22
Pleurotus eryngii	87.29±0.55	1.11±0.00	3.08±0.04	4.33±0.18
Mean	87.81	1.13	3.10	4.54
SE(d)	0.45	0.01	0.23	0.21
CD(p=0.05)	0.96	0.04	0.49	0.44

Table. 2 : Nutritional parameters of *Pleurotus* species grown on finger millet straw

Treatments	Moisture (%)	Ash (%)	Protein (g/100g)	Carbohydrate (g/100g)
Pleurotus florida	86.95±0.21	1.18±0.01	3.02±0.06	3.97±0.19
Pleurotus flabellatus	87.98±0.32	1.15±0.01	2.84±0.04	4.61±0.08
Pleurotus ostreatus	88.25±0.04	1.11±0.01	3.33±0.07	5.13±0.18
Pleurotus sapidus	87.65±0.21	1.14±0.01	3.30±0.16	4.50±0.15
Pleurotus sajor-caju	87.10±0.26	1.13±0.01	2.97±0.02	4.00±0.09
Pleurotus eryngii	88.00±0.32	1.17±0.01	2.29±0.07	4.77±0.06
Mean	87.66	1.15	2.94	4.49
SE(d)	0.35	0.02	0.12	0.19
CD(p=0.05)	0.75	0.04	0.25	0.40

very important character of any fresh mushroom, since it provides freshness of any mushroom. There was a slight difference in moisture content of *Pleurotus* species when grown in two different substrates. On the basis of data of moisture content of *Pleurotus* species, it was observed that when grown on wheat straw substrate was higher which may be due to good water holding capacity of substrate. *Pleurotus* species grown on finger millet straw showed low amount of moisture in comparison to wheat straw which may be due to poor water holding capacity of substrate. Higher water holding capacity of substrate will always favour higher moisture content. Moisture content of mushroom was also influenced by age of mushroom, growing environment, mushroom strain and postharvest environment.Related work was done by Patil *et al.*(2010) and alsoAshraf *et al.*(2013).The moisture percentage as reported by different researchers for different species are as follows *P. sajor-caju*- 90% (Gogavekar*et al.*2014) ; *P. ostreatus*- 86%, *P. sajor-caju*- 87%, *P. florida*- 87.5% (Alam*et*

*al.*2008) and *P. ostreatus*- 90%, *P. sajor-caju*-90% (Akyuz and Kirbag, 2010).

Ash

On wheat straw ash is also one of the most important physical factors which indicates the presence of mineral element in test sample. Highest amount of ash was found in *P. sajor-caju*(1.20%) which was found statistically at par with *P. florida* (1.19%) while minimum was found in *P. flabellatus* (1.08 %). In finger millet straw,maximum ash content among the treatments was found in *P. florida* (1.18 %) which was found statistically at par with *P. eryngii* (1.17 %) and *P. flabellatus* (1.15 %) while minimum was found in *P. ostreatus* (1.11 %). Ash content in mushrooms are the inorganic matter remains when the organic matter has been burnt away at very high temperature (600ºC). Ash content may vary due to presence of minerals in test sample. Ash content of any fresh test sample also depends on the amount of moisture; higher moisture content leads to less ash content whereas lower amount of moisture leads to higher ash content. Bonatti *et al.* (2004)observed 5.58 % ash in *P. ostreatus,* while Alam*et al.* (2008)obtained 1.18% ash in *P. ostreatus*. Similar results have also been reported by Patil *et al.* (2010) and Ashraf *et al*.(2013).

Protein

On wheat straw a significant difference in protein content was found among all the treatments. The species with abundant amount of protein was *P. sapidus* (3.54 g) which was found statistically at par with *P. florida* (3.50 g) and *P. sajor-caju* (3.28 g), while minimum was found in *P. flabellatus* (2.33 g). In finger millet straw,the data revealed that maximum amount of protein content was found in *P. ostreatus* (3.33 g) which was found statistically at par with *P. sapidus* (3.30 g) while minimum amount of protein was found in *P. eryngii* (2.29 g).Raghunathan and Swaminathan (2003) reported that three species of *Pleurotus, ie., P. sajor-caju, P. platypus* and *P. citrinopileatus*were cultivated on different agro-wastes-cotton stalk, coir fibre, sorghum stover and mixtures of these wastes. The primordial initiation day was observed between the 21st and 30th day after spawning. The yield was maximum on cotton stalks in *P. sajor-caju*, *P. citrinopileatus* and *P. platypus* yielded the maximum on sorghum stover. The biological efficiency, nutrient composition, energy value and energy recovery of the fruit bodies were estimated. Ahmed *et al.* (2009) observed 21% protein in case of *P. florida.*Helaly*et al.* (2016) reported that rich source of protein helps in good health and muscle building,such as that found in *P.ostreatus* (2.62 g/ 100g) grown in wheat straw. Hoa and Wang (2018) observed that differences in protein contents of mushrooms grown in different substrates could be due to the varying nitrogen content of substrate. High nitrogen content of substrate contributes to higher protein content of fruiting bodies. Such work was in conformity with those of previous workers (Patil *et al.* 2010;Ashraf *et al.*2013).As result indicates wheat straw contain slightly high amount of protein in comparison to finger millet straw because may be wheat straw contain higher amount of nitrogen in comparison to finger millet straw. Variation in protein content among the different *Pleurotus* species may be due to their inbuilt characters.

Carbohydrate

On wheat straw carbohydrate is one of the major biochemical parameter and significant variation was observed in quantity of carbohydrate was found. The maximum quantity of carbohydrate was observed in *P. flabellatus* (5.47 g) which was found statistically at par with *P. ostreatus* (5.21 g) while minimum quantity of carbohydrates was found in *P. sajor-caju* (3.80g). In finger millet straw, a significant variation was observed in amount of carbohydrate was found. The maximum amount of carbohydrate was recorded in *P. ostreatus* (5.13 g) which was found statistically at par with *P. eryngii* (4.77 g), while minimum amount of carbohydrates was found in *P. florida* (3.97g).The amount of carbohydrates was observed differ according to species but this difference also depends on substratum, atmospheric condition, age and part of fruiting body. Carbohydrates content may also depend on cellulose, hemicelluloses and carbon content of substratum. Alam *et al.* (2008)also reported similar findings (5.1g) in case of *P. ostreatus.* Das *et al.* (2015) have reported that protein, carbohydrate and polyphenol concentration were maximum in *P. ostreatus* and lowest in *P. florida.*

CONCLUSION

Among the substrates,wheat straw was found most effective for growth and yield performance of

Pleurotus species. Nutritional parameters basedon wheatstraw was found most effective for *Pleurotus* species *i.e.*showed higher moisture, ash, protein and carbohydrate. When finger millet straw was used as substrate, moisture, ash, protein and carbohydrate was slightly low in comparison to wheat straw.

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