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Performance of different substrate on the production and nutritional composition of blue oyster MUSHROOM (*Hypsizygus ulmarius* (Bull.:Fr.) Redhead)

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Abstract
The research experiment was carried out to investigate the cultivation of *Hypsizygus ulmarius* on different substrates. The objective of this study was to evaluate the best alternative substrate (wheat straw, sarpat, banana leaves, bamboo leaves, sawdust, and doob grass and bajra dry stem) that supports the growth of mushroom and produces the maximum yield with highest biological efficiency and nutritional content. Data relating to the time taken for complete spawn running, pin head initiation, days to maturity of the fruiting bodies, stipe length, pileus width, total yield and biological efficiency as well as the protein and carbohydrate content of the mushroom was recorded and analyzed. A total of seven treatments replicated six times were taken under the complete randomized design. The minimum time taken for complete mycelium run (19.33 days) was in T_3 (wheat straw + banana leaves) and maximum time was observed in T_6 (wheat straw + doob grass) (23.16 days). Minimum time from primordial stage to harvesting stage was recorded in T_3 (wheat straw + banana leaves) (25.83 days) and maximum time was recorded in T_6 (wheat straw + doob grass) (27.33 days). Maximum yield was obtained in T_3 (wheat straw + banana leaves) (936.6 g) with highest biological efficiency (93.66%). Maximum protein content as recorded in T_3 (wheat straw + banana leaves) (35%) and maximum carbohydrate in T_3 (wheat straw + banana leaves) (25.33%). Therefore, it can be concluded that Banana leaves substrates in combination proved to be best for cultivation of *Hypsizygus ulmarius*.

Keywords: *Hypsizygus ulmarius*, lignocellulosic substrates, growth, yield and nutrient content

Introduction
Mushroom are those fungi that have a stem (stipe), a cap (pileus), and gills (lamellae) or pores on the underside of the cap. The main body of fungi is situated on the substrate and consists of a network of branched hyphae (thread-like structures), which form the fungal mycelium**.** According to (Shivashankar and Premkumari, 2014) [4] out of the 10,000 known species of mushrooms, 2000 are safe for humans and about 300 of them have medicinal properties. *Hypsizygus ulmarius* commonly called as “Elm oyster” or “Blue oyster” is similar to oyster mushroom, but differ in morphology and biological efficiency. Volk (2003) [5] reported that *H. ulmarius* was first named as *Pleurotus ulmarius* and later put under genus *Hypsizygus* as *Pleurotus* spp. cause white rot and *Hypsizygus* spp. cause brown rot. Blue oyster mushroom appear as a good source of several vitamins (thiamine, riboflavin, niacin, ascorbic acid, vitamin A, B, C, D) and mineral (sodium, potassium, calcium, iron, etc). Mushrooms are classified as functional foods due to its properties like antibacterial, antihypertensive, anti-hypercholesterolemia, detoxification, hepatoprotective, anti-diabetic properties, anti-parasitic,

antitumor, anti-viral and also have an ability to maintain the blood cholesterol at the optimum level preventing cardiovascular diseases (Chioza, 2014) [1]. Different substrate like wheat straw, sarpat, bajra dry stem, banana leaves, bamboo leaves, sawdust and doob grass were evaluated for growth, yield and nutritional content of *Hypsizygus ulmarius* due to the varied nature and nutrient content of the substrates. *Hypsizygus ulmarius* help in an efficient management of straw by degradation of lignin, cellulose, and hemicellulose other than *Pleurotus* spp.

Materials and methods

All research work was done at Laboratory and Mushroom Crop Room, Department of Plant Pathology whereas Biochemical analysis at the Department of Agronomy and Soil Science, during the period of Oct. 2018 - Feb. 2019.

Wheat straw, sarpat, doob grass, bajra dry stem, banana leaves, leaves bamboo were collected from local areas and sawdust was procured from the Mehawa wood mill. The mushroom crop room was cleaned with plain water 2 to 3 times, white wash and complete sterilization with 0.2% formaldehyde to complete fumigation of the crop room. Hundred litres of tap water was filled in plastic drum mixed with bavistin (0.03%), calcium carbonate (2 gm) and formalin (2%) to make solution with water. The substrates were put in plastic drum, after sterilization the excess water was drained out and sixty per cent moisture content in the substrate. The polythene bags were used for cultivation of mushroom. The spawn was thoroughly broadcasted @ 6% (60 g/kg) of substrates. Seven treatments of 2.0 kg wet substrates was used which was equally divided in six bags representing each as replication. The temperature of the crop room was maintained at 25-26 ^{0}C and relative humidity at about 70-80%. After 3-5 days of removal of polythene bags small pinhead appeared on all sides of bags. The harvested fruiting bodies was weighed and data was recorded treatment wise at complete spawn run (days), pinhead formation (days), fruiting bodies formation (days), stipe length (cm), pileus width (cm), yield (g), biological efficiency (%), protein (%) and carbohydrate (%).

Result and discussion

The minimum spawn running days were recorded in T_3 (wheat straw + banana leaves) (19.33 days). Mondal *et al.* (2010) found, the presence of right proportion of alpha-cellulose, hemicellulose and lignin was responsible for higher mycelium running rate. The minimum time taken from stimulation of primordial initiation was recorded in T_3 (wheat straw + banana leaves) (22.83 days). The minimum days taken from primordial stage to harvesting stage was recorded in T_3 (wheat straw + banana leaves) (25.83 days). The maximum stipe length of mushroom was recorded in T_2 (wheat straw + bajra dry leaves) (11.17 cm). The maximum width of pileus was recorded in T_2 (wheat straw + bajra dry stem) (8.33 cm). The chemical composition of the agricultural wastes, single or mixtures used in preparing the mushroom substrates may be responsible for change in the stipe length and overall yield of the mushrooms grown in the different farm substrates was reported by Neupane *et al.* (2018) [2]. The maximum yield was recorded in the treatment T_3 (wheat + banana leaves) (936.6 g/ 2kg) and the minimum yield was recorded in T_5 (wheat + sawdust) (665g/ 2kg) of the wet weight of the substrate. The maximum biological efficiency was observed in T_3 (wheat straw + banana leaves) (93.66%). The maximum protein content was recorded in T_3 (wheat straw + banana leaves) (31.50%). The maximum carbohydrate content was recorded in T_3 (wheat straw + banana leaves) (22.67%). The total carbohydrate content found in *Hypsizygus ulmarius* (30.24% - 42.26%) was reported by Patil *et al.* (2010) [3]. The variation in carbohydrate content may be due to fiber, such as the structural polysaccharides, glucans, chitin, hemicelluloses and pectic substances.

Table 1: Efficacy of different substrate of *Hypsizygus ulmarius* on spawn run (days), pinhead formation (days), length of stipe (cm), width of pileus (cm), fruiting body formation (days), yield (gm), biological efficiency (%), protein (%) and carbohydrate (%).

Treatments	Spawn run(days)	Pinhead (days)	Fruiting body (days)	Length of stipe (cm)	Width of pileus(cm)
Wheat (T_0)	**18.33**	**21.33**	**24.67**	9.17	6.33
Wheat + sarpat (T_1)	21.33	25.33	29.33	7.50	5.67
Wheat + bajra dry stem(T_2)	20.66	24.16	28.17	**11.17**	**8.33**
Wheat+ banana leaves (T_3)	19.33	22.83	25.83	9.50	7.67
Wheat+bamboo leaves (T_4)	19.33	23.16	26.17	10.33	7.33
Wheat+ sawdust (T_5)	20.33	24.33	28.33	7.50	6.50
Wheat+doob grass (T_6)	23.16	27.33	31.33	7.50	6.00
F-test	**S**	**S**	**S**	s	**s**
S. Ed. (±)	0.31	0.99	0.35	0.53	0.41
CD(0.05)	0.63	0.73	0.72	1.07	0.83
Treatments	**Yield (gm)**	**B.E (%)**	**Protein (%)**	**Carbohydrate (%)**	
Wheat (T_0)	791.6	79.17	25.03	22.67	
Wheat + sarpat (T_1)	758.3	75.83	22.46	20.33	
Wheat + bajra dry stem(T_2)	841	84.17	26.54	21.67	
Wheat+ banana leaves (T_3)	**936.6**	**93.67**	**31.50**	**25.33**	
Wheat+bamboo leaves (T_4)	875	87.50	23.62	23.66	
Wheat+ sawdust (T_5)	665	66.50	19.25	18	
Wheat+doob grass (T_6)	682.5	68.25	21.58	16.33	
F-test	**s**	**s**	**s**	**s**	
S. Ed. (±)	34.74	3.47	1.22	0.73	
CD(0.05)	70.94	7.09	2.66	1.60	

Conclusion

It can be concluded that banana leaves enhanced the productivity and nutritional content of *Hypsizygus ulmarius*. Since, the combination of wheat straw and banana leaves @ 1:1 recorded minimum spawn run (days), pinhead initiation (days), fruiting bodies formation (days) and maximum yield (g/ kg wet weight substrates), biological efficiency (%), protein content (%) and carbohydrate (%). The results of the present study are of one crop season (October 2018- February 2019) at Prayagraj (U.P.) as such to validate the findings more such trials should be carried out in future.

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