CULTIVATION OF OYSTER MUSHROOM USING DIFFERENT SUBSTRATES

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Abstract: Mushroom is an edible macro fungus which is cultivated in many countries by using agricultural wastes. The cultivation of Mushroom is a bioconversion process of agro based ligno cellulosic wates and residues. Mushroom cultivation resembles with Sustainable farming as they use agro wastes for their growth. The objective of the present study is to produce spawns from different substrates like Sorghum, Pearl Millet and Wheat grains and to cultivate Oyster mushroom *Pleurotus ostreatus* using various substrates such as Paddy straw, Corn straw, Corn cob and Sugarcane bagasses. The amount of spawn produced from sorghum is more when compared with pearl millet and wheat grains. The mushroom produced from sugarcane bagasses showed faster growth followed by paddy straw, corn cob and corn straw.

Key words- Mushroom, Nutritional content, *Pleurotus ostreatus,* Spawns, Substrates.

I. INTRODUCTION

Fungi are the group of organisms which lack the ability to utilize sun rays directly for the production of food as they lack chlorophyll. They depend on other organisms for food by absorbing nutrients from the organisms they live. Mushrooms are edible macroscopic fungi which have fleshy fruiting bodies (Alexopoulos *et al*., 1996). They are a rich source of carbohydrates, proteins, vitamins and minerals (Ananbeh, 2003) and are commonly produced worldwide (Madbouly and Al-Hussainy, 1996). Mushrooms can grow on decayed organic matters which are rich in lignin, cellulose and other carbohydrates whereas oyster mushroom requires less nitrogen and more carbon source.

A huge amount of agro based ligno cellulosoic crop residues and byproducts are generated annually. The production of these wastes can cause environmental and many health problems (Garg and Gupta, 2009). The need for nutrition rich food and the management of agricultural residues paved the way for mushroom cultivation. Mushroom cultivation is an appropriate bioconversion of lignocellulosic wastes (Chang and Miles, 1992). Mushrooms provide people with high quality proteins, minerals and vitamins. They are highly nutritious and can be compared with eggs, milk and meat. They are easily digestible as they have no cholesterol (Oei, 2003).

Oyster mushrooms are the group of mushroom belonging to the genus *Pleurotus* and the family Pleurotaceae. They possess number of therapeutic properties like anti-inflammatory, immunostimulator and anticancer activity, immunomodulatory, ribonuclease activity, etc. (Yashvant patel, 2012). The present study is to prepare spawns from various substrates and to cultivate mushroom from different substrates.

II. MATERIALS AND METHODS

2.1 Pure Culture preparation:

Mushroom culture was grown on Malt Extract Agar medium for 7 days. MEA medium was prepared, sterilized and allowed to solidify in a slant position. After solidification, a piece of fleshy tissue of *Pleurotus*

ostreatus was aseptically transferred to individual MEA slants in laminar airflow chamber. After inoculation, the cultures were incubated at 25 °C until sufficient growth is obtained. The slant culture were transferred to perti plates containing MEA medium and incubated at 25 °C for 7 days. After 7 days, the mycelia growth covers the agar medium and the culture was used for spawn preparation (Girmay, *et al.*, 2016).

2.2 Preparation of spawn:

Different types of spawns are produced from different substrates like Sorghum, Pearl millet, and Wheat. The grains were thoroughly washed and soaked in water for 24 hours and then sieved (Amuneke, 2011). After overnight soaking, 5 kg of grain (Sorghum, Pearl millet, and Wheat) were taken in a vessel with 7500 ml of water respectively. It was boiled for about 15 minutes and allowed to cool for 15 minutes. After that, the spawns were dried in cotton cloth. 60g of Gypsum (CaSO4.2H2O) was added with 15g of ground limestone (CaCO3) and mixed well. The grains were packed into polypropylene bags. Each bag contains 300-350 g of the prepared grain and was packed tighty (Mondal, 2010). The packed bags were then autoclaved at 121°C (Buah, 2010). The autoclaved bags were cooled for 24 hours. Then, the bags were inoculated with pure culture of *Pleurotus ostreatus* in laminar air flow chamber (Ayodele and Okhunya, 2007). Once inoculated, the bags were incubated at 25°C for 15 days. After 15 days, the spawns were ready to use (Patil, *et al.*, 2012).

2.3 Processing of Substrate and preparation of mushroom bed:

Different substrates like paddy straw, corn straw, corn cob and sugarcane bagasses were taken. They were dried under sunlight for 10-12 days. After drying, the substrates were subjected to overnight soaking. Then, the substrates were drained off and autoclaved for 1 hour. After sterilization, they were shade dried. Then the substrates were packed in polypropylene bags and spawns were added correspondingly. Later, it was pressed gently, and the bags were sealed for spawn development. Then, small holes were made into the bags for respiration of the mycelium. Spawned bags were placed in closed position with the temperature of about 25°-35°C and humidity was maintained by spraying water twice in a day (Oei, 2003). Maintaining adequate moisture content favours mushroom growth (Abdul, 2011). The mycelia start to develop after inoculation.

2.4 Data collection and analysis

The growth and development of mushroom were monitored daily. The number of days required from inoculation to the formation of mycelium, and time required till the first round harvesting were recorded. Growth parameters like stipe length (cm), stipe diameter (cm), pileus diameter (cm), and pileus thickness (cm) were recorded with a slide caliper before each harvest. Yield parameters, such as number of fruiting bodies per bunch, and total fresh weight (g) of mushroom were also recorded at harvest time. Matured fruiting bodies (white in color, with up curved pileus) were harvested with a sharp blade. Two rounds of mushroom harvests were made across all substrate types in the course of the experiment. Yield and biological efficiency were calculated to evaluate the growth performance of mushroom on different substrates. Accordingly, biological yield (g) was determined by weighing the whole cluster of fruiting bodies without removing the base of stalks, and economic yield (g) was determined by weighing all the fruiting bodies on a substrate after removing the base of stalks. Finally, Biological efficiency was calculated by

$$\%BE = \left(\frac{FWm}{DWs}\right) \times 100\%$$

Where BE refers to Biological efficiency, FWm is the total fresh weight (g), DWs is the substrate dry weight (g).

III. RESULTS AND DISCUSSION

Results from mycelia running, pin head formation and the maturation of fruit bodies are illustrated as follows (Table 1, Table 2, and Table 3). The mycelial growth was faster on Sugarcane bagasses and paddy straw than corn cob and corn straw in all the spawned substrates. Pin head formation occurred quickly in Sugarcane bagasses followed by Paddy straw, Corn cob and corn straw in all the spawned substrates. Among various spawns, Sorghum showed faster growth. The maturation period of fruiting bodies ranges from 26 days (Sugarcane bagasses) to 38 days (Corn straw).

Table 1. Growth of mushroom in Sorghum spawned substrates.

Growth	Sugarcane bagasses	Paddy straw	Corn Cob	Corn straw
Mycelial growth	14 days	14 days	16 days	19 days
Pin head formation	16 days	17 days	24 days	26 days
Maturation of fruiting bodies	26 days	28 days	36 days	38 days

Table 2. Growth of mushroom in pearl millet spawned substrates.

Growth	Sugarcane bagasses	Paddy straw	Corn Cob	Corn straw
Mycelial growth	16 days	16 days	17 days	20 days
Pin head formation	18 days	19 days	26 days	28 days
Maturation of fruiting bodies	28 days	30 days	38 days	41 days

Table 3. Growth of mushroom in Wheat grains spawned substrates.

Growth	Sugarcane bagasses	Paddy straw	Corn Cob	Corn straw
Mycelial growth	17 days	17 days	20 days	22 days
Pin head formation	20 days	22 days	29 days	32 days
Maturation of fruiting bodies	32 days	34 days	40 days	44 days

Results of Yield components of each spawned substrate are illuatrated as follows (Table 4, Table 5, and Table 6). It was found that Sugarcane bagasses showed better yield components than other substrates.

Table 4. Results of yield components of Sorghum spawned substrate

Parameters	Sugarcane bagasses	Paddy straw	Corn cob	Corn straw
No. Of fruiting bodies	33.00	30.12	27.34	26.26
Pileus diameter (cm)	7.85	6.95	5.48	5.02
Pileus thickness (cm)	1.67	1.32	1.05	0.98
Stripe diameter (cm)	5.87	5.23	4.85	4.07
Stripe length (cm)	3.81	2.98	2.09	1.98

Table 5. Results of yield components of Pearl millet spawned substrate

Parameters	Sugarcane	Paddy	Corn cob	Corn

	bagasses	straw		straw
No. Of fruiting bodies	30.00	28.50	23.04	22.16
Pileus diameter (cm)	6.52	5.85	4.38	4.22
Pileus thickness (cm)	1.27	1.02	0.08	0.04
Stripe diameter (cm)	5.67	5.03	4.65	4.27
Stripe length (cm)	2.81	2.08	1.89	1.68

Table 6. Results of yield components of Wheat spawned substrate

Parameters	Sugarcane bagasses	Paddy straw	Corn cob	Corn straw
No. Of fruiting bodies	28.50	26.32	24.34	23.26
Pileus diameter (cm)	6.05	5.75	4.48	4.02
Pileus thickness (cm)	0.67	0.52	0.35	0.08
Stripe diameter (cm)	4.87	4.73	3.65	3.07
Stripe length (cm)	2.07	1.88	1.09	0.98

The matured fruit bodies are harvested and weighed for calculating biological yield and economic yield. The results are tabulated as follows (Table 7, Table 8 and Table 9). The Sorghum spawned sugarcane bagasses showed more weight when compared with other substrates.

Table 7. Results of biological and economic yield in Sorghum spawned substrates

Substrates	Biological yield (g)	Economic yield (g)
Sugarcane bagasses	398.54	276.24
Paddy straw	350.40	240.16
Corn cob	320.65	220.08
Corn straw	304.87	202.68

Table 8. Results of biological and economic yield in pearl millet spawned substrates

Substrates	Biological yield (g)	Economic yield (g)
Sugarcane bagasses	380.44	264.14
Paddy straw	330.30	210.06
Corn cob	310.45	202.12
Corn straw	294.67	190.58

Table 9. Results of biological and economic yield in Wheat spawned substrates

Substrates	Biological yield (g)	Economic yield (g)
Sugarcane bagasses	368.44	250.42
Paddy straw	320.30	220.60
Corn cob	300.05	192.98
Corn straw	280.87	187.80

Biological efficiency of the mushroom was determined as the ratio of Biological yield harvested to the dry weight of the substrate. The sorghum spawned sugarcane bagasses substrate showed more biological efficiency followed by paddy straw, corn cob and corn straw. The results are tabulated as follows (Table 10).

Table 10. Results of biological efficiency of oyster mushroom

Spawns	**Sugarcane bagasses**	**Paddy straw**	**Corn cob**	**Corn straw**
Sorghum	84.68	80.72	77.68	72.80
Pearl millet	78.24	76.65	72.14	68.64
Wheat	72.15	70.23	68.65	64.42

IV. DISCUSSION

As per the finding of this study, the growth of *P. Ostreatus* mycelia was relatively faster on Sugarcane bagasses and paddy straw as compared to the other substrates used (corn straw and corn cob). On an average, it took about 15 days for the mycelia to run on each substrate. This is comparable with the study of (Onuoha *et al.*, 2009) who reported the completion of spawn running on paddy straw waste to be 15 days while others reported it to be between 13 and 16 days using similar substrate (Patra and Pani 1995; Jiskani 1999). The variation in the number of days taken for a spawn to complete colonization of a given substrate is a function of the fungal strain, growth conditions and substrate type (Chang and Miles 2004). According to (Oei 1996), mushroom mycelia require specific nutrients for its growth; the addition of supplements can, thus, increase mushroom yield through the provision of these specific nutrients.

Pin-head formation (premordium initiation) was observed following the invasion of substrates by mycelial growth. The time required for the formation of pin-heads is comparable with other studies of (Ahmed, 1998) reported pin-head formation of oyster mushroom cultivated in different substrates to be between 23 and 27 days from spawning, while (Fan *et al*., 2000) reported it to be 20–23 days. It was evidently observed from this study that the overall cropping period for oyster mushroom, varied for each of the different substrates used. According to (Khanna and Garcha, 1981), it may take up-to 104 days to harvest yield from oyster mushroom grown on paddy straw. These variations in cropping periods were due to the variations in the growing environment and physiological requirements for mushroom cultivation like the constant temperature, humidity and light arrangements.

It was observed that the yield components of *P. Ostreatus* were found to be affected by the use of different substrates. Sugarcane bagasses resulted in a relatively better growth in terms of diameter and thickness of pileus, and diameter and length of stipe. The study confirmed that the use of different substrates brought about a significant effect on yield (biological and economic yield) of oyster mushroom. The largest yield was harvested from sugarcane bagasses, followed by paddy straw while the least was obtained from corn straw. Similarly, the biological efficiency also varied among the different substrates. Variable ranges of BE have been reported when different lignocellulosic materials were used as substrates for cultivation of oyster mushroom (Liang *et al*. 2009).

V. CONCLUSION

Oyster mushroom is an edible mushroom which can be grown on various substrates like Paddy straw, wheat straw, sugarcane bagasses, saw dust etc. This study confirmed that the Oyster mushroom, *Pleurotus ostreatus* grown well in Sugarcane bagasses when compared with other substrates and also it is confirmed that the spawn produced from Sorghum have more potential than other spawns. Further studies need to be conducted on the potentials of various agricultural and industrial wastes on oyster mushroom cultivation, their economic feasibility and other related issues of mushroom (particularly oyster mushroom) to fully realize the multiple socio-economic and environmental significances of the mushroom.

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