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Substrate evaluation for the growth of *Pleurotus ostreatus* mushroom

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Abstract

The type of substrate is a critical factor influencing the growth and yield of oyster mushroom (*Pleurotus ostreatus*). Seven substrates, namely wheat straw, paddy straw, maize straw, jowar straw, soybean straw, green gram straw, and black gram straw, were evaluated for their effect on oyster mushroom productivity. Among these, the highest yield was observed on soybean straw (815.66 g/kg straw) with a biological efficiency (B. E.) of 81.56 %, followed by yield on wheat straw (721.33 g/kg straw) with 72.13 % B. E. The lowest yield was recorded on maize straw (605.66 g/kg straw) with a B. E. of 60.56 %.

Keywords: *Pleurotus ostreatus*; Mushroom; Biological efficiency (B. E.); Yield

1. Introduction

Oyster mushroom (Pleurotus species) are commercially essential mushrooms and third most widely cultivated mushroom globally due to their simple and low cost production technology. *Pleurotus* is an efficient lignin-degrading mushroom and can grow on various lignocellulosic materials. Among all cultivated mushrooms, *Pleurotus* has the highest number of commercially grown species, making it suitable for year-round cultivation. Species such as P. flabellatus, P. sajor-caju, P. sapidus, P. membranaceous, P. citrinopileatus, and P. eous are commercially cultivated during the summer, while species like P. ostreatus, P. florida, P. cornucopiae, P. fossulatus, and P. eryngii are cultivated during the winter (Chitra *et al.*, 2021).

Sanchez (2010) reported the *P. ostreatus* is the second largest cultivated mushroom next to *Agaricus bisporus* in the world market. P. ostreatus is edible as well as delicious mushroom. Nutritionally, this mushrooms is a good source of protein, vitamins and minerals (calcium and sodium) (Stamets, 2005). *P. ostreatus* requires minimal environmental control, and its fruiting bodies are less susceptible to diseases and pests. Additionally, its cultivation can be carried out using simple and cost-effective methods. These factors make *P. ostreatus* an excellent option for mushroom production, especially when compared to other varieties. Consequently, it is a more suitable choice for farmers with limited technical skills. According to Chang and Miles (2004), the nutrient content of substrates significantly affects the growth and fruiting body formation of Pleurotus species. The objective of this study was to evaluate the productivity of Pleurotus ostreatus grown on different locally available substrates.

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2. Material and methods

2.1. Strains of Mushroom

Pleurotus ostreatus strain was obtained from National Centre for Industrial Microbes, National Chemical Laboratory, Pune, India. The cultures were preserved on 2% malt extract agar slants at 4 ºC. Sub-culturing was done after every 15 days interval.

2.2. Spawn Preparation

Spawn was prepared in polyethylene packets. Sorghum grains were boiled in a water bath for 10-15 minutes at a 1:1 ratio (sorghum grains to water) and then mixed with 4% (w/w) $CaCO_3$ and 2% (w/w) $CaSO_4$. The treated sorghum grains (250 g) were packed into polyethylene bags (200 × 300 mm) and sterilized in an autoclave at 121°C for 30 minutes. After sterilization, the bags were inoculated with actively growing Pleurotus ostreatus mycelium from malt extract slants and incubated at 27 ± 2 °C in the absence of light for 10-15 days, allowing the mycelium to fully colonize the grains.

2.3. Cultivation of Mushroom

Agro-waste materials including soybean straw, paddy straw, wheat straw, jowar straw, maize straw, green gram straw, and black gram straw were collected from local farms and used as cultivation substrates. The substrates were chopped into 2-3 cm pieces, soaked in water overnight to moisten them, and then drained of excess water. After soaking, the substrates were steam sterilized at 121 °C for 20 minutes in an autoclave. Polyethylene bags (35 × 45 cm) were filled with the sterilized substrates, and a multi-layered technique was employed for spawning. Each bag was filled with 1.0 kg of dry substrate, and spawn was added at a rate of 2% based on the wet weight of the substrate.

After inoculation, the bags were placed in a controlled environment where temperature and humidity were maintained at approximately 25 °C and 80-90%, respectively, with adequate light and ventilation for 20 days. The spawn run was completed within 18 days. After the spawn run, the polyethylene bags were removed. Fruiting body formation was observed within 3-4 days after bag removal. The cultivation beds were maintained until the harvest of the third flush, which was completed 35 days after spawning. A thin layer of substrate was scraped off from the sides of the beds after each harvest. Each of the seven treatments was replicated three times.

2.4. Yield and Biological efficiency

The total weight of all fruiting bodies harvested from the three pickings was recorded as the total mushroom yield. The B. E., defined as the yield of mushrooms per kg of dry substrate, was calculated using the following formula (Chang *et, al.*, 1981)

$$\text{Biological Efficiency (\%)} = \frac{\text{Fresh weight of mushroom}}{\text{Weight of Air} - \text{dried substrate}} \times 100$$

2.5. Statistical Analysis

The recorded data in the present study was subjected to statistical analysis as per the procedure recommended by Panse and Sukhatme (1978).

3. Results and discussion

The results reveal the yield and the B. E. of Pleurotus ostreatus cultivated on different agro-waste substrates (Table 1). Soybean straw recorded the highest yield during the first picking (375.00 g/kg straw), which decreased to 288.66 g/kg during the second picking and 152 g/kg during the third picking. The total yield on soybean straw was 815.66 g/kg with a B.E. of 81.56 %. This finding indicates that soybean straw is the most favorable substrate for maximizing yield, consistent with the observations of Patil and Baig, (2023), who reported the highest yield of Pleurotus sajor-caju grown on soybean straw.

Wheat straw produced a maximum yield of 326 g/kg during the first picking, which decreased to 255.33 g/kg during the second picking and 140 g/kg during the third picking. The B. E. for Pleurotus cultivated on wheat straw was 72.13 %. These results align with the findings of Patil (2012). For paddy straw, the highest yield of 285.33 g/kg was observed during the first picking, followed by 259.33 g/kg during the second picking, and the lowest yield of 173.00 g/kg during

the third picking. Patil and Baig (2023) also reported similar findings for Pleurotus sajor-caju grown on various substrates. Khanna and Garcha (1982) and Jain and Vyas (2005) found that paddy straw is a superior substrate for Pleurotus cultivation.

Table 1: Effect of different substrates on yield of *Pleureotus ostreatus*.

Substrate	Yield (g/Kg) dry straw			Total	E. (%)
	1st Picking	2nd Picking	3rd Picking		
Soybean straw	375.00	288.66	152.00	815.66	81.56
Wheat straw	326.00	255.33	140.00	721.33	72.13
Paddy straw	285.33	259.33	173.00	717.66	71.76
Maize straw	250.33	215.00	140.33	605.66	60.56
Jowar straw	282.00	219.00	136.00	637.00	63.70
Green gram straw	284.00	251.00	185.00	720.00	72.00
Black gram straw	290.00	250.33	172.33	712.66	71.26
SE ±	06.38	07.48	03.86	-	-
CD at 5%	16.48	21.20	12.22	-	-

Maize straw produced the highest yield of 250.33 g/kg during the first picking, followed by 215.00 g/kg during the second picking, and the lowest yield of 140.33 g/kg during the third picking, with an overall B.E. of 60.56 %. Babar Iqbal *et al.* (2016) reported a 96 % biological efficiency for Pleurotus florida grown on maize straw. Jowar straw yielded a maximum of 282 g/kg during the first picking, which decreased to 219.00 g during the second picking and 136 g/kg during the third picking. These results are consistent with the findings of Telang *et al.* (2010), who observed similar results for P. sapidus grown on jowar straw.

Green gram straw yielded 284 g/kg during the first picking, 251.00 g during the second picking, and 185.00 g/kg during the third picking, with the B. E. of 72.00 %. Survase (2012) reported similar findings for Pleurotus sajor-caju cultivated on green gram straw. Black gram straw showed a maximum yield of 290 g/kg during the first picking, followed by 250.33 g during the second picking, and 172.33 g during the third picking, resulting in an overall B.E. of 71.26 %. Earlier, Patil and Baig, (2023) reported a biological efficiency of 76.26 % for Pleurotus sajor-caju cultivated on black gram straw

4. Conclusion

This work was carried out to study the effect of different substrate on yield of *P. ostreatus.* Among the different substrate studied, soybean straw was found superior substrate to give maximum yield of P. ostreatus. In Maharashtra majority of farmers grown soybean crop. So surplus substrate from this crop is obtained on large scale, major portion of this substrate remain unused and becomes a big problem of its disposal. Utilization of this substrate towards mushroom cultivation is a positive way of waste management. Through the activity of mushroom cultivation, it is possibly to generate the employment potential in rural area and can raise the economic status of poor and landless farmers. This also provides the viable solution to malnutrition in this region. Hence it is possible for poor and vulnerable people to utilize highly priced protein riched food from mushroom cultivation at very low cost.

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