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Research Article

EFFECT OF DIFFERENT SUBSTRATES ON THE GROWTH AND YIELD OF OYSTER MUSHROOMS *(Pleurotus djamor)*

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Abstract- Mushroom is a popular nutrient and protein-rich food of the world. Oyster mushroom is the second most popular mushroom after button mushroom all over the world. Growing medium of the mushroom is generally known as substrate. Substrate is the base of mushroom cultivation same as soil for crops. The present study was conducted with the aim to find out the most suitable substrate for the cultivation of Oyster mushroom (*Pleurotus djamor*). In the present experiment Wheat straw, Paddy straw, and Chickpea straw were used alone and also in a combination of each other with 1:1 ratio(w/w) for the cultivation of *Pleurotus djamor*. The results obtained during the present experiment, maximum yield (440.00g/kg of dry substrate with 44.00% B.E.), minimum days for spawn run (23.00 days), minimum days for first harvesting (30.00 days),maximum days for cropping period (61.00 days), highest pileus length and width (9.0 cm and 9.67cm) were observed at wheat straw while highest number of fruiting body (17.00) and highest number of lob (46.00) was observed in wheat straw + paddy straw. Based on the results obtained, Wheat straw would be recommended as most suitable substrate for the cultivation of *Pleurotus djamor*.

Keywords- Oyster mushrooms, Wheat straw, Paddy straw, Chickpea straw, *Pleurotus djamor*, Yield.

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Introduction

Mushrooms are recognized as important food items from ancient times. Usages of mushrooms are increased day by day because of the significant role in human health and nutrition [1]. A mushroom is a macro fungus, which has a distinct fruiting body, which can be either hypogenous or epigenous and large enough to be seen by a naked eye and picked by hand [2]. Mushrooms of *Pleurotus* spp. are commonly known as "Oyster mushroom". These are the second most popular mushroom after button mushroom all over the world [3]. Cultivation of edible mushrooms with agricultural and agro-industrial residues as substrate is an efficient and economically reliable technology for converting these materials into a valuable protein rich food and a cash crop of commercial interest [4]. The last decade has witness an empirical approach towards its cultivation for both large-scale industrial or commercial scales compared to the crude conventional method [5]. Growing medium of the mushroom is generally known as substrate [6]. An attractive feature of oyster mushrooms is that they can utilize a large variety of agricultural waste products and transform the lignocelluloses biomass in to high quality food, flavor and nutritive value [7-9] The economy of India is agriculture-based, with considerable amount of crop production. Crop residues are largely abundant as agricultural waste after harvest. It is important to dispose agricultural waste in a green way, which is environmentally friendly in this era of climate change. Mushroom cultivation is one of the most commercially important steps towards diversification of agriculture. Microbial technology can help in large scale recycling of agro waste in India [10]. An alternative way of use of agricultural residues/wastes is in the use of the organic material in mushroom production [11 & 12]. Thus, the objective of this study was mainly to assess the effect of different locally available substrates for growth and yield of Oyster mushroom (*Pleurotus djamor*).

Material and Methods

Culture of *Pleurotus djamor* were purified and maintained by single hyphal tip method. For this purpose, the culture was grown in sterilized Petri plates on Potato Dextrose Agar Medium (PDA) for 8-10 days. Single branched hyphae from the periphery of the growing colony were marked under low power (10^x) in the compound microscope and transferred to PDA slants. These tubes were incubated at 21-24^{0}C for about a week, again sub cultured on PDA and then stored in a refrigerator at 5-10^{0}C for further use [13].

Spawn Production

Spawn was prepared in half litre capacity wide mouthed glass bottles. The grains were cleaned to remove any broken, shrivelled grains either by sieving or winnowing or by hand picking of undesired grains. After this, the grains were soaked overnight in clean water and then washed. They were boiled in water for

15 minutes taking care that grains should not split but remain slightly hard after boiling.

The boiled grains were spread in thin layer over a wire net to remove excessive water and enable them to cool about 25-30^{0}C. The cooled grains were then mixed with 1.2 per cent commercial grade gypsum ($CaSO_4$) and 0.3 per cent calcium carbonate ($CaCO_3$). Gypsum prevents the sticking of wheat grains together and calcium carbonate maintains the pH 5.5 - 7.5. The grains were filled up to (100 mm) in the bottle in three replicates. The bottles were plugged with non-absorbent cotton and covered with butter paper. These bottles were then sterilized at 121^{0}C (15 lbs pressure) for 2 hours on two consecutive days. Sterilized bottles were taken out from the autoclave, while still hot and were shaken to avoid clumping of grains. Sterilized bottles were inoculated from the pre maintained culture of *Pleurotus djamor* by 9 mm disc in individual bottle. The spawn bottles were incubated without shaking at 24±1^{0}C in B.O.D incubator.

Mushroom Production Technology

Substrate Preparation:

Wheat straw, Paddy straw and Chickpea straw were used alone and also in a combination of each other with 1:1 ratio (w/w) as substrate for this experiment. These were soaked (10kg wheat straw/100liter water) in different- different tank with solution of Carbendazim (8gm/100liter water) + Formalin (120ml/100liter H_2O) for 18 hrs (tank should be covered with polythene sheet to prevent the evaporation of formalin) [14]. Thereafter, straw was taken out from the solution and kept for 2-3 hours to drain out the excess water.

Spawning

Spawning was done under aseptic condition. Different sugars spawn of *Pleurotus djamor* (preparation method described under spawn production)wasmixed in Wheat straw (substrate) @ 4 percent per kg on dry weight basis and 3kg substrate (containing 60-75% moisture) filled in each polythene bags (22×12") in three replications and made 8-10 holes in each bags for aeration. After spawning bags were kept in the spawn running room under dark condition. The observations were recorded as total yield (g/kg dry straw) and minimum days for spawn run (DFSR), minimum days for first harvesting (DFFH), number of lobe per beg (NOL), number of fruiting body per beg (NOFB) and maximum average weight of fruiting body (g/FB).

Spawn run

In crop room temperature (22^o-26^{o}C) and relative humidity (80-90 %) was maintained during spawn run. Humidity was maintained by water spraying three times a day. After the compilations of spawn run in the straw it becomes a compact mass which also sticking to the polythene bags and after the complete spawn run in the bags, bags were opened for sporophores formation by removing of polythene and kept in cropping room. At the time of sporophores formation the windows were kept open for 1–2 hrs to provide fresh air, to release CO_2 and to maintain the relative humidity at 80-90 per cent inside the crop room.

Sporophores production

After spawn run, compact stack of substrate (wheat straw) were kept in crop room for the sporophores production. The fruiting bodies were started to appear in 6-8 days. The sporophores were harvested 3-4 days after pinhead initiation. These were harvested by one gentle twisting at the base, taking care that the broken stumps were not left there to avoid rotting in the remaining flushes of running crop. 3-4 flushes were taken after that very few fruiting bodies appear. After the first two flushes, the spawn run blocks were over turned to allow the lower surface and the base to produce fruiting bodies. A total time for cropping up to 3rd flush is about 60-70 days. Watering of the crop is quite important which must be done with a mist sprayer. The water spraying should be done by sprinkler on the blocks after the fruit body start coming up but the floor and walls of the mushroom crop room must be kept moist to maintain requisite humidity (80-90 %). Adequate ventilation in the crop room was provided by opening the doors and windows at night for a short time. The fruiting bodies must be protected from direct sunlight but some diffused light (2500-3000 Lux) should be allowed to induce fruiting body formation. The crop room floor and wall were sprayed with 0.1 per cent Malathion or Sevin and/or light trap to protect it from insect infestation. To prevent the fungal infection, two sprays of Carbendazim 0.02 per cent were given.

Harvesting

The sporophores of *P.djamor*were harvested after the maturity. Before the harvesting sporophores were irrigated for keep it fresh. The yield obtained in 7 weeks harvesting period were compared with each other. After the first harvesting begs were scraped and remain without irrigation for three days and then again irrigated after pinhead initiation. Same process was follow after second harvesting. Adequate ventilation in the crop room was provided by opening the doors and windows at night for a short duration during cropping.

Result and Discussion

The experiments results indicated that, maximum yield (440.00g/kg of dry substrate with 44.00% B.E.) was observed at wheat straw which was significantly similar to paddy straw + wheat straw (430.00g/Kg of dry substrate with 43.00 B.E.) and significantly higher than other treatments. The minimum yield was observed at pigeon pea straw (380.00g/kg of dry substrate with 38.00% B.E.) which was significantly lower than all other treatments.

The minimum days for spawn run (23.00 days) was observed at wheat straw which was significantly at par with pigeon pea straw + wheat straw (25.00) and wheat straw + paddy straw. The maximum days for spawn run (27.67 days) were observed in paddy straw and pigeon pea straw. The minimum days for first harvesting (30.00 days) was observed at wheat straw, which was significantly at par with all other substrates. The maximum days for cropping period (61.00 days) were observed at wheat straw which was significantly higher than other substrates. The minimum days for cropping period (41.67 days) were observed at paddy straw which was followed by pigeon pea straw and pigeon pea straw + wheat straw which were significantly similar. The maximum average weight of fruiting body (36.36) was observed in pigeon pea straw, which was significantly higher than all other treatments.

The highest number of fruiting body (17.00) was observed at wheat straw + paddy straw which was significantly similar to paddy straw (15.20). The minimum number of fruiting body (11.00) observed at pigeon pea straw which was significantly at par with pigeon pea straw + paddy straw. The highest number of lob (46.00) was observed in wheat straw + paddy straw which was significantly similar to paddy straw. The minimum number of lob (27.31) observed at pigeon pea straw which was significantly at par with pigeon pea straw + wheat straw. The highest pileus length and width (9.0 cm and 9.67cm) observed at wheat straw which was significantly higher than other substrates. The minimum pileus length and width (6.00cm, 6.00cm) observed at pigeon pea straw which was significantly at par with wheat straw + paddy straw. Results are shown in [Table-1] .

Table -1 *Effect of different type substrate on spawn run, cropping period and yield of oyster mushroom (P. djamor)*

Substrates	DFSR	DFFH	DFCP	NOFB	NOL	Pileus length (cm)	Pileus width (cm)	Yield (g/kg dry Substrate)	Average Wt. /FB	Biological efficiency (%)
Wheat straw	23.00	30.00	61.00	14.67	34.44	9.00	9.7	450.00	29.99	45.00
Pigeon pea straw	27.67	32.00	45.00	10.00	27.31	6.00	6.00	400.00	36.36	40.33
Paddy straw	27.67	32.00	41.67	15.20	45.22	5.33	7.33	410.00	26.97	41.00
Pigeon pea straw + Paddy straw	27.33	32.00	45.00	11.10	30.44	5.00	5.67	380.00	34.23	38.00
Pigeon pea straw + Wheat straw	25.00	31.00	52.33	13.67	28.11	7.00	6.00	410.00	29.99	41.00
Wheat straw + paddy straw	25.67	31.00	53.00	17.00	46.00	6.00	6.33	430.00	25.29	43.00
SEM±	1.33	1.29	1.34	0.96	0.77	0.74	0.66	7.69	0.75	_
CD at 5%	2.93	2.84	2.96	2.12	1.69	1.64	1.46	16.95	1.66	_

DFSR= Days for spawn run, DFCP= Days for cropping period, DFFH= Days for first harvesting, NOFB= Number of fruiting body, NOL- Number of lob.

The results were accordance with the findings Sharma, and Jandaik, [15] reported that wheat straw is better than paddy straw for the cultivation of Oyster mushroom. Das [16] used different agricultural waste like banana pseudo stem, wheat straw, water hyacinth, congress grass for cultivation of *P. Sajorcaju* and *P. flabellatus*. The best results were obtained from wheat straw using spawn multiplied on wheat straw. Upadhyay [17] evaluated the malt industry waste, tea leaves industry waste and dry popular leaves for cultivation of *Pleurotus*spp. Tea leaves alone proved to be poor substrate for mycelial growth of *P. sapidus* and *P. flabellatus* but in combination with wheat straw (3:1 and 1:1), it gave better yield. Dias, [18] was also cultivated *P. florida* on wheat straw: soybean straw (1:1) to show highest biological efficiency (93%) [19].

Conclusion

The study was conducted to check the effect of pure substrate and mixed substrate on the growth and yield of *Pleurotus djamor.* It can be concluded that Wheat straw (substrate) supported the growth and yield of the *Pleurotus djamor*, thus Wheat straw would be recommended as most suitable substrate for the cultivation of *Pleurotus djamor.*

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Conflict of Interest: None declared

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