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Comparison of different substrates for growth behaviour and yield potential of oyster mushroom *P. djamor* (Rumph.) Boedijn

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ABSTRACT

The present study was undertaken to observe the different agricultural wastes for growth behavior and yield potential of oyster mushroom (*Pleurotus djamor)* with a view to help the mushroom growers in selection of substrates for obtaining better growth and yield. Experimental findings showed that maximum total yield was obtained from wheat straw mushroom bag (941.13gm/bag) followed by mixture substrate of wheat straw with paddy straw (1:1), wheat straw with saw dust (1:1), wheat straw with paddy straw and tamarind leaves (1:1:1) and wheat straw with paddy straw and Bermuda grass (1:1:1) having 811.78g, 628.33g, 533.15g and 473.90g yield respectively. Spawn run period, weight of fruiting body was also found better in wheat straw substrate. So, the best performing substrate was wheat straw for yield and yield contributing parameters of oyster mushroom. This investigation will help to mushroom growers for selection of suitable substrate for cultivation of oyster mushroom (*Pleurotus djamor)*.

Key words: *Pleurotus djamor,* substrates, fruiting boy and yield

India is an agriculture country and Indian agriculture will continue to be a main strength of Indian economy. With the variety of agricultural crops grown today, we have achieved food security by producing over 264 million tons of food grain in 2014. However, our struggle to achieve nutritional security is still on. Though we have significant achievements in milk, vegetables and fruit production still we have to do more. In future, the ever-increasing population, depleting agricultural land, changes in environment, water shortage and need for quality food products at competitive rates are going to be important issues. Mushrooms are one such component that not only impart diversification but also help in addressing the problems of quality food, health and environment related issues. One of the major areas that can contribute towards goal of conservation of natural resources as well as increased productivity is recycling of agro-wastes including agro-industrial waste. Utilizing these wastes for growing mushrooms can enhance income and impart higher level of sustainability. Commercial production of edible mushrooms biologically converts the agricultural, industrial, forestry and household wastes into nutritious food (mushrooms) (Gupta *et al.,* 2018). The cultivation of mushrooms utilizes the vertical space and is regarded as the highest protein producer per unit area and time-almost 100 times more than the conventional agriculture and animal husbandry. This hi-tech horticulture venture has a promising scope to meet the food shortages without undue pressure on land.

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In developing countries malnutrition is one of the major problems because most of the population remains under the economic line. Mushrooms are considered to be healthy food because of their relatively high and qualitatively good protein content and because of their good vitamins, minerals and low fat content (Sharma and Annepu, 2018). India being predominantly vegetarian country requires protein from pulses, vegetables and mushrooms. So this technology of growing mushrooms on different agricultural residues not only provide protein rich foods to vegetarian population, also this will minimize the use of excessive chemical, pesticides, fertilizer in mushroom production technology. Mushrooms have been recommended by FAO as food that contributes to the protein nutrition of developing countries which depend largely on cereals. Therefore, mushroom cultivation is one of the alternatives to overcome the unfavourable natural climatic conditions and to reduce the input of cultivation. Mushroom cultivation involve less input and gives high. The present studies has been conducted on utilization of agricultural waste for growth behaviour and yield potential of *Pleurotus djamor*.

Cultivation of oyster mushroom (*Pleurotus* spp.) was started on tree stumps and logs at the beginning of 20th century (Falck, 1917). During 1958 Block and his co-workers wrote an extensive account on the requirement of this mushroom for saw dust cultivation (Block *et. al.,* 1958).Oyster mushroom has been recognized as a potential converter of cheap cellulose in to valuable protein at the very nominal cost. They evaluated different substrates namely wheat straw, paddy straw, maize straw, sugarcane bagassae, dehulled maize cobs and wood shavings on the yield related parameter of blue oyster mushroom. Results indicated that wheat straw gave better biological efficiency of 83.6% followed by paddy straw with 76.8% while wood shavings gave the lower biological efficiency of 2.7%. Raina *et al*. (2009) evaluated wheat straw, paddy straw, and chickpea straw alone and also in a combination of each other with 1:1 ratio (w/w) for the cultivation of *Pleurotus djamor*. 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 in wheat straw while highest number of fruiting body (17.00) and highest number of lob (46.00) was observed in wheat straw + paddy straw (Singh, 2017).

MATERIALS AND METHODS

Evaluation of different straw substrates on yield on *P. djamor*

The effect of different agricultural wastes as substrate *viz*., paddy straw, sawdust, wheat straw, Bermuda grass and tamarind leaves were investigated. The mixtures of wheat straw + paddy straw (1:1), wheat straw + sawdust (1:1), wheat straw + paddy straw+ Bermuda grass (1:1:1), wheat straw + paddy straw + tamarind leaves (1:1:1) and wheat straw were evaluated on yield attributing parameters.

Preparation of substrates

Different substrates were used for growing of *P. djamor* oyster mushroom (*Pleurotus* sp.). Wheat straw, paddy straw, Bermuda grass and tamarind leaves were collected from Agro Farm, B.H.U. while sawdust was collected from a local shop. The substrate was dipped in water overnight. Next day, it was steam sterilized at 121°C and 15 lbs PSI for 30 minutes. Thereafter, excess water was drained off and the substrate was spread over on clean, cemented floor till the moisture content remained 65-70 per cent.

Spawning and packing

The prepared substrate was well mixed with freshly prepared spawn (18-25 days old) in the room previously fumigated with formaldehyde. The spawned substrate was filled in polythene bags and mouth of the spawned bag was tied with the help of rubber band. Each bag contained 1.0 kg of moist substrate. For

perforation, 8-10 holes (1mm) were made in each bag with the help of sterilized needle to allow free passage of air within the bags. The spawned bags were kept in mushroom growing room, where appropriate temperature (25-30°C) and relative humidity (80-90 per cent) were maintained by frequently sprinkling of water on walls and floor.

Cropping

After complete colonization of substrate by mushroom mycelium (spawn run), the polythene bags were cut and removed. The compact mass of aggregated straw termed as 'bed' were ready to be placed on glass rods. The mushroom beds were kept 50 cm apart on glass rod. The beds were watered twice or thrice depending upon the moisture content of the bed. The mushroom as beds were kept moist all time. Mature sporophores were picked up just before the edges of the pilei begin to fold or curl upwards. Picking was done by slight twisting and pulling of sporophores. Harvesting was done at an interval of 10-15 days over a cropping period of 45-50 days.

Observation and measurements

The growth behavior such as spawn run period, pinhead initiation, harvesting period growth parameters total number of fruiting bodies (per bag), maximum weight of fruiting body (g), minimum weight of fruiting body (g), average length of stalk (cm), average diameter of pileus (cm) and yield potential were observed and measured on different substrates.

Biological efficiency

The yield was expressed in biological efficiency and calculated using formula (Chang *et al.,* 1981).

$$\text{Biological efficiency} = \frac{\text{Fresh weight of mushroom}}{\text{Dry weight of substrate}} \times 100$$

RESULTS AND DISCUSSION

Growth behavior (spawn run period, pin head initiation, harvesting of three flushes and crop period), growth parameters (number of fruit bodies, minimum and maximum weight of fruit bodies, average length of stalk, and average diameter of fruiting body cap) and yield potential (harvesting of three flushes, total yield and biological efficiency) were observed and measured for suitability of best substrate for production of oyster mushroom.

Results showed that minimum spawn run period and fast colonization was reported in wheat straw which took 11.33 days followed by wheat straw with paddy straw, wheat straw with saw dust, wheat straw with paddy straw and tamarind leaves and lastly slowest growth was reported in wheat straw with paddy straw and Bermuda grass with 13.33, 16.33, 17.00 and 17.33 respectively. The pinhead initiation was first in wheat straw which took 17.66 days for the first pinhead to appear followed by wheat straw with paddy straw (19 days). During a crop period, three flushes of pink oyster mushroom were harvested. Variations in period of harvest in 1st, 2nd and 3rd flush were recorded in different substrates as presented in table 1. Bags with wheat straw as substrates showed better performance as it took the minimum time for harvest of 1st, 2nd, and 3rd flushes (20.66, 31.00 and 46.00 days respectively). Maximum cropping period was recorded in wheat straw with paddy straw and Bermuda grass as substrates where it took 23.33, 35.00 and 52.33 days for 1st, 2nd and 3rd flushes respectively.

It is evident from the table no. 2 that, maximum no. of fruit bodies harvested from the mushroom bag which had only wheat straw as substrates as it produced 61 fruit bodies followed by wheat straw with paddy straw (43.33). Maximum weight of fruit body, 28.75 g, was reported in wheat straw followed by wheat straw with paddy straw, wheat straw with saw dust, wheat straw with paddy straw and tamarind

Table 1. Effect of different substrates on growth period of oyster mushroom (*Pleurotus djamor)*

Substrates	Growth behaviour (days)					
	Spawn run period	Pinhead initiation	1st harvesting	2nd harvesting	3rd harvesting	Total crop period
WS	11.33	17.66	20.66	31.00	46.00	46.00
WS+PS	13.33	19.00	21.33	32.33	47.33	47.33
WS+SD	16.33	20.00	22.00	32.66	48.33	48.33
WS+PS+TL	17.00	20.66	22.33	33.33	51.00	51.00
WS+PS+BG	17.33	21.33	23.33	35.00	52.33	52.33
SE(m)	0.394	0.856	0.745	0.730	0.775	
C.D. (5%)	1.259	N/A	N/A	2.331	2.472	

WS= Wheat straw; PS= Paddy straw; SD= Saw dust; TL= Tamarind leaves; BG= Bermuda grass

Table 2. Effect of different substrates on growth parameters of oyster mushroom (*Pleurotus djamor)*

Substrates	Growth parameters				
	No. of fruiting bodies	Max. weight of fruit) body (gm	Min. weight of fruit body (gm)	Average length of stalk (cm)	Average diameter of pileus (cm)
WS	61.00	28.75	10.70	5.75	9.87
WS+PS	57.00	27.23	9.43	5.00	9.10
WS+SD	50.66	25.67	8.53	4.98	8.43
WS+PS+TL	47.33	24.93	8.28	4.97	8.10
WS+PS+BG	44.66	24.55	7.90	4.57	7.87
SE(m)	1.000	0.601	0.548	0.413	0.639
C.D. (5%)	3.192	1.919	1.751	N/A	N/A

leaves, and wheat straw with paddy straw and Bermuda grass producing 27.23, 25.67, 24.93, and 24.55 g of fruit body respectively of maximum weight. Maximum average length of stalk i.e. 5.75 cm, was measured from wheat straw followed by wheat straw with paddy straw 5.00 cm, wheat straw with saw dust (4.98 cm), wheat straw with paddy straw and tamarind leaves (4.97 cm), while minimum average length of stalk was measured in wheat straw with paddy straw and Bermuda grass (4.57 cm). The average diameter of oyster mushroom fruiting body was found maximum in wheat straw which is 9.87 cm followed by wheat straw with paddy straw, wheat straw with paddy straw , wheat straw with paddy straw and tamarind leaves, and wheat straw with paddy straw and Bermuda grass producing 9.10, 8.43, 8.10, and 7.87 cm of pileus respectively.

Maximum yield in first, second and third harvesting was reported in mushroom bag with wheat straw as substrate with 375.10g, 340.28g and 225.75g of yield, respectively. Total yield was also obtained maximum from the wheat straw followed by wheat straw with paddy straw, wheat straw with saw dust, wheat straw with paddy straw and tamarind leaves and wheat straw with paddy straw and Bermuda grass having 811.78g, 628.33g, 533.15g and 473.90g yield, respectively (Table 3).

Above results have conformity with the findings of Singh (2017) who conducted an experiment to find

Table 3. Effect of different substrates on yield potential of oyster mushroom (*Pleurotus djamor*)

Substrates	Yield potential (gm)				
	1st harvesting	2nd harvesting	3rd harvesting	Total yield	Biological efficiency (%)
WS	375.10	340.28	225.75	941.13	94.11
WS+PS	355.33	293.47	162.98	811.78	81.17
WS+SD	277.33	200.75	150.25	628.33	62.83
WS+PS+TL	246.67	186.00	100.48	533.15	53.31
WS+PS+BG	227.00	152.67	94.23	473.90	47.39
SE(m)	14.040	11.290	8.027	7.667	
C.D. (5%)	44.812	36.034	25.620	24.473	

out the most suitable substrate for the cultivation of Oyster mushroom (*Pleurotus djamor*). He had used wheat straw, paddy straw and chickpea straw alone and also in a combination of each other with 1:1 ratio (w/w) for the cultivation of *Pleurotus djamor*. 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 in wheat straw while highest number of fruiting body (17.00) and highest number of lob (46.00) was observed in wheat straw + paddy straw. As per the results obtained, wheat straw would be recommended as most suitable substrate for the cultivation of *Pleurotus djamor*. Results are also in accordance with the findings of Jagdeesh *et al*. (2018) who investigated different substrates viz. paddy straw, sugarcane bagasse, coir pith, sorghum straw, ragi straw and mixed bed for the cultivation of pink oyster mushroom and observed Primordium initiation on 17-22nd day after spawning. Maximum yield of *P. djamor* var. *roseus* was obtained using paddy straw.

The yield and yield contributing parameters were obtained best in wheat straw. This investigation will help the mushroom growers for selection of suitable substrate for the cultivation of oyster mushroom (*Pleurotus djamor)*.

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