

# EVALUATION OF DIFFERENT STRAINS OF OYSTER MUSHROOM FOR THEIR CULTURAL, MORPHOLOGICAL AND YIELD ATTRIBUTES

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## ABSTRACT

Oyster mushroom is one of the important edible mushrooms grown in India as well as in world having high nutritive value and manifold uses. Different strains of oyster mushroom (PL-1, PL-3, PL-4 and PL-5) were evaluated for their cultural, morphological and yield attributes. Strain PL-3 grew best (maximum mycelium growth) at temperature 30 °C and at pH 6 however, higher temperature (30 °C) and higher pH level (pH 8) suited PL-1. The low temperature (20 °C) and higher pH 8 suited for PL-5 strain. Among different media tested, the maximum radial growth of mycelium was observed on oat meal agar (OMA) medium in PL-3 and PL-1 strain. The strain PL-3 had maximum stipe length, whereas shortest stipe was recorded in PL-5 strain. The maximum pileus diameter was recorded in strain PL-1 whereas minimum in PL-5 strain. On the basis of yield performance, strain PL-4 was found the best producing 395.42 g/2 kg wet substrate with biological efficiency 65.90% on wheat straw + waste paper (1:1). It was observed that the supplementation of waste paper (50%) to the wheat straw is suitable for PL-1, PL-3 and PL-4. However, supplementation of palm leaves (50%) to wheat straw was suitable only for PL-5 with 53.94% biological efficiency.

**Keywords:** oyster mushroom, physiological requirements, substrate, yield performance

## INTRODUCTION

Among the various cultivated mushrooms, oyster mushroom is easy to cultivate due to its strong enzymatic action towards the utilization of various kinds of organic substrates. It has gained importance only in the last decade and is now cultivated in many countries in the subtropical and temperate zones. Generally *Pleurotus* is referred to as 'oyster mushroom' all over the world, while in India as 'Dhingri'.

Oyster mushrooms are a diverse group of saprotrophic fungi belonging to the genus *Pleurotus* [1]. This mushroom is a good source of non-starchy carbohydrates, with high content of dietary fiber and moderate quantity of proteins, including most amino acids, minerals, and vitamins [2]. The protein content varies from 1.6 to 2.5%, and the niacin content is about ten times higher than that of any other vegetable. Oyster mushroom significantly reduced serum triglyceride and serum cholesterol in diabetic subjects [3]. Oyster mushroom diet effectively prevented the progress of hypercholesterolemia (decreased by 38%) and cholesterol accumulation in liver (decrease by 25%) that were induced by the cholesterol diet in rats [4]. This mushroom is gaining popularity day by day considering the nutritional and medicinal importance of this mushroom, an attempt was made to evaluate different strains for their physiological requirements and the substrate suited for their production

## MATERIALS AND METHODS

### Culture and culture maintenance

The culture of different strains of oyster mushroom i.e. PL-1, PL-3, PL-4 and PL-5 obtained from Mushroom Research and Training Center (MRTC), GBPUA&T, Pantnagar which obtained cultures from Directorate of Mushroom Research, Solan were used. The cultures were maintained on potato dextrose agar (PDA) medium at 28±1 °C temp for further studies. To determine a suitable temperature for the mycelial growth of different strains of oyster mushroom, the Petri plates containing 20 ml PDA medium were inoculated and incubated at four different temperature viz., 15 °C, 20 °C, 25 °C and 30 °C. Three replications were maintained for each temperature and radial growth of each replication was taken till the colony covered the full plate.

Pre-sterilized PDA medium was adjusted at 5, 6, 7, and 8 pH levels. Poured Petri plates inoculated with 5 mm culture disc of test mushroom cultures were incubated at  $28 \pm 1$  °C temperature. For each treatment, there were three replications. The radial mycelial growth of the fungus was measured as described earlier. Six different media viz. oat meal agar (OMA), malt extract agar (MEA), potato dextrose agar (PDA), Czapek's dox agar (CDA), wheat extract agar (WEA) and water agar (WA) were used to investigate the mycelial growth of the strains. Petri plates containing 20 ml of the sterilized medium were inoculated at the centre with 5 mm diameter disc of actively growing mycelium under aseptic conditions and incubated at  $28 \pm 1$  °C temp. For each strain and each medium, three replications were maintained and radial growth was recorded.

### Evaluation of substrate

The substrates used for the experimentation were wheat straw (WS), WS + palm leaves (1:1), and WS + waste paper (1:1). All the substrates were chemically treated with carbendazim 37.5 ppm + formalin 500 ppm for 18 hrs. The tank was covered with polythene sheet to prevent the evaporation of formalin. Thereafter, substrate was taken out from the tank and spread on cemented floor already treated with 2 per cent formalin and left for 2-3 hours to drain out excess water [7].

Spawning was done under clean conditions with already prepared commercial wheat grain spawn @ 2 per cent on wet weight basis of the substrate. The spawned substrate was filled in 2 kg capacity polypropylene bags and the mouth of the bags was folded and stapled. After spawning, bags were kept in the cropping room at relative humidity of 70-80 per cent and a temperature of 25-28°C for spawn run. After complete spawn run, it becomes a compact mass and bags were cut open to expose the substrate. The relative humidity in the crop room was maintained by sprinkling of water twice/thrice a day. The fruit bodies were harvested at the time of maturity. Biological efficiency was calculated using the following formula: Biological efficiency (BE) % = (Fresh weight of fruit body/Dry weight of substrate 4 x 100

### RESULTS AND DISCUSSION

Diametric growth of the four strains of *Pleurotus* was studied at temperature range from 15 °C - 30 °C on potato dextrose agar (PDA) medium. The results revealed that out of four strain, strain PL-3 showed maximum diametric growth of mycelium (9.0 cm) with average growth rate of 1.13 cm per day followed by PL-1 and PL-4 which were at par to each other but significantly higher than the mycelial growth recorded in PL-5 strain at 30 °C temperature. However at 25 °C the fastest mycelial growth was recorded as 8.33 cm from the strain PL-1 in 8 days followed by PL-3 and PL-4, whereas minimum of 3.23cm in PL-5 which is significantly lower than other strains. The maximum mycelial growth of strain PL-5 (3.73 cm) recorded at 20 °C followed by 25°C temperature (Table 1).

**Table 1.** Effect of different temperatures on mycelial growth of different strains of oyster mushroom

Sl.	Strain	Days															
		2 <sup>th</sup>				4 <sup>th</sup>				6 <sup>th</sup>				8 <sup>th</sup>			
		15°C	20°C	25°C	30°C	15°C	20°C	25°C	30°C	15°C	20°C	25°C	30°C	15°C	20°C	25°C	30°C
1	PL-1	0.57	0.80	1.23	1.53	1.80	1.87	3.37	3.23	1.97	3.93	5.97	6.93	4.13 (0.52)	4.97 (0.62)	8.33 (1.04)	8.97 (1.12)
2	PL-3	1.63	1.90	1.23	1.73	2.17	1.90	2.77	3.17	2.50	3.50	5.17	7.30	3.40 (0.43)	4.57 (0.57)	7.50 (0.94)	9.00 (1.13)
3	PL-4	1.77	2.03	1.57	1.83	2.33	2.03	3.50	4.03	2.70	4.27	5.53	6.63	4.33 (0.54)	5.17 (0.65)	7.17 (0.90)	8.67 (1.08)
4	PL-5	0.60	1.00	0.63	0.63	0.87	1.00	1.00	0.93	0.93	2.63	2.20	1.83	2.53 (0.32)	3.73 (0.47)	3.23 (0.40)	2.80 (0.35)
CD at 5%		a(Temp.) 0.13				a(Temp.) 0.23				a(Temp.) 0.49				a(Temp.) 0.53			
		b(Strain) 0.13				b(Strain) 0.23				b(Strain) 0.49				b(Strain) 0.53			
		a* b 0.25				a* b 0.45				a* b 0.99				a* b 1.054			

**Note:** figures in parenthesis are growth rate per day (cm)

These findings are in accordance with the results reported by earlier worker that the temperature ranges of 25-30°C is the best for the mycelial growth of *P. sajor caju* [4]. Of the six temperature conditions tested, i.e. 15, 20, 25, 30, 35 and 40°C, all hybrids and parental species exhibited maximum growth at 25°C, slowest at 15°C and almost no growth at 35°C and above. From the data (Table 2) it is clear that the strain PL-3 showed maximum diametric mycelial growth (8.57 cm) at pH 6.0 with average growth rate of 1.07 cm followed by pH 7.0. The strains PL-1, PL-3 and PL-4 showed approximately similar diametric growth ranges from 8.03-8.40 cm with average growth rate of 1.0-1.05 cm per day at pH 7.0 i.e. most suitable pH level for all the strains. It was observed that the strain PL-1 grows faster at all pH level tested and showed diametric growth ranges from 8.27-8.40 cm with average growth rate of 1.03-1.05 cm per day. The strain PL-5 showed slow diametric growth at all the pH level. The strain PL-1 and PL-5 favored higher pH level 8.0 however, low pH level of 5.0 favor by strain PL-1. These result are in agreement with the findings of earlier workers who reported the best growth of *Pleurotus djamor*, *P. ostreatus*, *P. sajor caju*, *P. cystidiosus* and *V. volvacea* on MEA medium [6, 8,9].

**Table 2.** Effect of different pH on the diametric growth of different strains of oyster mushroom

Sl.	Strain	Days															
		2 <sup>th</sup>				4 <sup>th</sup>				6 <sup>th</sup>				8 <sup>th</sup>			
		pH5	pH6	pH7	pH8	pH5	pH6	pH7	pH8	pH5	pH6	pH7	pH8	pH5	pH6	pH7	pH8
1	PL-1	1.97	1.87	1.60	1.57	3.13	3.20	3.20	2.73	6.53	6.13	5.90	5.37	8.33 (1.04)	8.27 (1.03)	8.27 (1.03)	8.40 (1.05)
2	PL-3	1.83	1.90	1.70	1.40	3.47	3.13	2.93	2.30	5.80	6.30	6.30	5.13	7.73 (0.97)	8.57 (1.07)	8.40 (1.05)	7.00 (0.88)
3	PL-4	1.63	1.83	1.87	1.47	2.63	2.97	3.10	2.60	5.40	5.57	6.03	4.10	7.57 (0.95)	7.37 (0.92)	8.03 (1.00)	5.93 (0.74)
4	PL-5	0.53	0.57	0.57	0.37	0.83	0.90	0.90	0.67	1.60	1.40	1.97	1.67	2.23 (0.28)	2.03 (0.25)	2.80 (0.35)	2.83 (0.35)
CD at 5%	a (pH)	0.14				a (pH) 0.15				a (pH) 0.37				a (pH) 0.59			
	b (Strain)	0.14				b (Strain) 0.15				b (Strain) 0.37				b (Strain) 0.59			
	a * b	0.28				a * b 0.29				a * b 0.73				a * b 1.17			

**Note:** figures in parenthesis are growth rate per day (cm).

### Morphological characterization

Stipe length is the most important character of oyster mushroom, as shorter the stipe length, better the quality. The stipe length varied significantly from strain to strain. The average stipe length recorded as short as 0.97 cm in strain PL-5 and as long as 5.97 cm in PL-3 strain. The maximum width was recorded in the strain PL-4 (1.77 cm) and minimum 0.47 cm in PL-5 strain. However, the pileus diameter was maximum (10.97 cm) in strain PL-1 and minimum (5.25 cm) in strain PL-3. The margin of the pileus of strains PL-1, PL-4, and PL-5 were wavy except PL-3 which produced the irregular margin.

The hybrids of *P. djamor* were different with each other in pileus morphology. The pileus length and width ranges from 5.2-8.4 cm and 6.0-12.1 cm, respectively. It was reported that the stipe length and width varied among the recombinant strains of *P. djamor* [7]. In terms of number of fruiting bodies produced, PL-5 produced significantly higher number of fruiting bodies than other strain on all the substrate tested. The minimum number of fruiting bodies was recorded in PL-3 on Ws and Ws+Pls. In terms of yield (fresh weight), all the strains produced higher yield on Ws+Wp except PL-5 that produces maximum yield on WS+Pls. On wheat straw, the strain PL-5 gave higher yield (193.12 g/2kg wet substrate) with biological efficiency of 32.19 per cent followed by the strain PL-1 (141.33 g/ 2 kg wet substrate with biological efficiency 23.56 per cent) and PL-3 (120.49 g/2 kg wet substrate with biological efficiency 20.08 per cent) and minimum yield was recorded from PL-4 (119.9 g/2kg wet substrate) with biological efficiency 19.98 per cent. However, the significantly higher yield (323.64 g/2 kg wet substrate) with biological efficiency 53.94 per cent was recorded from Ws+Pls in strain PL-5. Strain PL-3 gave poor yield on Ws+Pls substrate (Table 5). In terms of average weight per fruiting body the strain PL-1 average

**Table 3.** Effect of different media on diametric mycelial growth (in cm) of different strains of oyster mushroom

Sl. Strain	Days																													
	2 <sup>th</sup>					4 <sup>th</sup>					6 <sup>th</sup>					8 <sup>th</sup>														
	OMA	PDA	MEA	WA	WEA	CDA	OMA	PDA	MEA	WA	WEA	CDA	OMA	PDA	MEA	WA	WEA	CDA	OMA	PDA	MEA	WA	WEA	CDA						
1	PL-1	1.87	1.27	1.10	0.57	1.13	0.77	1.13	0.77	1.13	0.77	1.30	6.83	6.23	5.13	2.10	2.77	1.53	8.47	8.47	7.20	2.40	3.57	1.87	(1.06)	(1.06)	(0.90)	(0.30)	(0.45)	(0.23)
2	PL-3	1.77	1.33	1.20	0.50	1.20	1.50	1.50	1.50	1.20	1.50	3.30	7.27	6.00	5.73	2.77	3.70	4.50	9.00	8.30	7.80	3.30	5.03	5.13	(1.13)	(1.04)	(0.98)	(0.41)	(0.63)	(0.64)
3	PL-4	1.60	1.27	1.20	0.93	1.70	1.40	3.97	3.60	3.20	1.63	3.20	6.13	5.67	5.27	2.47	4.13	3.67	7.90	7.93	7.37	3.13	5.37	4.03	(0.99)	(0.99)	(0.92)	(0.39)	(0.67)	(0.50)
4	PL-5	1.80	0.57	0.37	0.50	0.77	1.27	3.53	2.00	1.63	1.50	2.23	4.17	2.57	2.60	2.37	4.00	3.20	4.53	3.47	3.70	2.80	4.83	3.80	(0.57)	(0.43)	(0.46)	(0.35)	(0.60)	(0.48)
<b>CD at 5%</b>																														
a (Media) 0.14																														
b (Strain) 0.12																														
a*b 0.28																														
a (Media) 0.32																														
b (Strain) 0.26																														
a*b 0.63																														
a (Media) 0.37																														
b (Strain) 0.30																														
a*b 0.74																														

**Note:** figures in parenthesis are growth rate per day (cm).

**Table 4.** Morphological characters of different strains of oyster mushroom on wheat straw + waste paper substrate

Sl.No.	Strains	Stipe length (cm)	Stipe width(cm)	Pileus diameter(cm)	Margin of fruit body	Colour of fruit body
1.	PL-1	5.53	1.00	10.97	wavy	Dark creamy white
2.	PL-3	5.97	0.98	5.25	irregular	creamy white
3.	PL-4	4.23	1.77	7.37	wavy	creamy white
4.	PL-5	0.97	0.47	5.93	wavy	Dark creamy white
CD at 5%	0.11	0.13	0.14			

**Table 5.** Yield performance of different strains of oyster mushroom on available agrowaste.

Strain	Wheat straw			Wheat straw + Waste Paper			Wheat straw + Palm leaves		
	Av. No. of fruit body	Av. Yield (g/2kg wet subs.)	BE (%)	Av. No. of fruit body	Av. Yield (g/2kg)	BE (%)	Av. No. of fruit body	Av. Yield (g/2kg wet subs.)	BE (%)
PL-1	32.74	141.33	23.56	29.56	311.82	51.97	-	-	-
PL-3	14.3	120.49	20.08	49.23	249.93	41.66	14.97	81.59	13.60
PL-4	15.5	119.9	19.98	52.26	395.42	65.90	-	-	-
PL-5	137.16	193.12	32.19	98.02	193.18	32.20	271.05	323.64	53.94
CD at 5%	26.87	45.59	—	35.35	141.32	—	58.93	122.29	—

weight of 10.55 g per fruiting body on Ws +Wp and minimum on Ws 4.32g per fruiting body. In case of strain PL-3, the highest average weight 8.43g per fruiting body was recorded from Ws followed by on Ws + Pls 5.45 g per fruiting body and minimum on Ws 5.08 g per fruiting body. In case of PL-4 maximum average weight 7.74 g per fruiting body was recorded from wheat straw followed by on Ws+Wp 7.57 g per fruiting body. The PL-5 strain, proved poor as it produced fruiting body with minimum average weight ranged between 1.19-1.97 g per fruiting body on the tested substrate.

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