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Practicability analysis and economics of using different substrates for oyster mushroom *Pleurotus djmore* and *Pleurotus sajor-caju* by woman self help group in Uttarkashi district of Uttarakhand

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ABSTRACT

Pleurotus djmore and *Pleurotus sajor-caju* were cultivated on different plant substrates in District Uttarkashi, Uttarakhand. *P. djmore* fruits well at 20 - 30^{0}C and *P. sajor-caju* at 18 -28^{0}C. Plant wastes or substrates, viz. wheat straw, hybrid Napier, maize cob shell, finger millet waste, blackgram waste, lentil kernel, and chopped mustard straw were used as alternative substrates for the cultivation of *P. djmore* and *P. sajor-caju*. The biological efficiency (BE) obtained from each substrate was more than 90%. The highest yields of *P. djmore* (1180 g/500 g dry substrate, BE 118%) and *P. sajor-caju* (1020 g/500g dry substrate, BE 102%) were obtained on wheat straw substrate. Others also proved to be good substrates for mushroom cultivation. Economic profitability analysis showed that *Pleurotus* mushroom cultivation is income-generation entrepreneurship that woman self help group and unemployed youth can easily adopt. Mean cost benefit ratio of 1:4.6, 1:3.7 and 1:2.2 were obtained at 100%, 80% and 60% of experimental yields.

Key words: Economic profitability, *Pleurotus djmore*, *Pleurotus sajor-caju* cultivation, Substrates

The Uttrakhand hill region of India with varied climate offers tremendous scope for the cultivation of several species of mushrooms. Recently, cultivation of oyster mushroom (*Pleurotus* spp.) is gaining popularity as an income generating enterprise. Normally wheat straw is used as substrates for oyster mushroom cultivation. Very often, availability of these substrates become a limiting factor, as they are the main cattle feed in this region. Hence utilization of alternative locally available substrates for successful cultivation was investigated. Mishra and Shukla (2007) attributed the oyster mushroom growth and yield to temperature, substrate and RH (moisture regime). Hybrid napier, maize cob shell, finger millet, blackgram waste, lentil waste, chopped mustard straw, etc are some of the agro wastes which could be used as an alternative substrates for mushroom cultivation. Therefore, the present experiment was conducted at the KVK Chinyalisaur and woman self help group in Uttarkashi district.

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MATERIALS AND METHODS

The studies were conducted in a traditional Uttarakhand type thatched house with mud rock wall, having a dimension of 25×12×10 feet during July-October, 2011 and 2012, by following compact poly bag method. *P. djmore*, and *P. sajor-caju* spawn was prepared on wheat grain. Dried agro waste, viz. hybrid napier, maize cob shell, finger millet, blackgram waste, lentil waste, chopped mustard straw, and wheat straw. Ninety litres of water was taken in a rust proof drum of 200 litres capacity. Fifteen kg of wheat straw was slowly dipped/ steeped in water. In another plastic bucket, carbendazim (7.5g) and 41% formaldehyde (125 ml) was dissolved and slowly poured on the already soaked wheat straw. Straw was pressed and covered with a polythene sheet. After 12 hr the wheat straw was taken out and excess water was drained and used it for spawning. Other substrates were also prepared in the same way for spawning. The substrates were filled in perforated polythene bags @ 2 kg dry substrate/bags. Thirty days old spawn was used @ 150 g/bag in 5 layers and tied at the top. Spawned bags were incubated in a dark room. Within 25 days after spawn run, polythene bags were removed and tied with plastic rope and beds were transferred to the cropping room and sprayed with water regularly. Two oyster mushroom, *P. sarjor-caju* and *P. djmore* the former tolerant to a tropical maximum and minimum temperature of 22°C-28°C and RH

Table 1 Effect of different substrate on average yield of *Pleurotus djmore* (PD), and *Pleurotus sajor-caju* (PS)

Plant substrates	*Pleurotus sajor-caju* (PS)				*Pleurotus djmore* (PD)			
	Spawn run (d)	First harvest (d)	Total yield (g/bag)	BE (%)	Spawn run (d)	First harvest (d)	Total yield (g/bag)	BE (%)
Wheat straw	55.0	65.0	1020.0	102.0	20	28	1180.0	180.0
Hybrid napier	65.0	80.0	850.0	85.0	24	33	900.0	90.0
Maize cob shell	67.0	82.0	700.0	70.0	19	30	850.0	85.0
Finger millet waste	64.0	85.0	650.0	65.0	22	34	790.0	79.0
Blackgram waste	75.0	94.0	500.0	50.0	29	38	700.0	70.0
Lentil kernel	72.0	72.0	400.0	50.0	26	35	680.0	68.0
Chopped mustard straw	74.0	88.0	300.0	30.0	30	40	350.0	35.0
Control	70.0	67.0	260.0	27.0	28	35	270.0	27.0
SEm	1.8	1.5	14.1		1.0	1.4	9.2	
CD (P=0.05)	3.8	3.3	30.3		2.2	3.0	19.8	
CV (%)	1.3	1.6	5.7		0.8	1.5	5.1	

BE, Biological efficiency

Table 2 Returns (₹) in three month profit % to management from the production of *Pleurotus* mushroom on 500 kg of paddy straw with different substrates and sold @ ₹ 150/kg

	Different type substrates							
	Optimistic yields (Experimental yields)							
	Wheat straw	Hybrid napier	Maize cob shell	Finger millet waste	Blackgram waste	Lentil kernel	Chopped mustard straw	Control
Yield in kg ½ t substrate	1100.0	875.0	775.0	720.0	600.0	540.0	325.0	265.0
Gross returns (₹)	165000.0	131250.0	116250.0	108000.0	90000.0	81000.0	48750.0	39750.0
Production costs (₹)	29302.0	28302.0	27802.0	28002.0	27502.0	27402.0	27202.0	27102.0
Returns (₹)	135698.0	102948.0	88448.0	79998.0	62498.0	53598.0	21548.0	12648
Cost/kg mushroom	26.6	32.3	35.9	38.9	45.8	50.7	83.7	102.3
Return/ kg mushroom	123.4	117.7	114.1	111.1	104.2	99.3	66.3	47.7
% profit	463.9	364.4	317.8	285.6	227.5	195.8	79.2	46.7
Expected yields (80% of experimental yields)								
Yield in kg ½ t substrate	880.0	700.0	620.0	576.0	480.0	432.0	260.0	212.0
Gross returns (₹)	132000.0	105000.0	93000.0	86400.0	72000.0	64800.0	39000.0	31800.0
Production costs (₹)	29302.0	28302.0	27802.0	28002.0	27502.0	27402.0	27202.0	27102.0
Returns (₹)	102698.0	76698.0	65198.0	58398.0	44498.0	37398.0	11798.0	4698.0
Cost/kg mushroom	33.3	40.4	44.8	48.6	57.3	63.4	104.6	127.8
Return/kg mushroom	116.7	109.6	105.2	101.4	92.7	86.6	45.4	22.16
% profit	350.5	271.2	234.7	208.6	161.8	136.5	43.4	17.3
Pessimistic yields (60% of experimental yields)								
Yield in kg ½ t substrate	660.0	525.0	465.0	432.0	360.0	324.0	195.0	159.0
Gross returns (₹)	99000.0	78750.0	69750.0	64800.0	54000.0	48600.0	29250.0	23850.0
Production costs (₹)	29302.0	28302.0	27802.0	28002.0	27502.0	27402.0	27202.0	27102.0
Returns (₹)	69698.0	50448.0	41948.0	36790.0	26498.0	21198.0	2048.0	-3252.0
Cost/kg mushroom	44.4	53.9	59.8	64.8	76.4	84.6	139.5	170.5
Return/kg mushroom	105.6	96.1	90.2	85.2	73.6	65.4	10.5	-20.5
% profit	237.8	178.2	150.8	131.5	96.3	77.3	7.5	-11.9

Table 3 Costs benefit ratio for optimistic yields (100% experimental yields), expected yields (80% of experimental yields) and pessimistic yields (60% of experimental yields)

Substrates	Optimistic yields (100% of experimental yields)				Expected yields (80% of experimental yields)				Pessimistic yields (60% of experimental yields)			
	Yield in kg ½ t substrate	Gross returns (₹)	Production costs (₹)	Cost benefit ratio	Yield in kg ½ t substrate	Gross returns (₹)	Production costs (₹)	Cost benefit ratio	Yield in kg ½ t substrate	Gross returns (₹)	Production costs (₹)	Cost benefit ratio
Wheat straw	1100.0	165000.0	29302.0	1:5.6	880.0	132000.0	29302.0	1:4.5	660.0	99000.0	29302.0	1:3.4
Hybrid napier	875.0	131250.0	28302.0	1:4.6	700.0	105000.0	28302.0	1:3.7	525.0	78750.0	28302.0	1:2.8
Maize cob shell	775.0	116250.0	27802.0	1:4.2	620.0	93000.0	27802.0	1:3.3	465.0	69750.0	27802.0	1:2.5
Finger millet waste	720.0	108000.0	28002.0	1:3.9	576.0	86400.0	28002.0	1:3.0	432.0	64800.0	28002.0	1:2.3
Blackgram waste	600.0	90000.0	27502.0	1:3.3	480.0	72000.0	27502.0	1:2.6	360.0	54000.0	27502.0	1:1.9
Lentil kernel	540.0	81000.0	27402.0	1:2.9	432.0	64800.0	27402.0	1:2.4	324.0	48600.0	27402.0	1:1.8
Chopped mustard straw	325.0	48750.0	27202.0	1:1.8	260.0	39000.0	27202.0	1:1.4	195.0	29250.0	27202.0	1:1.1
Control	265.0	39750.0	27102.0	1:1.5	212.0	31800.0	27102.0	1:1.2	159.0	23850.0	27102.0	1:0.9

60% the later fruiting better at medium temperature, 24°C – 30°C suiting to different climatic conditions of Uttarakhand were selected for the study of various aspects of their production. Yield up to four flushes was recorded and the bio-efficiency was worked out. The mushrooms were obtained from each bag over a period of 90 days. The cost benefit analysis was done to determine the relative profitability by using yields on wheat straw with following formula, Relative profitability = yield + price – other variable costs – cost of factors (substrates and mix all substrates).

The mushroom yields used were the experimental yields obtained with wheat straw substrates. However, because the yields were typically at the higher end of the yields realized by women self help group, the results were subject to sensitivity analysis for expected, optimistic, and pessimistic yield scenario. Experimental yields were considered as optimistic. A more realistic or expected yield level would be 80% of the optimistic yield while a pessimistic or poor yield would be 60% of the yield (Kelly *et al.* 1995). Thus, to arrive at the expected and pessimistic yields, the experimental data was multiplied by 0.8 and 0.6, respectively. Gross returns were calculated by matching the actual total yield of mushroom obtained from 500 kg of the substrates with the appropriate average mushroom market price (₹ 150/kg).

RESULTS AND DISCUSSION

All the substrates resulted good yield performance on mushroom tremendously and significantly as compared to control. Biological efficiency obtained from wheat straw was 110% and other substrate was below 100%. There was statistically significant good performance from all the substrates on the total yield and the computed BE. The highest yield of *P. djmore* (1 180 g/2kg dry substrate) and *P. sajor-caju* (1 020 g/2 kg dry substrate) was obtained from wheat straw substrate. The yield obtained from the chopped mustard straw substrate was lower and significantly different from other substrate. Wheat straw and hybrid napier proved to be good substrate in achieving good yields of the two species. Similar results were reported by (Pant *et al.* 2012) and (Singh *et al.* 2012).The type of species did not contribute significantly to the mean variations of the total yield and biological efficiency (BE). Average commercial yield was 1 kg of fresh mushroom/kg of dry substrate that is, BE of 100%. However, with special growing practices and care exercised during spawning, pinhead formation, and cropping, BE as high as 150% was achieved under commercial conditions. In the present study, the biological efficiency of 100% was achieved when *P. djmore* was grown on paddy straw substrate (Khare *et al.* 2007).

Table 2 and 3 showed that when 500 kg of wheat straw substrate was a return of ₹ 102 698/month was obtained, with a profit of 351% (Benefit cost ratio1:4.5). This was

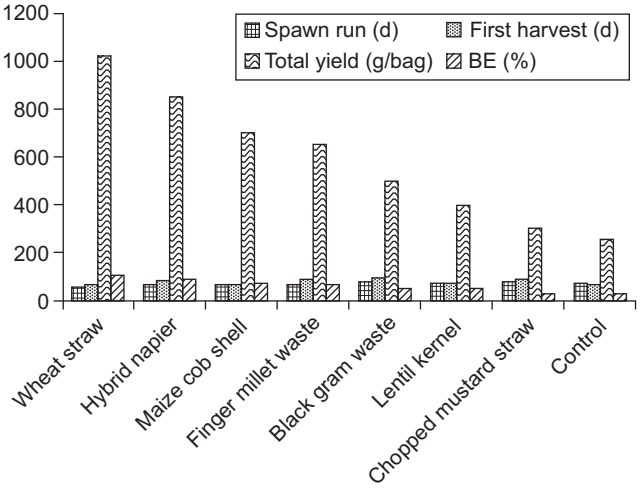

Fig 1 Performance of different substrate of muhroom

Table 4 Fixed production costs (Excluding land rent and depreciation on building) for 500 kg of wheat straw

Item description	Number	Unit cost	Total cost
Substrate	50	60	3000.0
Sterilization chemical (Formaldehyde)	4.5	300	1245.0
Polythene bags	4.5	150	667.0
Grain spawn	33	70	2310.0
Labour	162	90	14580.0
Transport collecting materials			5000.0
Total expenditure			26802.0

achieved when the expected yield (80% of the experimental yield) was taken into account and mushroom sold @ of ₹ 150/kg. A profit of 242% BC ratio 1:4.5, 271%, BC ratio 1:3.7, 235% BC ratio 1:3.3, and 209% BC ratio 1:3, was obtained with wheat straw, hybrid napier, maize cob shell and finger millet waste, respectively. Blackgram waste, lentil kernel and chopped mustard straw though not supported good yield as compared to other substrates also showed a profit of 161% BC ratio 1:2.6 137% BC ratio 1:2.4, 43% and BC ratio 1:1.4, respectively (Pant *et al.* 2012) and (Singh *et al.* 2012).

The lowest yield, the pessimistic yield (60% of the experimental yield) with 500 kg substrate was 44 kg/month, and will generate an income ₹ 69 698/month from a total expenditure of ₹ 29 302. Therefore, even with pessimistic yield *Pleurotus* mushroom cultivation was likely to generate about 100% profit. Chauhan *et al.* (2003) also, calculated cost benefit ratio. The cost benefit analysis portrayed *Pleurotus* mushroom cultivation as a profitable agricultural business, most suited to farmers. The analysis indicated that the business was likely to generate income even with the pessimistic yield and it is very unlikely that the yield will go to that level. Paddy straw and maize cob shell also proved to produce good yield of two *Pleurotus* mushrooms (Singh *et al*. 2012). Farmers may, therefore, choose the substrate and good supplement that are easily available in their areas in order to reduce transport expenses.

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