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Evaluation of Oyster Mushroom Species for Utilization of Resistant Organic Substrates

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Abstract

Four oyser mushroom species viz., *Pleurotus florida, P. sajorcaju, P. oestreatus* and *P.* sp. were evaluated for degradation of coir pith, sugar eane bagasse, aracanut husk and their combination with paddy straw. Results revealed that all the four species have effectively utilized these substrates. Combination of equal quantity of paddy straw enhanced the mushroom yield and percentage biological efficiency. Among different combinations the paddy straw with sugarcane bagasse and aracanut husk were found to be better compared to coir pith : paddy straw combination. Paddy straw alone was found to be superior over other substrates. Utilization of each substrate and their combination varied among the four species of *Pleurotus.*
Key words : Oyster mushroom, Resistant organic substrates, Evaluation.

Oyster mushroom (*Pleurotus* spp.) is the second most important edible mushroom species grown in tropics. It has the capacity to degrade lignin, cellulose and hemicellulose which are resistant to other microbial degradation. Therefore, cultivation of mushroom is the most suitable technology for creating wealth out of waste. There are several studies carried out on the utilization of recalcitrant agricultural wastes to produce oyster mushroom fruit bodies. Different species of *Pleurotus* grown on mycorrhiza inoculated castor and mulberry stalks produced significantly higher fruit bodies compared paddy straw and wheat straw (1). Ouseph et al. (2) reported the efficiency of degradation of paddy straw and coir pitch by *P. sajorcaju* among the four *Pleurotus* species used. *Pleurotus sajorcaju* and *P. florida* when grown on wild grasses in combination with 50% paddy straw produced more yield (3). Similarly, acid hydrolyzed forest leaves with 50% paddy straw yielded 90% bioefficiency (4). Nine species of *Pleurotus* evaluated using coconut leaf stalk produced higher mushroom yield and biological efficiency (5). *Pleurotus* sp. supplemented with cell crude extract of *Bacillus, Trichoderma* and yeast sludge revealed rapid degradation of coir pith (6). Sangeetha and Theradimani (7) successfully cultivated *Pleurotus* species on various agro-waste including sugarcane bagasse. In Karanataka, lignocellulose rich organic substrates viz., coir pith, sugarcane baggasse, aracanut husk are abundantly available. These remained unutilized and burnt frequently in the field. Hence, mushroom cultivation technology is found suitable for conversion of these wastes into food. However, biodegradation of lignocellulose rich wastes, which are abundantly available, are limited due to low yield, inconsistency in flush appearances and its adoption particularly by mushroom species. The present study explores the efficiency of four *Pleurotus* species on utilization of coir pith, aracanut husk and sugarcane bagasse with 50% paddy straw combination to produce higher yield.

Methods

Four species of *Pleurotus* namely, *P. florida, P. sajorcaju, P. oestreatus* and *P.* sp. were obtained from Mushroom laboratory of the Indian Institute of Horticultural Research, Hesaragatta (ICAR), Bangalore and used for evaluation.

Spawn Production

Spawn for all the four species of oyster mushroom was prepared using sorghum grains. Healthy sorghum seeds were washed in water and boiled for 45 minutes or until the seed softened. Water was decanted and the seeds were shade dried on clean polythene sheet. The seeds were mixed with 2% each $CaCO_3$ and $CaSO_4$. These treated seeds were filled in

Table 1. Effect of different substrates on yield of four species oyster mushroom. Means with the same superscript do not differ significantly at *P*= 0.05 level by Duncan's multiple range test.

	Fresh weight of mushroom (g)			
Treatments	*P. florida*	*P. sajorcaju*	*P. oestreatus*	*P.* sp.
Paddy straw	513.33^{a}	510.00^{a}	503.33^{a}	496.67^{a}
Paddy straw + coir pith	306.66^{c}	413.33^{b}	388.33^{bc}	365.00^{c}
Coir pith	243.33^{c}	276.67^{d}	311.66^{c}	285.00^{d}
Paddy straw + sugarcane baggasse	490.00^{a}	340.00^{c}	366.00^{c}	436.67^{b}
Sugarcane baggasse	383.33^{b}	374.33^{bc}	382.00^{bc}	381.67^{c}
Paddy straw + aracanut husk	495.00^{a}	405.00^{b}	455.00^{ab}	426.67^{b}
Aracanut husk	385.00^{b}	371.67^{bc}	348.33^{c}	378.33^{c}
LSD at 0.05%	67.57	41.80	70.88	42.98

Table 2. Effect of different substrates on biological efficiency of four species oyster mushroom. Means with the same superscript do not differ significantly at *P*=0.05 level by Duncan's multiple range test.

	Biological efficiency (%)			
Treatments	*p. florida*	*p. sajorcaju*	*p. oestreatus*	*P.* sp.
Paddy straw	51.33^{a}	51.00^{a}	50.33^{a}	49.67^{a}
Paddy straw + coir pith	30.67^{c}	41.33^{b}	38.50^{b}	36.50^{d}
Coir pith	24.33^{c}	27.67^{d}	31.67^{b}	28.50^{e}
Paddy straw + sugarcane baggasse	49.17^{a}	34.00^{c}	36.60^{b}	43.67^{b}
Sugarcane baggasse	38.33^{b}	37.43^{bc}	38.20^{b}	38.17^{cd}
Paddy straw + aracanut husk	51.67^{a}	40.50^{b}	45.83^{a}	41.00^{bc}
Aracanut husk	38.50^{b}	37.17^{bc}	34.83^{b}	37.83^{cd}
LSD at 0.05%	6.53	4.18	7.04	3.79

saline bottles of 500 ml capacity up to 3/4th of the bottle. Mouth of the bottles were plugged with cotton and sterilized at 121 C, 151b psi for 30 minutes. The sterilized bottles were cooled to room temperature and the grains were inoculated with mushroom mycelium aseptically. The bottles were incubated at room temperature for 15 days to attain full growth of mushroom mycelium on the grains.

Substrate Preparation

The substrate namely, coir pith, sugarcane baggasse, aracanut husk and paddy straw were procured from the abundantly available regions of Karnataka. Paddy straw and sugarcane baggasse were cut into approximately 4—6 cm bits and coir pith and aracanut husk were used as such. One kg each of the substrate either singly or in combination was soaked in water over night and sterilized. The substrates were cooled on sterilized polythene sheet and used for inoculation. There were three replications for each treatment. Based on the treatment allocation, spawn of different oyster mushroom species were inoculated to the substrate layer by layer in polythene bags (45.7 × 53.3 cm). The mouth of the bags were tied with rubber bands and incubated at room temperature in the cropping room for 20 days. After 20 days, the polythene bags were opened and removed by cutting on the edge. Then water was sprinkled on the spawn run substrate to maintain the moist condition for fruiting body formation. Mushroom fruit bodies were harvested as and when they occur until third harvest. Percent biological efficiency was calculated using the formula given below.

$$\text{Bioefficiency (\%)} = \frac{\text{Fresh weight of mushroom (g)}}{\text{Dry weight of the substrate}} \times 100$$

The data were analyzed using Mstat-C software. The treatment means were separated by using Duncan's multiple range test (DMRT).

Results and Discussion

The results are presented in Tables 1 and 2 for yield and percentage biological efficiency respectively. All the four species of *Pleurotus* grown on paddy straw alone produced significantly higher sphorophore yield and biological efficiency compared to coir pith, sugarcane bagasse and aracanut husk. Paddy straw has been proved to be superior substrate for oyster mushroom production compared to any agricultural waste used so for (7). The next best substrates were the sugarcane bagasse and aracanut husk respectively. The coir pith produced least mushroom yield. Coir pith is rich in lignin content and resistant to degrade (2). However, the study indicated the feasibility of utilizing coir pith for the production of edible mushroom fruiting bodies while decomposing as indicated in earlier studies. Further, the other two substrates viz., sugarcane bagasse and aracanut husk also produced relatively higher yield. This indicated the possibility of utilization of these substrates as alternatives to minimize the waste augmentation in abundantly available regions. In the earlier studies of Sangeetha and Theradimani (7), *P. citrinopileatus* cultivated on sugarcane bagasse produced higher biomass. Balakrishna et al. (8) observed moderate yield of *P. sojorcaju* cultivated on cotton and sunflower wastes. Among the combinations of paddy straw with other substrates at 1 : 1 ratio, the combination of paddy straw + aracanut husk recorded highest yield and percent biological efficiency which followed by the paddy straw + sugarcane bagasse and paddy straw + coir pith. This indicated that the combination of all the three alternative substrates with paddy straw at equal proportion are ideal combination for obtaining higher yield in all the four species. Das et al. (3) reported significantly higher yield of oyster mushroom on the substrate mix prepared with equal quantity of wild grass and paddy straw. However, utilization of these substrates by different species varied in terms of yield and percentage biological efficiency. Of the three combinations, *P. florida* produced significantly higher mushroom yield in paddy straw + sugarcane bagasse combination which is followed by *P. oestreatus* and *P.* sp., *P. sajorcaju* and *P. oestreatus* have revealed higher fruit bodies in paddy straw + aracanut husk and paddy straw + coir pith. This indicated their efficiency in degrading the coir pith when mixed with paddy straw at equal quantity. The varied rate of degradation between the species is due to the extracellular enzyme producing ability of the *Pleurotus* species (9). Shah et al. (10) reported the maximum sphorophore yield and percentage bioefficiency of *P. oestratus* grown on saw dust. A substrate combination of 25% coconut residue and 75% saw dust encouraged to produce higher yield and bioefficiency by *P. oestreatus* (11).

Thus, the present study envisaged that the lignocellulose wastes like coir pith, sugar-cane bagasse, aracanut husk which are locally available can be degraded by using oyster mushroom species. The combination of these substrates with paddy straw at equal quantity can be used as alternative substrate for mushroom production. Utilization of these substrates depends upon the ability of the *Pleurotus* species.

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