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A comparative study on cultivation and nutritional status of Oyster Mushroom *Pleurotus ostreatus* on different substrates

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Abstract

Four different substrates such as paddy straw, sugarcane trash, banana leaf sheath, and leaf litter were evaluated for the cultivation of the oyster mushroom *Pleurotus ostreatus* individually and in combinations. Spawn running, pin heads formation, fruitbody formation, yield of mushroom, number of fruiting bodies, biological efficiency and nutritional status (protein, carbohydrates, amino acid and lipid) were higher when paddy straw was used as a substrate when compared to the other substrates.

Keywords : oyster mushroom, *Pleurotus ostreatus*, nutritional status, substrates, biological efficiency

INTRODUCTION

Incorporation of non-conventional crops in existing agricultural system can help in improving the social as well as economic status of small farmers. Mushroom cultivation is one of the profitable agribusinesses. The technology of cultivation of mushroom is somewhat a recent innovation. Oyster Mushroom (*Pleurotus ostreatus*) is an edible mushroom having excellent flavour and taste. It belongs to the Class Basidiomycetes, Sub Class Homobasidiomycetidae and Order Agaricales.

Mushrooms are the source of protein and medicine. They are used in the preparation of many continental dishes and have medicinal properties as they possess anticancerous, anticholesteral and antitumorous compounds (Shah *et al.,* 2004). Mushrooms are useful foods as well for patients suffering from diabetes, ulcer and lung diseases (Quimio, 1976).

India has a large number of agro-climatic regions that offer favourable climatic conditions for diverse crops. There are enormous potential of agro-wastes in India, which include crop residues, tree wastes and aquatic weeds, and they form one of the potential renewable resources. Every year about 300 million tons of agro-wastes are produced from major crops like paddy, wheat, cereals etc., in India, especially the state of Tamil Nadu is producing about 20 million tons of crop residues annually. But all these agro-wastes are not utilized properly. This paper examines the use of various agro-wastes for the cultivation of Oyster Mushroom *Pleurotus ostreatus.*

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MATERIALS AND METHODS

Spawn

Mother spawn of Oyster Mushroom (*Pleurotus ostreatus*) was obtained from Tamil Nadu Rice Research Institute (TRRI), Aduthurai, Tamil Nadu, India. It was multiplied in half cooked sorghum grains filled in saline bottle/ polypropylene bag and sterilized at 121° C for 30 min. The bottles were incubated for 15 days for the complete establishment of mycelium over the cereal grains. The spawn bottles were stored for further use.

Preparation of mushroom bed

The substrates used for the cultivation of Oyster Mushroom were i) banana leaf sheath (BL), ii) sugarcane trash (ST), iii) leaf litter, iv) paddy straw (PS), v) banana leaf sheath (50%) + sugarcane trash (50%), vi) banana leaf sheath + leaf litter, vii) banana leaf sheath + paddy straw, viii) sugarcane trash + leaf litter, ix) sugarcane trash + paddy straw and x) leaf litter + paddy straw. The substrates were soaked in water for 6 hrs and sterilized in boiled water for 10 min. They were dried on cemented floor under shades until the excessive moisture is removed. The bed was prepared by using different combinations and individually layer by layer with the spawn of mushroom. After preparation the substrate beds were kept at 20-25° C in the spawn running rooms. All substrates were inoculated in the same day. Mushroom cultivation has two important phases *viz.,* spawn running and fructification, during which temperature and humidity are the two vital factors that facilitate the completion of these two processes. The humidity of bags were maintained at the desired level by spraying water.

The time taken for the completion of growth of mycelium on substrates, appearance of pinheads, and maturation of fruiting bodies were recorded. The data were also

recorded for the yield in terms of number of fruiting bodies and biological efficiency of substrates. The total biological efficiency was worked out against the dry weight of each substrate.

Quantitative estimation of total proteins
(Lowry *et al*., 1951)

One hundred mg of ground samples of mushroom was taken into a clean test tube, 5 ml of 10% tricholoro acetic acid (TCA) was added and kept in a waterbath for 30 min. The content was cooled and centrifuged at 5000 g for 5 min. The pellet was dissolved in 5 ml of 1 N NaOH. One ml of this solution was taken and made upto 1 ml with distilled water, 5 ml of alkaline reagent was added and incubated for 3 min. Then 0.5 ml of folin phenol reagent was added to the mixture and allowed to stand for 30 min. After mixing thoroughly, the absorbance was read at 750 nm in a spectrophotometer (Systronic 20, Miltone Roy, USA). The amount of protein was obtained from a standard graph.

Estimation of total carbohydrates (Dubois *et al*., 1956)

One hundred mg of mushroom sample was ground, taken in a test tube, and then hydrolysed with 2 ml of 96% percent conc. H_2SO_4 for 30 min at 100° C. 0.5 ml of this hydrolysate was taken and one ml of 5 percent phenol and 5 ml of H_2SO_4 were added and mixed thoroughly. The colour developed was measured at 490 nm in Spectrinic 20. The amount of carbohydrate was estimated from a standard graph.

Quantitative estimation of free amino acids (Jeyaraman, 1981)

One hundred mg of mushroom sample was taken and ground with 80 per cent ethanol in a pestle and mortar and homogenized. The homogenate was centrifuged at 15,000 g. One ml of the supernatant was diluted to 5 ml (1:4 conc.) with distilled water, one ml of ninhydrin reagent was added and kept in a water bath for 15 min. Then the tubes were cooled and one ml of 50 per cent ethanol was added. The purple colour developed was measured in Spectronic-20 at 450 nm. Standard graph was made using a mixture of alanine, aspartic acid, tryptophan, proline and lysine. The result was recorded as mg/g of the samples.

Estimation of total lipids (Sato and Murata, 1988)

One hundred mg of fresh mushroom sample was homogenized in a pestle and mortar with extraction solvent and filtered through filter paper. The moisture in the filtrate was removed with sodium sulphate in a vortex mixer. Then it was taken in a pre-weighed bottle and dried with a steam of nitrogen. The dried extract was weighed and the total lipids were estimated by subtracting the initial weight from the final weight. The amount of total lipids was expressed as mg/g fresh weight.

RESULTS AND DISCUSSION

The spawn running, pinheads formation and fruit body formation are three important phases in the cultivation of mushroom which require proper humidity and temperature. In the present study it was found that temperature 20-25° C and 17-20° C were optimum for spawn running and fructification, respectively. It has also been reported earlier that 25° C is the optimum temperature for mushroom spawn running and 17-20° C for fructification (Shah *et al*., 2004).

Spawn running

Spawn running is the primary phase of mushroom cultivation. Spawn running took 2-3 weeks after inoculation (Table 1). The results clearly support the findings of Tan (1981) who reported that the spawn running took 3 weeks and fruit bodies appeared 2-3 days after the composition of spawn running.

Pinheads formation

The pinheads formation is the second stage of mycelial growth during cultivation of mushroom. Small pinheads like structure were observed. Pinheads were formed 2-3 days after the spawn running. The present findings support the previous report of Ahmad (1986) who stated that *Pleurotus ostreatus* completed spawn running in 17-20 days.

Fruit body formation

Fruit body formation is the third and final stage of mushroom cultivation. The fruiting bodies developed 24-34 days after inoculation of spawn (Table 1). These results are similar to the previous findings of Quimio (1976, 1978), who reported that fruit bodies were formed 3-4 weeks after inoculation of spawn.

Yield of Oyster Mushroom

The crop of oyster mushroom was harvested in three flushes. The yield was more in the first flush than in the second and third flushes. Maximum average yield 526 g was from the paddy straw and minimum 68 g was recorded from sugarcane trash (Table 2). So paddy straw could be a suitable substrate for the cultivation of oyster mushroom. Similar result has also been reported by Usha and Panneerselvam (2004) for the milky mushroom *Calocybe indica*.

Number of fruiting bodies

The caps of oyster mushroom were also counted in three flushes, and the average range of three flushes was found to be 11-24 (Table 1). Paddy straw and leaf litter produced more number of fruit bodies than other substrates used for cultivation of mushroom (Table 1).

Biological efficiency

The biological efficiency was determined against the

Table 1. Time course for completion of spawn running, fruiting bodies formation and pinheads formation of the oyster mushroom *P. ostreatus* in different substrates

Name of the substrate	Spawn running (days)	Pinheads formation (days)	Fruiting bodies formation (days)	Average no. of fruiting bodies
Banana leaf sheath (BL)	21	27	34	11
Sugarcane trash (ST)	20	26	30	12
Leaf litter	16	23	24	18
Paddy straw (PS)	15	20	24	18
Banana leaf sheath + sugarcane trash (BL & ST)	20	25	32	14
Banana leaf sheath + leaf litter (BL & leaf litter)	20	26	31	18
Banana leaf sheath + paddy straw (BL&PS)	18	24	29	16
Sugarcane trash + leaf litter (ST & Leaf litter)	19	25	31	15
Sugarcane trash + paddy straw (ST & PS)	18	24	30	14
Leaf litter + paddy straw (leaf litter & PS)	16	22	25	22

Table 2. Weight and average yield of oyster mushroom *P. ostreatus* in different substrates and biological efficiency of different substrates in oyster mushroom cultivation

Name of the substrate	Weight of substrate (g)	Average yield (g)	Biological efficiency (%)
Banana leaf sheath (BL)	1000	79.2	7.92
Sugarcane trash (ST)	1000	68	6.8
Leaf litter	1000	152	15.2
Paddy straw (PS)	1000	526	52.6
Banana leaf sheath + sugarcane trash (BL & ST)	1000	74	7.4
Banana leaf sheath + leaf litter (BL & leaf litter)	1000	128	12.8
Banana leaf sheath + paddy straw (BL & PS)	1000	276.9	27.69
Sugarcane trash + leaf litter (ST & leaf litter)	1000	148.4	14.84
Sugarcane trash + paddy straw (ST & PS)	1000	310	31.0
Leaf litter + paddy straw (Leaf litter & PS)	1000	478.6	47.86

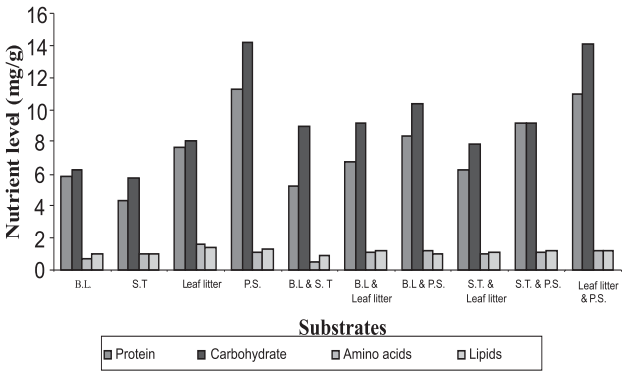

Figure 1. Nutritional status of *Pleurotus ostreatus* on different substrates (see Table 1 for description of different substrates)

dry weight of each substrate. Paddy straw as a substrate showed greatest biological efficiency (52.6%) followed by leaf litter + paddy straw (47.86%), sugarcane trash + paddy straw (31.0%), banana leaf sheath + paddy straw (27.69%), leaf litter (15.21%), sugarcane trash + leaf litter (14.84%), banana leaf sheath + paddy straw (12.8%), banana leaf sheath (7.92%), banana leaf sheath + sugarcane trash (7.4 %) and sugarcane trash (6.8%) (Table 2). Similarly, Shah *et al.* (2004), Hami (1990) and Usha and Panneerselvam (2004) also reported that *P. ostreatus* gave maximum bio efficiency on saw dust and paddy straw. Thus the present and previous reports suggest that the farmers could effectively utilize the agro wastes such as paddy straw, leaf litter, banana leaf sheath, sugarcane trash and saw dust to cultivate mushrooms.

Mushrooms are the best source of various nutrients especially proteins and carbohydrates. The nutrient status of the Oyster Mushroom (*Pleurotus ostreatus*) varied in different substrates and their combinations (Fig.1). Maximum content of proteins and carbohydrates were recorded in the mushrooms when either paddy straw or leaf litter + paddy straw were used as substrates for the cultivation of mushroom, while minimum content of protein and carbohydrates were recorded when cultivated on sugarcane trash. The amounts of amino acids and lipid contents were very low (0.5-1.5 mg/g) in all the substrates used for the cultivation of mushroom (Fig. 1). Paddy straw was found to be a suitable substrate for the cultivation of *Calocybe indica* (Milky Mushroom), yield and nutrient composition (vitamins and minerals) by Usha and Panneerselvam (2004) and also for Oyster Mushroom by Hami (1990). So it is concluded that paddy straw is a suitable and low cost substrate for the cultivation of mushrooms.

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