

Full Length Research Paper

Cultivation of oyster mushroom (*Pleurotus* spp.) on palm oil mesocarp fibre

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Oyster mushroom is a popular mushroom due to its nutritional, medicinal and potential commercial value. In Malaysia, the fungus is currently cultivated on sawdust and rice husk. In this study, the efficiency of cultivating oyster mushroom was assessed using palm oil mesocarp fibre as a substrate. The experiment consisted of four samples; sample A (composed of 100% mesocarp fibre), sample B (composed of 88% fiber, 10% rice bran and 2% lime), sample C (composed of 85% fiber, 10% rice bran and 5% lime), and sample D (composed of 50% fibre, 10% rice bran, 38% sawdust and 2% lime). Different spawn running time was determined and fruiting bodies were also observed. Results indicate that samples B, C, and D fruiting bodies were higher and better than that in sample A, thus establishing that palm oil fibre served as a good substrate for the cultivation of *Pleurotus* spp. A further study on the protein composition of oyster mushroom (*Pleurotus* spp.) is however suggested.

Key words: *Pleurotus*, mycelium, mushroom, spawn, cultivation, mesocarp fibre.

INTRODUCTION

Cultivation of oyster mushroom has been universally recognized because of its nutritional value and minimal technology. This type of mushroom obtains its nutrient by decomposing various agricultural by-products due to its saprophytic nature. Cultivation of edible mushroom is a biotechnology process, which aids in reducing and equally protecting the environment from excess solid waste (Mshandete and Cuff, 2008; Sánchez, 2010). Oyster mushrooms have ability to grow at wide range of temperatures and utilizing various lignocellulose substrates (Khan and Garcha, 1984). Species of *Pleurotus* are usually found to be most efficient in the degradation of lignocellulose substrates among all types of white rot fungi (Das and Mukherjee, 2007). It is composed of 90% water and 10% dry matter (Morais et al., 2000; Sánchez, 2004). Malaysia is among the leading palm oil producer worldwide. Therefore, it is expected to produce large amount of wastes.

A lot of studies were reported on the suitability of

various substrates for mushroom production namely straws of rice (*Oryza sativa*), wheat (*Triticum vulgare*), ragi (*Elucine coracana*), bazra (*Pennisetum typhoides*), sorghum (*Sorghum vulgare*), maize (*Zea mays*) (Bano et al., 1987; Goswami et al., 1987; Gupta and Langar, 1988), woods of poplar (*Populus robusta*), oak (*Quercus leucotrichopora*), horse chest nut (*Aesculus indica*), *Acasia* sp., chopped banana pseudostem, cotton stalk, pea shells and poplar saw dust (Philippoussis et al., 2001; Zervakis et al., 2001). These substrates are however not available in large quantities compared to palm oil mesocarp fibre in Malaysia. Availability of mesocarp fibre is due to the activities of palm oil mills. Hence, it will be of interest to utilise mesocarp fibre for the cultivation of mushroom. However, mushroom has nutritional and medicinal values, and hence developed high commercial interest in recent times. For this reason, there is need to have a constant supply of the substrates which is readily available with low cost price rather than depend on specific types of materials or some seasonal forest supply for cultivation of mushroom (Onuoha et al., 2009). Most of the commercial producers of mushroom in Malaysia presently are using sawdust and rice husk. Thus, there is need to identify alternative and suitable

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Table 1. Percentage ratio of substrates in sample mixtures.

Sample	Substrate	Substrate ratio (%)
Sample A	MF	100
Sample B	MF:RB:L	88:10:2
Sample C	MF:RB:L	85:10:5
Sample D	MF:RB:SD:L	50:10:38:2

MF, Mesocarp fibre; RB, rice bran; SD, saw dust; L, lime.

substrate for mushroom cultivation.

The use of palm oil mesocarp fibre which is readily available at low cost will reduce the rate of waste generated in palm oil mills. According to Sreekala et al. (1997), mesocarp fibre are left as a waste material after oil extraction, creating great environmental problems. There-fore economic utilization of these fibre will be beneficial to the commercial cultivators and the country as a whole. Similarly, utilization of agricultural waste as growing media for the production of mushroom play a key role in reducing the waste and at the same time useful as a fertilizer (Sher et al., 2011). The objective of this study was to explore the viability of cultivating oyster mushroom on the palm oil mesocarp fibre.

MATERIALS AND METHODS

The experiment was conducted at Mushroom Ambra Biotech Sdn Bhd, Kulai Jaya, Johor Bahru, Malaysia. Pure culture of *Pleurotus* spp. was prepared on agar medium composed of 20 g agar and 10 g dextrose. The mixture was boiled on a gas burner until it was solubilized. The medium was dispensed into glass Petri dishes (100 × 15 mm). The Petri dish containing the medium was sterilized in an autoclave for 20 min at 120°C under 1 kg/cm² pressure. The solidified media were inoculated with *Pleurotus* spp. The tissues were collected from the inner region of stalk of sporophore. The tissues were cut into pieces and placed on the solidified Petri dish containing potatoes dextrose agar. The inocula were transferred to a growth chamber which was maintained at ≤ 30°C and incubated for eight days.

Spawn preparation

The method of Patil et al. (2010) for spawn preparation was adopted for this study. The spawn was prepared in a polystyrene bag. Wheat grains boiled in a water bath for 20 min and mixed with 4% (w/w) CaCO₃ and 2% (w/w) CaSO₄ were used. The grains were inoculated with actively growing mycelium of the *Pleurotus* spp. from malt extract slant and incubated for mycelia growth for 14 days until the mycelium fully covered the grains in a room temperature maintained at 30°C. Completely covering the grains with mycelium rapidly colonizes the bulk growing substrate (Sánchez, 2010).

Substrate preparation for cultivation

The palm oil mesocarp fibre was collected from Tai Tak Palm Oil Mill, Kota Tinggi, Johor State, Malaysia. The substrate was spread to dry and the impurities were removed manually, it was then milled my electric miller to reduce the particle size, then palm oil mesocarp

fibre was chopped to small particles. A total of 10 kg was used (Table 1): Sample A (100% mesocarp fibre), sample B (88 % mesocarp fibre, 10 % rice bran and 2 % lime), Sample C (85% mesocarp fibre 10% rice bran, and 5% lime), and Sample D (50% mesocarp fibre, 38 % saw dust, 10% rice bran and 2% lime). The constituents of each sample were thoroughly mixed. Rice bran was added to balance carbon / nitrogen ratio and lime to maintain the pH of the mixture. The mixture was then transferred to polypropylene bags of 15 by 30 cm long. The top of the bags were fitted with PVC necks, which served as the opening, and then covered with brown paper. The bags filled with the mixture were taken to the autoclave and sterilized at 130°C for 4 h. After sterilization, the bags were left to cool and later inoculated with prepared spawn; 20 g of spawn to 1.3 kg of the mixture. The bags were then marked and stored on the shelf with an indirect sun light at a temperature of 26°C under 80 to 85% relative humidity.

Cultivation of oyster mushroom

The method of cultivation as described by Sarker et al. (2007) was adopted for this research. After the mycelium run covered the entire packets then the brown paper, rubber cap and the plastic neck were removed. The openings of the packets were opened for watering twice in a day (morning and evening). Proper ventilation was maintained for the fruiting body to develop quickly and later harvested by gently twisting the fruit.

Statistical analysis

The results obtained were statistically analysed using analysis of variance (ANOVA), and tests of significance carried out by Duncan's multiple range test (Steel and Torrie, 1980) at P≤0.05.

RESULTS AND DISCUSSION

The mycelium running time in the column bag, spawn packet and numbers of days required from the time of inoculation to harvesting of the mushroom using different mix ratio, shows a significance difference with the sample which contains mesocarp fibre alone (Figure 1). Mycelium running time in sample A was slow however, it was fast in samples B, C, and D at almost equal rate. The fastest spawn running time of mycelium in mother culture was observed between second and third weeks which give an average of 8 cm spawn running (Figure 1). The spawn running time, using different levels of substrate in the mixtures, was plotted as a linear growth of *Pleurotus* spp. in cm against the spawn running time in weeks.

The variations in the spawn running time using different

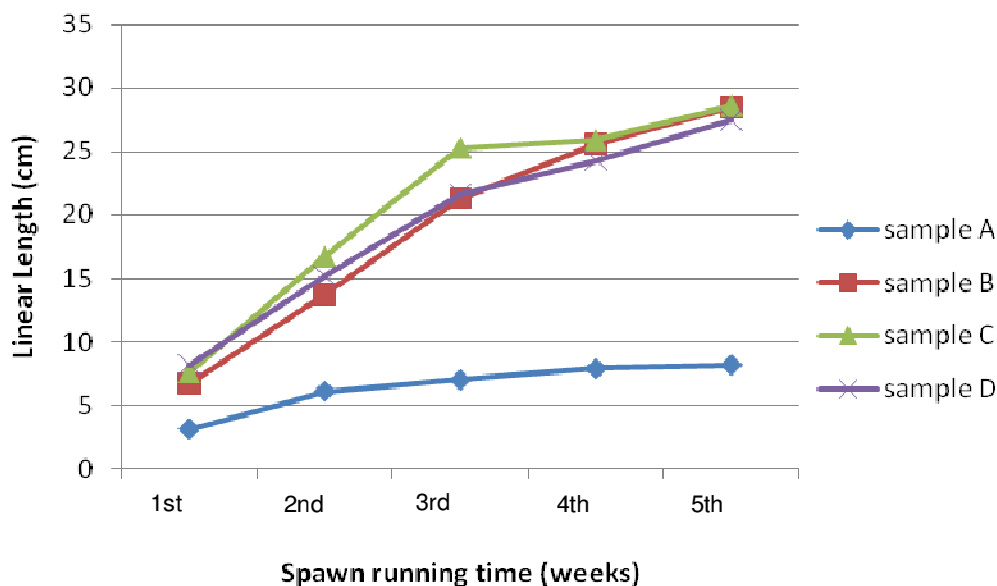


Figure 1. Spawn running time using different mix ratio.

Table 2. Parameters of mushroom yield.

Sample	Average number of fruit body	Average fresh weight of fruit body (g)	Average dry weight of fruit body (g)	Water content of the fruit body
Sample A	-	-	-	-
Sample B	6.8	9.1	6.3	30.8
Sample C	6.7	9.2	6.2	32.6
Sample D	6.4	9.0	6.0	33.3

supplements (Figure 1), shows that the rapid spawn running took place between second and third week of incubations. The potential variation in the production was due to different substrate combination in both physical and nutritional composition. The slow spawn running and low yield of mushroom due to sample A was attributed to its high water holding capacity, high oil content and lack of nitrogen to balanced the C/N ratio and the lime to maintain the pH. In a related study, it was established that low yield and slow spawn running was due to non additional supplement to balance the production process (Pani, 2010). The results of this study do not concur with the findings of Ahmed (1986), who reported that species of *Pleurotus* complete the spawn in at least 20 days and fruit head formation in 27 days. The spawn running time and fruit head formation observed in this study were longer than previous by Ahmed (1986). This was due to difference in type of substrate, oil content of the fibre and water holding capacity. However, this research agreed with the findings of Shah et al. (2004) who reported that the fruiting from the bodies started appearing from 27 to 34 days after inoculation. This study on palm oil mesocarp fibre can also be compared to the study carried out by Pathmashini et al. (2008), who reported that

sorghum, kurakkan, maize and paddy are suitable as a substrate for mushroom cultivation. Organic supplement increases the yield of the production, but Mane et al. (2007) corroborated that supplementation enhanced the yield, though not yet adopted by many commercial cultivators.

From the results in Table 2, the average weights of the fruiting bodies cultivated on samples B, and C, were higher than that in sample D. The values are the average of ten replicate. Values in both the average number of fruiting bodies and that of average fresh weight of fruiting bodies are not significantly different according to Duncan's multiple range test ($p \leq 0.05$). Sample D was lower due to the addition of the saw dust which may increase the carbon content of the substrate. There was no much significance difference in the percentage of water content of the fruiting bodies and similarly, there was no significant different between the average dry weight of the fruiting bodies since $P \leq 0.5$ gives high percentage confidence interval difference as earlier reported by Dundar et al. (2009). The results equally confirms the report of Onuoha et al. (2009) which shows 32% of water content of the fruiting bodies to that of the study which gives 30.8, 32.6 and 33.3% respectively.

Sample A was however unable to grow, as it was observed that it retained high water and oil content, thus affecting the level of growth.

Conclusion

Oyster mushroom presents a promising potential for treatment of waste generated in the palm oil mill. Substrate mixtures made of mesocarp fibre + rice bran + lime, and that of saw dust with mesocarp + rice bran + lime are viable materials for mushroom cultivation, since they increased the mushroom yield. Mesocarp fibre when used alone, was affected by high moisture and oil content which leads to low yield. Oyster mushroom cultivation on palm oil-mesocarp fibre indicates that it is a method of reducing mesocarp fibre as a waste in the mill and thereby producing protein rich food. Therefore palm oil mesocarp fibre could be used as a substrate for the production of mushroom just as other types of lignocelluloses materials.

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