Cey. J. Sci. (Bio. Sci.) 37 (2): 177-182, 2008

CULTIVATION OF OYSTER MUSHROOM (*PLEUROTUS OSTREATUS*) ON SAWDUST

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Accepted 25 November 2008

ABSTRACT

A study was conducted to examine the effect of different types of spawns on oyster mushroom (*Pleurotus ostreatus*) production using sawdust. Locally available grains of kurakkan (*Eleusine coracana*), maize (broken) (*Zea mays*), sorghum (*Sorghum bicolor*), and paddy (*Oryza sativa*) were used for spawn production. Sawdust spawned with different types *P. ostreatus* spawns were examined for spawn running (mycelia development), pinhead formation and fruit body formation, mean yield, and biological efficiency. The experiment was setup as a complete randomized design with three replicates. The kurakkan spawn produced an acceleration of spawn running, pinhead formation, fruit body formation and increased yield, compared with other types of spawn *viz.*; maize, sorghum, and paddy. The fastest spawn running of 21 ± 1 days, pinhead formation of 35 ± 1 days, highest mean yield of 55.37 ± 0.67 g and maximum fresh mushroom yield percentage of 30.76 ± 0.01 were realized for kurakkan spawn.

Key words: *Eleusine coracana*, *Pleurotus ostreatus, Sorghum bicolor*, *Oryza sativa, Zea mays*, spawn

INTRODUCTION

Oyster mushroom (*Pleurotus* spp.) cultivation has increased tremendously throughout the world during the last few decades (Chang, 1999; Royse, 2002). Oyster mushroom accounted for 14.2 % of the total world production of edible mushroom in 1997 (Chang, 1999). Oyster mushroom cultivation can play an important role in managing organic wastes whose disposal has become a problem (Das and Mukherjee, 2007). Oyster mushroom can be cultivated in any type of ligno cellulose material like straw, sawdust, rice hull, etc. Hami (1990) studied the oyster mushroom cultivation on sawdust of different woods and found that *P.ostreatus* gave the maximum yield. Presently sawdust is commonly used and is the preferred medium at commercial scale. Hami (1990) reported that *P.ostreatus* gave maximum biological efficiency on sawdust. Of the sawdust types, softwood sawdust like mango and cashew are known to be more suitable than hardwood sawdust.

Malnutrition is a problem in developing third world countries. Mushrooms with their flavour, texture, nutritional value and high productivity per unit area have been identified as an excellent food source to alleviate malnutrition in developing countries (Eswaran and Ramabadran, 2000). Among the reasons for the quick acceptance of mushroom is its nutritive content. Mushrooms are eaten as meat substitutes and flavouring. In general edible mushrooms are low in fat and calories, rich in vitamin B and C, contain more protein than any other food of plant origin and are also a good source of mineral nutrients (Bahl, 1998).

Currently, high biofuel prices have caused an increase in food prices and food scarcity in many countries (World Bank, 2008). To alleviate hunger and malnutrition in a world of rising food prices, cultivation of mushrooms is a very reliable and profitable option.

The objectives of this study were to evaluate selected grain media for spawn production and find out the most suitable media for spawn production.

MATERIALS AND METHODS

Location

The spawn production was carried out at the Industrial Technology Institute (ITI), Colombo. Experiments were carried out in a pre built mushroom hut at the Faculty of Agriculture, Eastern University.

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Stock pure cultures

Stock pure culture of *P. ostreatus* obtained from Industrial Technology Institute (ITI), Colombo was maintained on Potato Dextrose Agar (PDA).

Spawn production

The grains, kurakkan, maize, sorghum and paddy were cleaned manually to remove inert matter, stubble and debris. The cleaned grains were soaked in 0.5% $CuSO_4$ for 10 min and the soaked grains were thoroughly washed and soaked in tap water for 2 hours. Thereafter, the soaked grains were drained and the excess water removed and the following additives added. Rice bran at the rate of 10%, chalk ($CaCO_3$) at the rate of 2%, and epsom ($MgSO_4$) at the rate of 0.2% on dry weight basis of the grains. The additives were thoroughly and evenly mixed with the grains. The grain medium was filled in to polypropylene bags (200 gauges, 37.5 cm long, and 17.5 cm wide). About 200 g of medium was packed in each bag. The bags were sealed using cotton wool plugged conduit/ poly vinyl chloride pipe rings, and covered by a piece of paper by tying a rubber band around the neck. The bags were autoclaved at 121^{o}C, 15 psi, for 30 min and the sterilized bags were allowed to cool for 24 hours. The bags were immediately inoculated with mycelial culture of *P. ostreatus* maintained on PDA.

Media preparation

A medium was prepared using sawdust of mango, rice bran (at the rate of 10%), chalk (at the rate of 2%), and epsom (at the rate of 0.2%) on the dry weight basis of the substrate and were mixed thoroughly with water. The correct water content was checked by pressing the medium by hand. The medium was filled into polypropylene bags. About 800 g of medium was packed into each bag.

The bags were then sealed, autoclaved and inoculated with the four types of spawn sorghum (T1), kurakkan (T2), maize (T3), and paddy (T4). Sawdust substrate in bags were inoculated with approximately 2 g of spawn using surface spawning technique under laminar flow and incubated in a dark chamber.

Determination of spawn run

The growth of mycelium (linear length) in each bag was measured by a measuring tape at 6 day intervals. Using this data, spawn run rate (cm/day) was determined for every spawn type. When the mycelium fully covered the substrate bag (spawn run completed), bags were kept open in the growing house. The days required for the completion of spawn running in the substrate bag were recorded. Days for pinhead formation, fruit body (flush) formation and for harvest was recorded.

Mushroom yield

Total mushroom yield (five flushes) was expressed as accumulated fresh weight of mushrooms and as the accumulated biological efficiency (BE), *i.e.* accumulated fresh weight of mushrooms expressed on the basis of dry weight of initial substrate.

Experimental design

In the experiments complete randomized design with three replicates and four types of spawn were tested *viz*., paddy spawn, maize (broken) spawn, sorghum spawn, and kurakkan spawn.

Data analysis

Data were analyzed using the analysis of variance (ANOVA) procedure by SAS and means were separated using Duncan's Multiple Range Test (DMRT) at p = 5%.

RESULTS

Kurakkan spawn (T2) showed a faster rate of mycelium growth (Fig. 1) during the spawn run. Paddy spawn showed a markedly slow rate of mycelium growth in relation to all other spawn types. Kurakkan spawn (T2) showed the highest rate of spawn run of 0.827cm/ day, while it was 0.797, 0.763, and 0.524 cm/day for maize (T3), for sorghum (T1) and paddy (T4), respectively.

There were significant differences in the days taken for completion of spawn run between paddy spawn and others *viz*., sorghum, kurakkan, and broken maize (Table 1). Paddy spawn was significantly different from the other three types of spawn in taking the longest period of 32 ± 2 days for the completion of spawn run (Table 1). Sorghum, kurakkan, and broken maize took 23 ± 1, 21 ± 1, and 22 ± 1 days for the completion of spawn run respectively. Days for pinhead formation was longest in paddy spawn (50 ± 1 days), while sorghum, kurakkan, and broken maize took 36 ± 1, 35 ± 1, and 45 ± 1 days for pinhead formation, respectively (Fig. 2).

Time taken for the first flush, was also longest in paddy spawn (43 ± 1 days) while sorghum, kurakkan, and broken maize took 32 ± 1, 31 ± 1, and 38 ± 1 days, respectively.

Total mushroom yield differed significantly among the four types of grain spawns tested (Table 2). Highest fresh weight (yield) of 276.87 ± 0.30 g was obtained with kurakkan spawn (T2) followed by sorghum (T1), maize (T3), and paddy (T4) of 228.45 ± 0.29, 149.15 ± 0.30, and 107.87 ± 0.30 g, respectively. There were significant differences in the mean biological efficiency (BE) of five harvests among the four different spawn types (Table 2) with maize and paddy having similar efficiency.

Highest BE was recorded for the harvests obtained from kurakkan spawn (30.76 ± 0.01) which significantly differed from that of the other three spawn types. Sorghum recorded the second highest (25.38 ± 0.05) for BE, which significantly differed from BE of maize and paddy spawns.

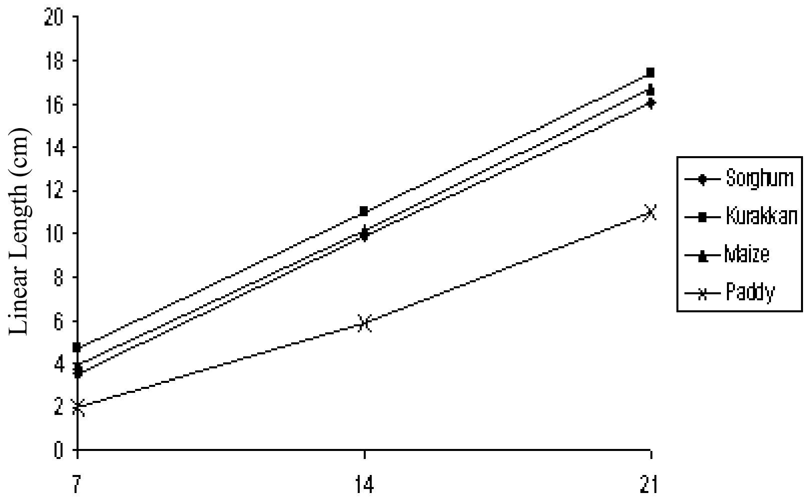

Figure 1. Time course of spawn running using different spawn types to inoculate sawdust based substrate.

Table 1. Spawn Run: Length of mycelia over time.

Spawn Type	**Spawn Run (cm)**		
	7^{th} Day	**14^{th} Day**	**21^{st} day**
Sorghum (T1)	3.533 ± 0.257 ^{b}	9.875 ± 0.760 ^{a}	16.033 ± 0.601 ^{b}
Kurakkan (T2)	4.667 ± 0.629 ^{a}	11.014 ± 1.658 ^{a}	17.375 ± 0.705 ^{a}
Maize (T3)	3.95 ± 0.180 ^{ab}	10.142 ± 0.302 ^{a}	16.75 ± 0.661 ^{ab}
Paddy (T4)	2.00 ± 0.508 ^{c}	5.902 ± 0.806 ^{b}	11.00 ± 0.500 ^{c}

Values followed by the same letter in a row are not significantly different at p=0.05 - DMRT.

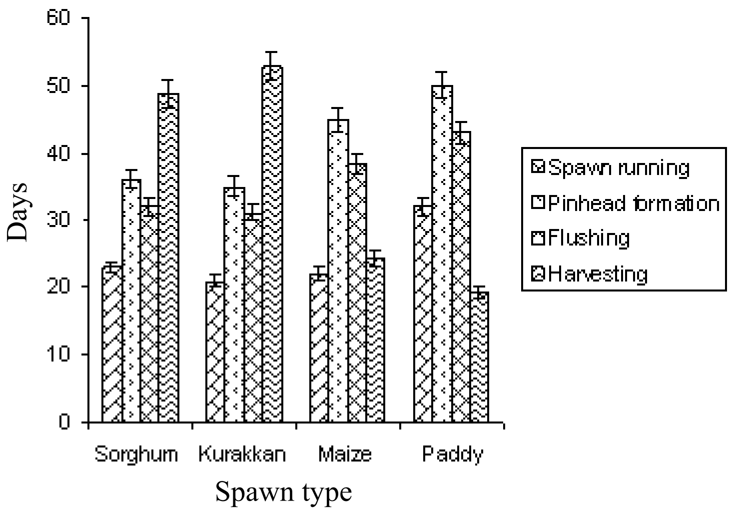

Figure 2. Days for spawn running, pinhead formation, flushing and harvesting of different spawn types.

Table 2. Interaction of spawn types on sawdust.

Time in days (Mean±SD)	**Spawn Types**			
	Sorghum (**T1**)	Kurakkan (**T2**)	Maize (**T3**)	Paddy (**T4**)
Spawn run	23 ± 1^{b}	21 ± 1^{b}	22 ± 1^{b}	32 ± 2^{a}
Pinhead	36 ± 1^{c}	35 ± 1^{c}	45 ± 1^{b}	50 ± 1^{a}
Flush	32 ± 1^{c}	31 ± 1^{c}	38.33 ± 1^{b}	43 ± 1^{a}
Harvest	48.85 ± 0.67^{b}	52.94 ± 0.67^{a}	24.35 ± 1.37^{c}	19.37 ± 1.58^{d}
Total Yield ¶(g)	228.45 ± 0.29^{b}	276.87 ± 0.30^{a}	149.15 ± 0.30^{c}	107.87 ± 0.30^{d}
Mean Yield* (g)	45.69 ± 0.67^{b}	55.37 ± 0.67^{a}	29.83 ± 1.37^{c}	21.57 ± 0.37^{d}
BE % ┼	25.38 ± 0.05^{b}	30.76 ± 0.01^{a}	16.57 ± 0.67^{c}	11.99 ± 0.67^{c}

¶ Total fresh weight of five harvests.
* Mean yield of five harvests.
┼ Accumulated BE %, the ratio of fresh mushroom harvested/ initial dry weight of substrate expressed as a percentage.
Values followed by different letters in a row differ significantly at p=0.05 based on DMRT.

DISCUSSION

The days taken for the completion of spawn run except for paddy spawn, were in agreement with the findings reported by Shah *et al.* (2004) and Tan (1981) where the spawn run took three weeks.

Variations in spawn run rate may be attributed to the size of the grains. Smaller grains have a greater number of inoculation points per kg than larger grains (Mamiro and Royse, 2008). It was found that the spawn run rate of smaller grains was higher than the larger grains. However, larger grains have a greater food reserve (Elliot, 1985) and can sustain the mycelium for longer periods of time during stress (Fritsche, 1988). Thus, different types of spawn may influence productivity and growth.

The findings of the spawn run did not agree with those of Ahmed (1986) who stated that *P. ostreatus* completed the spawn run in 17 – 20 days and pinheads formation in 23 – 27 days. Shah *et al.* (2004) reported 24 days for pinheads formation on sawdust medium. The days for pinhead formation and days for flush (fruiting bodies) formation recorded in this study were longer than previous findings. This may probably be associated with the temperature and humidity. Study by Shah *et al.* (2004) was conducted at 25°C where spawn running and pinhead formation were observed. Quimo (1976, 1978) too reported that fruiting bodies appear 3 – 4 weeks after inoculation of spawn while Shah *et al.* (2004) stated that pinheads appear 27 – 34 days after inoculation at 17 – 20° C.

This finding on the yield contrasted with the results of Shah *et al.* (2004) and seems relatively low compared to commercial production and was probably associated with the substrate (sawdust). Shah *et al*. (2004) recorded maximum yield of 646.9 g for three harvests through a different cultivation technique. Shah *et al*. (2004) adopted fermentation of substrates (sawdust) for five days to boost the yield and the temperature was maintained at 17 – 20^{o} C throughout the period of fructification (flush forming). Bano and Srivastava (1962) recorded a yield of 22 g of total fresh weight.

Arulnandhy and Gayathri (2007) obtained a mean yield of 24 g on sawdust medium while Obodai and Vowotor (2002) obtained a mean yield of 25.5 g. Compared to these findings we obtained higher mean yields for sorghum (45.69 g), kurakkan (55.37 g) and maize (29.83 g) and comparable yield for paddy (21.57 g) spawns.

Bano and Srivastava (1962) obtained a mean yield of 60 g by using sawdust and straw in the ratio of 1:1, while Arulnandhy and Gayathri (2007) obtained 55 g using the same substrate composition. When sawdust was incorporated with dry leaves Arulnandhy and Gayathri (2007) obtained a mean yield of 22 g and with shredded paper a mean yield of 47 g. Sawdust incorporated with substrates like straw and grasses (Udugama and Ranjani, 1997), shredded paper (Arulnandhy and Gayathri, 2007) enhanced the yield rather than sawdust alone.

CONCLUSION

Kurakkan spawn showed the highest rate of spawn run of 0.827cm/ day. Kurakkan spawn was found to be the most efficient spawn type for growth in the sawdust medium compared to other spawns tested. Paddy spawn took significantly longer time for spawn running, flush formation, and days for harvest. Kurakkan spawn produced the highest mean yield of 55.37 ± 0.30 g and fresh mushroom yield percentage of 30.76 ± 0.01. Thus kurakkan is the best spawn type among the four spawn types tested.

ACKNOWLEDGEMENTS

We express our sincere gratitude to the World Bank funded IRQUE project for providing funds for this study.

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