

Original Research Article

<http://dx.doi.org/10.20546/ijcmas.2017.602.146>

Feasibility of Maize Stalks for Milky Mushroom Cultivation

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ABSTRACT

Keywords

Maize Stalks,
Milky
Mushroom
Cultivation

Article Info

Accepted:
22 January 2017
Available Online:
10 February 2017

Maize is one of the food crop grown all over Andhra Pradesh. After harvest of the cobs, farmers have the practice of burning the stalks in the field itself. To overcome this problem and to test the feasibility of utilizing maize stalks for oyster mushroom cultivation this study was carried out. In this study milky mushroom (*Calocybe indica*) was cultivated using maize stalks, paddy straw and with different ratios of these two substrates for three years. This study indicates that yield and bio-efficiency was more when 100% paddy straw and least in case of 50% paddy straw + 50% maize stalks but it was not statistically significant. But it was on par with the mushroom yield and bioefficiency obtained from 100 per cent maize stalks. Among the different substrate combinations used protein content was more in mushrooms obtained from 100% maize stalk used and least in case of 100 % paddy straw but it was not statistically significant. This study clearly elucidated the possibility of utilization of maize stalks for milky mushroom cultivation instead of burning.

Introduction

Milky mushrooms belonging to the class Basidiomycetes and family Agaricaceae. Milky mushrooms naturally grow in temperate and tropical forests on dead and decaying wooden logs or some times on trunks of drying trees (Philippoussis *et al.*, 2001). Milky mushrooms are primarily used as food for human consumption, rich in vitamins, proteins, mineral salts, fibres and low in fats. Reuse of agricultural wastes for mushroom cultivation serves a dual purpose by eliminating wastes and giving it an added value through production of nutritious low cost food (Villas-Boas *et al.*, 2002). Strategies were developed for the large scale disposal of lignocellulosic wastes through oyster mushroom production (Chang and Miles, 1992). Recent studies have employed to utilize

agricultural wastes for the production of mushrooms (Felix *et al.*, 2011). *Pleurotus* mushrooms can be easily grown in tropical climates by utilizing lignocellulosic crop residues (Santos, 2000). Oyster mushroom cultivation can play an important role in managing organic wastes whose disposal has become a problem (Das and Mukherjee 2007). To alleviate hunger and malnutrition in a world of rising food prices, cultivation of mushrooms is a very reliable and profitable option. Maize stalks can also be utilized for making compost, which in turn can be applied to the field to enrich the organic matter of the soil. Due to increasing demand for oyster mushrooms, there is a need to explore the possibilities of using different substrates for oyster mushroom cultivation (Lelly, 1987).

Since, maize stalk is available in plenty and there is demand for paddy straw as fodder purpose, this study was taken up to explore maize stalks for mushroom cultivation. In this context an investigation was carried out to utilize maize stalks for mushroom cultivation and other useful purposes as it poses problems for the disposal and they invariably need to be burnt.

Materials and Methods

Spawn production

The spawn material for mushroom cultivation was prepared by following the standard procedure (Krishnamoorthy, 1981). For this purpose, good quality, clean sorghum grains were washed in clean water three times and cooked until the seed coat was just opened. The moisture content of half boiled grains was adjusted by air drying to attain a moisture content of 50 to 55%. This was followed by mixing with 2% of calcium carbonate and calcium sulphate. This admixture was filled in to polypropylene bags of 15 x 20 cm of 250 gauges. It was filled to 2/3 capacity to have proper aeration and enable easy handling. The mouth of the poly propylene bag was closed with rubber band so as to avoid entry of moisture upon sterilization. The bags were sterilized in an autoclave at 121° C and 15 lb psi pressure for 45 minutes. After sterilization the bags were cooled and inoculated with *P. florida* mushroom mother culture and incubated at room temperature. The mushroom mycelium covered the entire sorghum in the bag in about 10- 12 days. After complete growth on substrate, spawn of *Pleurotus florida* was used for further studies.

Substrate processing

Paddy straw, maize stalks and sorghum stalks used in this study were chopped into 3-5 cm size bits after removing contaminant trash.

Cultivation of mushroom on different substrates

Cultivation was carried out by following the method prescribed by Desai (1982a). Paddy straw, maize stalks and sorghum stalks chopped to 3-5 cm bits were soaked in fresh water for 10 hrs in a container. The excess water was allowed to drain off and the substrate was pasteurized using steam for 30 minutes at 85⁰C in a closed chamber. The pasteurized substrate was spread on a clear cement floor inside the room and allowed to cool to room temperature.

Spawn and spawn running

In this study the substrate was filled in to polythene bag of size 45 x 30 cm of 150 gauge thickness. For *P. florida*, 100 g spawn was used for filling of each bag or 5 % of spawn on wet weight basis of the substrate. The substrate was filled in to the bag layer by layer altering with mushroom spawn.

Layer spawning was done leaving 5 to 7 cm gap at the top and the mouth of the poly bag was closed tightly with a rubber band. Three small holes were made at the bottom of the bag and 5 to 6 holes all over the bag for drainage and air exchange respectively. The bags were kept on racks in mushroom growing rooms. During spawn running humidity of 70–80 % was maintained in cropping room.

Cropping

After complete growth of mycelium the bags were fully covered with a white cottony growth, and then bags were cut opened by blade or scissor. The opened bags were then kept 15 cm apart on racks. The relative humidity was maintained at 80 % by spraying water in the rooms. Watering was done at regular interval to maintain the moisture. The

buds were appeared and developed in to the fruiting bodies. Finally, these fruiting bodies were harvested and the fresh weight of the fruiting bodies was recorded and biological efficiency was calculated.

Estimation of bio - efficiency

Fully matured fruiting bodies of oyster mushrooms were harvested prior to up curling at margin. Harvesting was done prior to watering and fresh weight was recorded soon after the harvest of mushroom. Further each bag was allowed to stand for 3 cropping.

Bio efficiency of mushroom was calculated by using the formula as given by Chang and Mailes (1989).

Bio efficiency (B.E.) (%) =

$$\frac{\text{Fresh weight of mushroom (g)}}{\text{Dry weight of substrate (g)}}$$

Estimation of total protein content in mushroom

Total protein content of mushroom was determined by Micro-Kjeldahl method (Thimmaiah, 2009).

Reagents

Conc. H₂SO₄

Mercuric oxide

Potassium sulphate

Sodium Hydroxide-Sodium Thiosulphate solution: 600g of NaOH and 50g of Na₂SO₃.5H₂O dissolved in water and made up to 1 lit.

0.002N standard HCl or H₂SO₄

4% Boric acid solution: 4g of H₃BO₃ dissolved in warm water and diluted to 100 ml.

Mixed indicator solution: Mixed 2 parts of

0.2% methyl red in ethanol with 1 part of 0.2% methyl blue in ethanol.

100 mg of finely powdered sample was taken in a digestion flask, and digested with tri acid mixture (K₂SO₄ + HgO + Conc.H₂SO₄) and heated with H₂O₂ till a clear solution appeared. The solution obtained was placed in a 100ml conical flask containing 5 ml of boric acid solution with few drops of mixed indicator. 10 ml sodium hydroxide-sodium thiosulphate solution was added to digest the above solution through the funnel and then rinsed with water. Ammonia was distilled and collected in boric acid. The color change from violet to green was the indication of absorption of ammonia. The tip of the condenser was rinsed with water and titrated the distilled sample against the standard HCl until the original violet color appeared as the end point. After estimating nitrogen percent, it was multiplied with 6.25 to get the protein percent.

Results and Discussion

Milky mushroom (*Calocybe indica*) cultivation experiment using maize stalks, paddy straw and with different ratios of these two substrate for three years, indicates that yield and bio-efficiency was more when 100% paddy straw and least in case of 50% paddy straw + 50% maize stalks but it was not statistically significant (Table 1). Highest milky mushroom yield and bioefficiency was recorded in the beds used with 100% Paddy straw {989g/bed and 98.9%} followed by 25%Maize stalk +75% paddy straw {955g/bed and 95.5%}, 75%Maize stalk +25% paddy straw {942g/bed and 94.2%}, 50%Maize stalk +50% paddy straw {902 and 90.2%}and least in 100% Maize stalk {899g/bed and 89.9%}.The variation in oyster mushroom yield between different treatments may be due to variation in the cellulose/ lignin ratio of substrates.

Table.1 Response of milky mushroom (*Calocybe indica*) to maize stalk and its combination with different ratios of paddy straw

Sl. No.	Substrate used	Mushroom yield(g)	Bioefficiency	Protein content (%)
1	100% Maize stalk	899	89.9	2.93
2	75%Maize stalk +25% paddy straw	942	94.2	2.93
3	50%Maize stalk +50% paddy straw	902	87.1	2.88
4	25%Maize stalk +75% paddy straw	955	95.5	2.86
5	100% Paddy straw	986	98.6	2.75
	CD at 0.05%	106	9.9	0.378

Table.2 Benefit cost ratio of cultivation of milky mushroom by utilizing maize stalks with different ratios of paddy straw

Treatments	Total cost of cultivation	Returns from mushrooms	Returns from Vermicompost	Gross profit	Net profit	B:C ratio
100% maize stalks(MS)	39.15	78.15	5.90	84.05	44.90	1:2.15
100% paddy straw (PS)	46.00	98.30	5.65	103.95	57.30	1:2.26
50%PS+50%MS	42.65	76.50	5.90	82.40	39.10	1:1.93
75%PS+25%MS	44.00	91.30	5.55	97.70	53.30	1:2.20
25%PS+75%MS	40.90	88.80	5.65	94.50	53.55	1:2.31

The difference in yield might be also due to difference in moisture holding capacity of different substrates, high susceptibility to weed fungi and improper aeration. Tupatker and Jadhao (2006) in their study also showed that difference in yield was due to moisture holding capacity of substrates, high

susceptibility to weed fungi, improper aeration. Tajudeen *et al.*, (2012) in their study of growing oyster mushroom with different substrates recorded a highest oyster mushroom yield of 410.4 g/ 500g substrate with bagasse. Narain *et al.*, (2008) reported that mushroom mycelial growth and

primordial development depends on the lignocellulosic materials and other factors especially the C:N ratio. The results of the present study are in agreement with the results of Tansakul and Klitroneephail (1985), who showed that rice straw was the most suitable substrate used for *Pleurotus spp.* cultivation. According to Sharma (1995), factors that determine mushroom yield were the proportion of fibrous component, cellulose and lignin present in the substrate.

Highest protein content[on wet basis]of the milky mushrooms was recorded in the mushrooms obtained from 100% maize stalks and 75%Maize stalk +25% paddy straw [2.93%] followed by 50% Maize stalk +50% paddy straw [2.88%], 25% Maize stalk +75% paddy straw [2.86%] and least in case of 100% paddy straw [2.75%]. The difference in protein content of mushroom when grown on different substrates may be due to differences in lingo cellulosic and nutrient contents of the substrates. Quin *et al.*, (1989) reported that protein content of *P. sajor-caju* greatly differed when cultivated on different cereal straws. Protein content was 41.26% when cultivated on rice straw whereas it was only 29.00% when grown on wheat straw. Shyam *et al.*, (2010) recorded a protein content of *Pleurotus ostreatus* grown on different lignocellulosic wastes in the range of 20.33% to 24.66%. The results of the present study are in agreement with the earlier investigations. Poppe (2000) in his study recorded a protein content of 23.40% which was similar to the present study. Chang *et al.*, (2003) recorded a protein content of oyster mushrooms grown on paddy straw in the range of 26.6–37.2%.

B:C ratio of milky mushroom cultivation was highest when 75% maize stalks + 25% paddy straw was used, followed by 100% paddy straw, 25% maize stalks + 75% paddy straw, 100% maize stalk 100 % paddy straw, used

and least in case of 50% paddy straw + 50% maize stalks. This study clearly showed that maize stalks can be utilized for mushroom cultivation replacing paddy straw or can be blended with paddy straw. Further, the spent mushroom substrate can be better utilized for vermicomposting.

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How to cite this article:

Lakshmipathy, R., P. Harikrishna, Bapuji Naidu and Bhaskar Rao, D. 2017. Feasibility of Maize Stalks for Milky Mushroom Cultivation. *Int.J.Curr.Microbiol.App.Sci*. 6(2): 1294-1299. doi: <http://dx.doi.org/10.20546/ijcmas.2017.602.146>