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Effect of different agro-wastes on mass production of edible mushroom Pleurotus ostreatus

KEYWORDS: Pleurotus ostreatus, agro wastes, spawn, flush yield

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ABSTRACT *The objective of the study aimed to compare the yield effect of edible mushroom Pleurotus ostreatus by agro wastes (Paddy straw, sugarcane bagasse, Coconut sawdust and Banana leaves) as substrates for its low cost commercial production. The moist substrates were sterilized and packed in heat resistant plastic bags seeded with 8 – 10% of spawn. Over the spawn, a layer of substrate was overlaid and the process was repeated for 6-7 layers and incubated for 2 to 3 months. Different growth parameters such as spawn running time, fresh weight, temperature and humidity, yield rate were evaluated for each substrate with three replicates. The result of this study indicates, paddy straw and sugarcane bagasse was found to be the better substrate for high yield. Even at 70 to 80% of humidity and 25-27°C banana leaves, coconut saw dust showed less yield.*

Summary : In this study concluded that the four different agro-wastes used as substrates for Pleurotus ostreatus production. In which, comparatively the higher flush yields were obtained in paddy straw and sugarcane bagasse than banana leaves, coconut sawdust.

Introduction:

Modern technology for human civilization is expanding every day. However, human beings have in continued to face basic problems as shortage of food, environmental pollution and diminished human health due to the continuous increase in the world population. Macro fungi (mushroom) area eukaryotic, fleshy, spore bearing fruiting body fungus, typically produced above ground on soil or on the food source and also unique within the fungal kingdom itself. There are more than 5000 mushroom varieties which could be employed for foods and medicines. The fungal classification system proposed by Ainsworth and followed by J. Webster (Sharma et al. 1989), includes almost all edible mushrooms as the members of the subdivision Basidiomycotina and Ascomycotina (Dung et al. 2007). These fungi are obviously non-toxic as these have been in an intimate human consumption of native and tribal, since antiquity (Pandey and Srivastava, 1994). Among many kinds of edible mushrooms, oyster mushrooms have been commercialized and consumed remarkably because of its medicinal and nutritive value. In addition, many research projects have revealed that oyster mushrooms could prevent and reduce several serious diseases, including high blood pressure and cholesterols (Agrawal et al. 2010), breast cancer and prostate cancer (Jedinak and Sliva, 2008).

The oyster mushrooms have three distinct parts - a fleshy shell or spatula shaped cap (pileus), a short or long lateral stalk called stipe, long ridges and furrows underneath the pileus called gills or lamellae. The gill stretches from the edge of the cap down to the stalk that bears the spores. The spores are smooth, cylindrical and germinate very easily on any kind of mycological media within 48-96 hrs and the mycelium of Pleurotus is pure white in color. Oyster mushroom can grow at moderate temperature ranging from 20^0 C to 30^0 C and humidity 55-80% for a period of 6 to 8 months in a year. It can also be cultivated in summer season, by providing the extra humidity for its growth. Hilly areas (above 900m) are also suitable for its growth. Three primary factors affecting the yield of oyster mushrooms are temperature, compost component and humidity. The process of cultivating oyster mushrooms has 3 main steps: isolating mushroom from fruiting bodies, preparing primary and secondary spawn and cultivating mushrooms from these spawns to harvest, fruiting bodies (Dung et al. 2003).

Many agro wastes used as substrate for mushroom cultivation, Darjania et al. (1997) suggested that non supplemented Sunflower Seed Hell (SSH) could be considered as a complete nutritive substrate because of its organic macronutrients (carbohydrate, protein and lipid). Oyster mushrooms (Pleutorus sp.) possess an extracellular enzyme system that makes them able to degrade the lignocellulosic material of SSH as well as others and thus exhibiting a great adaptability to different kind of lignocellulosic materials. In 1982, isolation and characterization of Pleurotus strains capable of growing on sterilized coffee pulp following this report, a series of studies have shown that coffee pulp, either as a sole substrate or mixed with other organic materials is a good substrate for cultivation of the edible mushrooms Pleurotus, Lentinula and Auricularia (Martinez-Carrera et al. 2000). Donini et al. (2009) reported, high biological efficiency of P. ostreatus with elephant grass (Pennisetum purpureum) supplemented with different kinds of bran (wheat, rice and corn), except for soybean, which showed the lowest biological efficiency. Gonçalves et al. (2010) reported the supplementation of cotton textile mill waste with wheat bran and/or in combination with sawdust to cultivate P. sajo-caju. Three species of oyster mushroom, namely P. florida, P. pulmonarius, P. sajorcaju were grown on wheat straw and bagasse amended with post-anaerobic distillery effluent, a high organic load wastewater with high biochemical oxygen demand and chemical oxygen demand (Nandy et al. 2002). The objective of this study was to compare the yield variation in different agro wastes (Paddy straw, sugarcane bagasse, Coconut sawdust and Banana leaves) as substrates for their maximum yield with a specified time limit.

Materials and Methods

Source of culture

The mycelium of P. oystreatus (spawn) was collected from Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu. The small piece of mycelial tissue was placed aseptically on sterile potato dextrose agar and the mycelium was allowed to develop from the spores. The developed mycelium was maintained on PDA by regular sub-culturing in same media.

Spawn preparation

The mycelia containing PDA plate was incubated at 25-27°C for 10 days, during incubation period intermediate observa-

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tion was done for avoiding contamination. For spawn preparation, 100g of healthy sorghum grains were soaked in tap water and kept overnight in 500ml flask. Then the grains were boiled for 1hour till partially cooked and dried until the moisture content of the seeds reduced in 50% then mixed with Calcium carbonate thoroughly. The grains were packed in plastic bags and sterilized for 1 hour at 121°C, after sterilization the spawn was sub cultured inside a laminar airflow chamber. The inoculated plastic bags were incubated at 26°C for 10- 15 days and this act as spawn for further process. Good spawn shows vigorous growth without contamination. It can be stored in a sterilized plastic bag at 4°C and will become less vigorous, on long storage.

Substrate preparation

The dried agro wastes (paddy straw, banana leaves, sugarcane bagasse and coconut saw dust) were collected from the crop production farm in Salem, Tamil Nadu. The agro wastes cut into small pieces and prepared as bundles of substrates for mushroom cultivation. The bundles were soaked in water overnight and the excess water was drained the following days. The substrates were sterilized for 1 hour at 121°C and kept in plastic bags and 10% of spawn was spread over it. Over the spawn, a layer of substrate was overlaid and the process was repeated for 7 layers. Finally the top of the bags was covered with loose straw and pressed in tight. Similarly for replicates (3 Bags) were prepared in the same manner and tightly closed. Holes were punctured aseptically by sharp sterilized pins to ensure adequate O_2, CO_2 and gas exchange. After this, bags were moved into separate rooms for 3 weeks of incubation at 25-27°C and monitored daily for possible contaminations.

Maintenance, Harvest and Preservation:

After spawning the bags were maintained at 25 to 27°C. The moisture of the bags maintained between 70-90% of humidity by spraying with cold water 2 to 3 times daily. Larger holes were made in the bags after 10-15 days to provide aeration for the fruiting bodies to develop. The fruiting bodies when developed, mushrooms were harvested by gentle twisting or with sharp sterilized knife. The mushrooms were dried at 50 -60°C to remove moisture and then packed.

Results and Discussion

The spawn preparation was carried out with healthy grains of sorghum in sterilized bags and maintained at 4°C till the entire usages. Different agro-wastes used as substrates, when paddy straw and sugarcane bagasse used as substrates the spawn running started from 3rd day and banana leaves whereas while using the spawn running started from 5thday, coconut sawdust showed less growth even at 5th day after inoculation (Figure 1). The less harvesting period, high flush height and bud formation were showed in Paddy straw, sugarcane bagasse substrates (Figure 2 and 3). The data regarding flushes intervals displayed that the minimum period on an average basis between flushes was taken on paddy straw which was 4-6 days in P. ostreatus. There was a reduction in the weight of the banana leaves (16.30%) used as a substrate and this shows that the mushroom has the ability to degrade lignocellulosic materials during the idiophase stage following severe nitrogen and carbon depletion (Mason et al. 1989). The protein content of the fungus treated banana leaves significantly higher than the untreated sample, probably due to the addition of fungal proteins during solubilisation and degradation.

Ramzan et al. (1982) obtained 3-5 flushes from wheat and paddy straw. Bhatti et al., (1984) got 4-6 flushes from different substrates. Baysal et al. (2003) reported that spawn running, pin head; fruit body formation and yield of oyster mushroom on waste paper supplemented with peat, chicken manure and husk rice were studied. The yields when different dried agro-wastes used as substrates were compared with each other and maitained till their harvest. In which, the better yields were obtained from paddy straw (611±5.85), sugarcane bagasse (348±10.13) compare than banana leaves (234±4.58) and coconut sawdust (123±1.77) (Table 1). Vetayasuporn et al. (2006) studied an experiment on cultivation oyster mushroom; combination of two substrates 75% bagasse + 25% saw dust and 50% bagasse + 50% saw dust. The substrate combination of 75% bagasse + 25% saw dust gave maximum yield.

The cultivation of edible mushroom using agricultural residues is a value added process to convert these materials into useful products, which are otherwise considered to be wasted. The spawn running completed earlier on paddy straw (22 Days) sugarcane bagasse (25 Days). Khan et al. (1981) reported that in pin-head formation, paddy straw showed earlier and it was observed in 21 days after spawning and the maximum time 22-23 days. Fan et al. (2000) observed that first fructification occurred after 20-23 days of inoculation.

The mushroom production capacity varies based on the substrates used. The production of oyster mushroom in paddy straw was very high, because the paddy straw contains all the essential micronutrients for the development of mushroom such as minerals, vitamins, amino acids etc., but there is a slight difference in the production of mushroom in sugar cane and less production in banana leaves due to the mycelia growth, in about 12 days the leaves get dried. In coconut husk substrate, there is less mushroom cultivation as well as less production. To conclude, the best growth and yield was obtained in paddy straw, sugarcane bagasse used as substrates at 25 to 27°C with 70 – 80% of humidity.

Figure 1: (A) Mother Culture (B) Grown mycelium (C) Spawn Preparation (D) Inoculated bag on day 1, (E) Inoculated bag on day 3, (F) Inoculated bag on day 12.

Figure 2: Fruiting body developmental stages of P. ostreatus cultivation: (A) Bud formation (B) Young stage fruiting body (C) Mature stage fruiting body and (D) Yield harvested.

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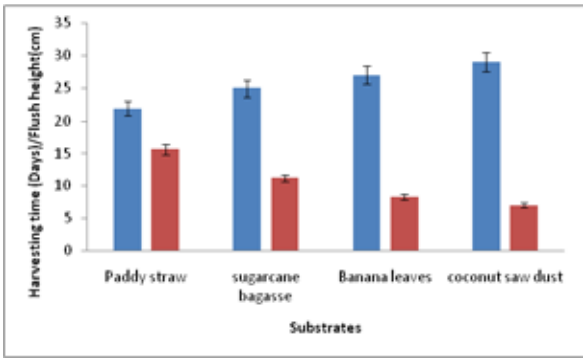

Figure 3: Fruit body harvesting time and flush height of P. ostreatus for different agro-wastes used as substrates.

Table 1: Yield variations in P. ostreatus from different substrates.

S.No	Substrates	Spawn running started (Days)	Yield(g) (Mean±SE)
1.	Paddy straw	3	611±5.85
2.	Sugarcane bagasse	3	348±10.13
3.	Banana leaves	5	234±4.58
4.	Coconut sawdust	7	123±1.77

The experiements were repeated and their mean values are calculated.

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