Edible oyster mushrooms on cotton plant stalks

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Oyster mushrooms can be artificially cultivated on various lignocellulosic crop residues, viz. rice straw, wheat straw, cotton stalks etc. This mushroom can also be grown on composted materials. The yield varies from substrate to substrate and in any case it is around 500-600 g/kg of raw material without any nutrient supplementation. The yield can be increased with supplementation.

Mushrooms are the fleshy sporophores of fungi known to grow in nature on decaying cellulosic materials, dead wood, soil and manure pits. Majority of these fungi belong to the class Basidiomytina and a few to the class Ascomycotina. Edible fungi under the order Agaricales and the families Agaricaceae, Polyporaceae and Pluteaceae have been under commercial cultivation.

The edible mushrooms are delicacy in food and form one of the choicest table dishes. They are rich in protein and an excellent source of vitamins and minerals. Most of the mushrooms have very low starch content and can form an ideal food for diabetic patients. Though, about 2000 species have been reported to be edible, the techniques of artificial cultivation are available only for a dozen of species of which about four are being cultivated on a commercial scale. These are, *Agaricus bisporus* (white button mushrooms), *Volvariella* spp (tropical mushroom or paddy straw mushroom), *Lentinus edodes* (Japanese mushroom) and *Pleurotus* spp (Oyster mushroom). The button mushroom requires low temperature and grows on fermented substrates, whereas paddy straw mushroom grows on unfermented substrates and at an elevated temperature of 35°C. The Japanese and oyster mushrooms also grow on unfermented materials at temperatures of around 20°C and 30°C, respectively. *Pleurotus* spp have the ability to grow on both fermented and unfermented materials.

Being a tropical country, India has been bestowed with bountiful crops suiting to all three different seasons. Crop residues are available throughout the year. The diversified mushroom cultures available in the country can be best adopted to different places as per the temperature conditions and raw material availability. For successful growing of oyster mushrooms, the substrate has to be processed, i.e. cut to about 3.0-4.0 cm size and pasteurized at around 80°C to ward off the competing moulds. This is an energy intensive step. Secondly, the spawn preparation using mostly the grain spawn is very common. The quality of the spawn decides the yield of sporophores. The yield of fleshy fruiting bodies is normally around 500g/kg of the substrate. The yield of *Pleurotus* on different substrates is given in Table 1.

Table 1. Yield of Pleurotus on different substrates*

Substrates	Mushroom species			
	P.sajor-caju	*P.florida*	*P.flabellatus*	*P.ostreatus*
Wheat straw	400	410	417	440
Rice straw	310	425	307	453
Pearl millet straw	365	440	362	513
Cotton stalks	480	453	450	600

*g/kg of the substrate

Pleurotus spp can be successfully cultivated at temperatures of around 30°C and hence is becoming increasingly popular in both tropical and sub-tropical countries. In India, the cultivation of this mushroom is picking up at an alarmingly high rate due to ease of its cultivation. The most important step in the cultivation of this mushroom is the pasteurization of huge quantities of raw material without which the competing moulds during spawn run could not be eliminated. Presently, the procedure adopted is to cut the raw materials to about 3-4 cm, soak them in cold water for 10-12 hr, followed by hot water treatment (about 80°C) for 2-4 hr. In addition, the practice of adding fungicides bavistin and formaldehyde to the substrate is also followed. It has been shown that the anaerobic treatment at room temperature replaces the hot water treatment. Using an anaerobic treatment plant constructed, studies were undertaken for one full year and data collected established that hot water replacement is completely effective.

ANAEROBIC TREATMENT

A batch type anaerobic digester (1 m dia and 0.6 m depth) was constructed underground with brick masonary construction. Water seal was provided at the top of the digester in which an MS lid (18 SWg, 1.25 mm thickness) was placed to create anaerobiosis. On top of the lid, an outlet was provided to release the gas produced during anaerobic treatment.

The cut materials of rice straw and cotton stalks were charged in the digester containing mixed microbial consortium as inoculum. Care was taken to see that the entire material was under water. This was achieved by placing a perforated lid. Thereafter the digester was covered by placing the lid in the water seal and the hose pipe taken out from the outlet was dipped in water. In the case of rice straw the treatment was for 24 hr, whereas it was for 48 hr in the case of cotton stalks. The anaerobically treated materials were given a wash in freshwater containing alkali (0.1% based on the original weight of the raw material) and the excess water was drained out by placing on a perforated wire mesh. The materials thereafter were packed in polythene bags by sprinkling grain spawn in each layer by the conventional polythene bag technique. The bags were incubated for spawn run and subsequently the mycelial entangled bags were hung for the production of mushroom sporophores.

HOT WATER TREATMENT

To compare the efficacy of this new method, the conventional hot water treated materials were also used for seeding the mushrooms.

The interesting feature of this inexpensive anaerobic treatment is that the resident microflora which normally cannot be dislodged from the surface of the cellulosic materials by soaking overnight in water are removed with the digester fluid. The organisms, if any, adhering loosely to the surface at the end of the treatment are removed by a simple dilute alkaline water wash. Thus, the numbers of organisms are reduced to a significant extent. The usual molds encountered as competitors, viz. the species of *Trichoderma* and *Penicillium* during the conventional method were not found to grow on the anaerobically treated materials.

The yield of fleshy mushroom fruiting bodies of *P. sajor-caju* is about 500-600 g on an aerobically pre-treated rice straw and cotton stalks which is akin to the hot water processed materials. Blending of rice straw with cotton stalks (75:25) reduces the spawn run period from 20 days to 15 days, whereas the period is only 10 days when only cotton stalks are used.

CONCLUSION

The anaerobic treatment being ecofriendly and devoid of hot water run, farmers can readily adopt this technology on the farm itself to process the raw materials for growing oyster mushrooms. It is possible to process 100 kg of the raw material every day by installing two digesters. Depending on the retention time, the material can be fed every day or alternate day. The materials taken out are to be washed in freshwater, drained and to be spawned. The requirement of 1000 litres of hot water at 80°C to pasteurize 100 kg material can be dispensed with. The initial investment incurred on the construction of semi-continuous plant or batch fed plant could be recovered in less than one year, since the energy to heat the water to 80°C is totally avoided. In view of this, the current method becomes inexpensive and ecofriendly as no fungicides are used.