Oyster Mushroom Cultivation

Part II. Oyster Mushrooms

Chapter 5

Substrate

SUGARCANE BAGASSE

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Mauritius is a small island in the Indian Ocean with a population of about 1.2 million. Mushroom industry is in its infant stage and oyster mushroom is mainly cultivated. Other species such as shiitake and *Auricularia* are cultivated on experimental scale at several governmental institutions. Oyster mushroom is rich in protein as well as contains less fat, less carbohydrate and salts. It also has rich fibre, high Vitamin B_{12} and folic acid contents uncommon in vegetables. Therefore, oyster mushroom is ideal food for patients suffering from hypertension, diabetes and obesity.

Table 1. Characteristics of sugarcane bagasse

	Moisture	Fibre	Soluble Solid (mostly sugar)
Composition (%)	49	48	2.3

Table 2. The Composition of Fibre

Cellulose	48%*
Pentosan	28.7%
Lignin	14.3%
Ash	2.4%
pH	6.1%
Total nitrogen	1.23%
Carbon	29.36%
Available phosphorus	2,399ppm
Available potassium	21.63ppm

* out of which 26.6% is alpha cellulose(a)

Sugarcane bagasse is the only substrate material available in large amount in Mauritius, and no other substitute has been proved as a good mushroom substrate till now. Sugarcane bagasse requires no chipping, cutting, or grinding to be utilized as substrate material, unlike corn cobs, grasses and banana leaves. It can be collected directly from factory, so we don't need extra labour for collecting and can preserve environment by using this agricultural waste. Previously, sugarcane bagasse was distributed by sugar factories free of charge. However, mushroom growers have to pay for it nowadays because the sugar factories see the waste as a fuel for electricity generation if ever earned. Moreover, the factories can sell the excessive power to the Central Electricity Board, so they have no reason to throw away the bagasse. Sugarcane bagasse is not available in out of season, so most mushroom growers suffer from substrate shortage. The sugarcane bagasse cannot be stored for a long time.

Sugarcane bagasse mainly consists of moisture, fibre, and soluble solid (Table 1). The main constituents of fibre are cellulose, pentosan, and lignin. Table 2 shows the composition of fibre. Sugarcane bagasse contains

cellulose which is easily degraded by oyster mushroom, a cellulolytic fungus. It also contains cellulo sugars especially sucrose which provides energy for mushroom. The total nitrogen content indicates that bagasse is not poor in nitrogen. The nitrogen is mostly in the organic form especially protein which is required for growth of mushroom. We use this waste from sugarcane industry to grow highly value added product, oyster mushroom.

Spawn Preparation

Tissue culture of oyster mushroom is inoculated to Potato Dextrose Agar (PDA) media (Fig.1) and incubated. After colonized by mycelium, the PDA media is cut into pieces and inoculated to sterilized millet grains, which will be mother spawn. After fully incubated, this mother spawn is inoculated to spawn bags filled with maize seeds. After fully colonized, this bag is used as spawn (Fig. 2). The spawn bag can be purchased from governmental organization in Mauritius.

Figure 1. Transfer of mycelium

Figure 2. Spawn bags in Incubation

Preparation of Mushroom Bags

Figure 3. Mixing substrate materials

Figure 4. Mixed substrate (sugarcane bagasse : crushed maize seed:lime=8:1:1)

Figure 5. Bagging

To prepare substrate for oyster mushroom, we mix 80% of sugarcane bagasse, 10% of lime, and 10% of crushed maize seed thoroughly (Fig. 3). Then, tap water is added to the dry mixture to keep the water content 60% (Fig. 4). The sugarcane bagasse is slightly acidic, so lime is added to adjust the pH. And crushed maize is a supplement to provide nitrogen source. The prepared substrate is filled into polypropylene bags (Fig. 5, 6) and the open end of the bag is tied. The size and weight vary ranging from 0.75 to 3kg according to growers. We have experimented with 25kg bags.

Figure 6. Weighing bags

Pasteurization and Inoculation

The bags are pasteurized at 60-70℃ for three hours by steam in pasteurizer (Fig. 7). The prepared bags are placed in three layers of the pasteurizer (Fig. 8). Enough space is left between bags so that steam can circulate and heat the bags evenly. Water is poured into the bottom of pasteurizer and boiled for 3 hours to keep the inside temperature of pasteurizer at 60-70℃. A mercury thermometer is used to monitor the temperature inside pasteurizer. The pasteurizer should be airtight to prevent any loss of steam and hence avoid a drop in temperature. It can be operated by electricity, gas or wood burning. As the temperature inside the pasteurizer rises to 70℃, it should be maintained for 3 hours to make substrate pasteurized. When pasteurization is done, the bags are cooled down in room temperature. Then, oyster mushroom spawn grown on maize seed is inoculated into the bags and PVC pipe of 53mm in diameter is placed in the open end of the bag and plugged by a piece of foam. The spawning rate reaches 2.5% of the wet weight of substrate.

Figure 7. Pasteurizer (outside)

Figure 8. Pasteurizer (inside)

Incubation and Fruiting

After inoculation, the bags are incubated in a dark room for 3-4 weeks. After the substrate bags are fully colonized by mycelium, the foam is removed and PVC pipe is replaced by PVC ring. To induce fruiting, the bags are watered 2-3 times daily at the opened ends, which should always remain moist.

5-10 days later, pinheads of oyster mushroom appear and grow into mature fruit bodies in 3-5 days (Fig. 9, 10). The mushrooms are harvested when the caps are flat and the gills are open (Fig. 11). Frills are observed at the edges of mushroom cap. The whole cluster should be harvested at one time. Mushrooms are packed for domestic and overseas market (Fig. 12).

Figure 9, 10. Oyster mushrooms growing from sugarcane bagasse substrate

Figure 11. Harvested oyster mushrooms

Figure 12. Ready for delivery and export

After harvest, remnants of fruit bodies on substrate should be removed from the bags to prevent contamination. Watering is done to induce second flush. Second flush can be harvested in 2 weeks. We usually harvest three flushes from each bag and the yield is approximately one quarter of the dry weight of substrate used in bag. We harvest 250g of oyster mushroom from 1000g of dry substrate (bagasse 800g + lime 100g + maize seed 100g), so biological efficiency is 25%. After completion of the final harvest, the spent substrate can be used as compost that can eventually be returned to the field.

Figure 13. Shiitake cultivated on sugarcane bagasse bagasse

Figure 14. ***Auricularia*** cultivated on sugarcane