Part II. Oyster Mushrooms

Chapter 5

Substrate

COCO LUMBER SAWDUST

J. Christopher D. Custodio
Bataan State College, the Philippines

Oyster Mushrooms (*Pleurotus* spp.) are saprophytic as they obtain there nutrients by decomposing various agricultural by-products. This mushroom has been cultivated worldwide because of its taste and low maintenance technology. There are different substrates that have already been identified that can be utilized for the cultivation of oyster mushroom. The possible substrates include rice straw, coffee pulps, sawdust, and even paper. Most of these are types of low-value lignocellulosic wastes that are primarily derived from agricultural practices or the agro-industry. (J.A. Buswell *et. al.*, 1996) The bioconversion of these wastes is one reason why the cultivation of edible mushrooms is an appropriate practice for a society that depends on its agriculture.

Figure 1. Coco lumber sawdust

In the early 1990s, 'coco lumber' was given a great attention in the province as a substitute for hardwood. Sawmills producing lumber from coconut trees bloomed in reaction to the increasing demand for this low cost constructional material. Though beginners in mushroom cultivation are usually persuaded not to use sawdust from softwoods, sawdust from coco lumber (Fig. 1) is another possible substrate for *P. ostreatus* and has shown great results. Growers living near a coco lumber sawmill can make use of this waste product in order to start their own cultivation of oyster mushroom species.

Coco Lumber Sawdust as a Substrate of Oyster Mushroom

Oyster mushroom is one example of edible mushrooms that can utilize lignocellulosic materials as a substrate. This capability of the oyster mushroom. is due to the presence of its lignocellulolytic enzymes, which help it convert cellulose and lignin into useful carbohydrates such as glucose, that can be used as an energy source for the fungi. Any agricultural waste that contains cellulose and lignin is a possible substrate for growing this fungi.

Cellulose and lignin are both structural carbohydrates that give rigidity to a plant. Lignin gives the plant its wood characteristic while cellulose is the basic component or structure of the cell wall. Once sugar is associated with cellulose or with any structural carbohydrates in a plant body, the plant can no longer utilize the sugar as a source of energy. Therefore, the potential energy source is not used by the plant and is preserved for the future use by mushrooms. Hardwoods like mahogany or narra contain much higher amounts of these structural carbohydrates than softwood trees like coconuts. This means that hardwoods have more nutrients that can be used by mushrooms than softwoods do. This is why beginners in mushroom growing technology classes in the Philippines are told to make use of sawdust from hardwood or good lumber rather than sawdust from coco lumber.

Organic supplements are usually added to substrates to provide organic sources of nitrogen (R.C. Upadhyay 2003). Some frequently used organic supplements are rice straw and rice bran. Rice bran is commonly used to provide nitrogen, especially during the formation of fruiting bodies.

Oyster Mushroom Growing with Coco Lumber Sawdust

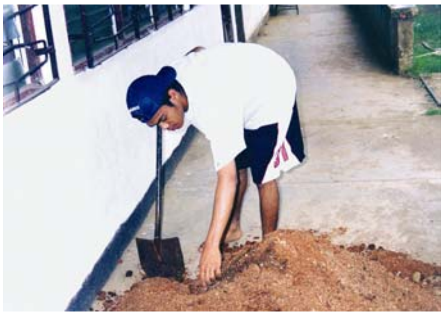

Figure 2. Removing impurities from sawdust.

Figure 3. Sawdust : rice bran=3:1

Figure 4. Stirring until a change in color is observed

We have tried coco lumber sawdust for cultivation of *P. ostreatus* by bag cultivation. The system followed the normal basic method of all substrate preparation using sawdust. The preparation of the substrate starts with the physical removal of impurities like chips of wood, plastics, leaves of plants, and other organic substances that might cause contamination (Fig. 2).

Afterwards, rice bran will be added to the sawdust. The total volume of the rice bran is 25% of the whole substrate (sawdust : rice bran = 3 : 1)(Fig. 3). The materials will be mixed until a light change in color of substrate materials is observed, but stirring should continue until no lumps of rice bran are found (Fig. 4).

Once the sawdust and rice bran is thoroughly mixed, lime will be added equal to 1% of the total volume of rice bran and sawdust mixture (Fig. 5). Lime neutralizes the acidity of the substrate. The mixture is again stirred until no lime is visible. Then, sugar is added equal to 1% of the mixture. Sugar can temporarily provide glucose to the mycelia while the cellulose and lignin are being converted into useful forms of carbohydrates. It is more practical to separately dissolve both the sugar and the lime in water before adding them to the mixture (Fig. 6).

Figure 5. Lime is added for pH control

Figure 6. Sugar is dissolved before being added to the mixture.

After the addition of sugar, water will then be added to the mixture of sawdust and rice bran. A simple way to determine the water content of the mixture is to get a handful of the substrate and squeeze it. A drop of water indicates that the amount of water added is enough while more than a drop shows that too much water was added to the mixture. Before doing so, make sure that the substrate is thoroughly mixed. Another way to add an appropriate amount of water is simply adding 1.5 parts of water to 3 parts of sawdust. But sometimes this amount is not enough due to the dryness of the sawdust.

When the substrate is evenly mixed, it is then transferred to polypropylene bags that are 6cm wide and 12cm long (Fig. 7). When too much water is added to the substrate it is better to squeeze the excess water away before it is packed into the polypropylene bags. The height of the substrate inside each polypropylene bag is 8-9 inches. The rest part of the plastic bag is fitted with a pvc neck which will serve as the opening of the bags (Fig. 8). After the pvc neck is placed, the opening is covered with a cotton plug and wrapped with paper to prevent the entry of insects. After they are filled with the prepared substrate, the bags are sterilized at 20 psi for about one hour (Fig. 9). After sterilization, the bags are left for cooling and then inoculated with the prepared planting spawn of *P. ostreatus* (Fig. 10). When inoculation is done, the bags are then marked with the date and species used. 10-20g of spawn is inoculated to 1.3kg bag, so spawning rate reaches 0.8-1.5% of wet weight of substrate.

Figure 7. The substrate is then transferred to pp bags.

Figure 8. PVC neckplacing

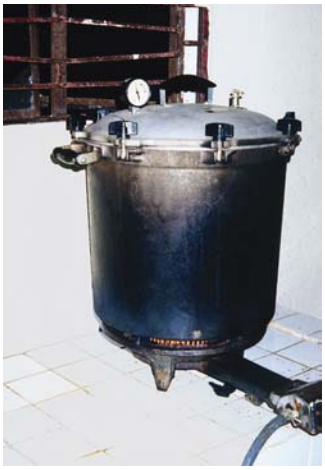

Figure 9. Sterilization at 20 psi for 1 hour

Figure 10. Spawn inoculation

Figure 11. Marking bags

Feasibility of Coco Lumber Sawdust as an Alternative Substrate

After the inoculation, the bags are then stored in a stock room with indirect sunlight and with a temperature of 26℃ Mycelial growth (Fig. 12) is observed after one week. The bags are completely colonized after 4-6 weeks of incubation.

After mycelia have completely colonized the bags, the bags are then opened to trigger fructification (Fig. 13). A single bag may have 4-6 flushes and the maximum yield is up to 800g of fresh oyster mushrooms per bag (1.3kg). Flushes will occur for 6-8 weeks depending on the humidity and temperature of the room (Fig. 14).

Figure 12. Three weeks of incubation

Compared to other substrates, the yield of mushrooms grown on coco lumber sawdust is lower. (A.Y. Gibriel *et al.*, 1996) A trial was also performed to identify the growth rate of mycelia and fruit bodies in the absence of rice bran in the substrate. The result was poor performance of the growing fungi in terms of mycelial growth and fructification of *P. ostreatus*. Poor sterilization processes also resulted in a higher rate of contamination. Thus, the one-hour sterilization at 20 psi should be strictly followed.

Infestation of Sciarid flies and mites has also been observed on growing mushrooms. Green molds are also visible especially after its second flush. The infected bags are removed to prevent second contamination to other bags. The chemical or biological control against infection was not performed because the trial only aimed to observe the efficacy of coco lumber sawdust as a substrate for *Pleurotus ostreatus* cultivation.

During or in between flushes, basic maintenance of stock was followed (e.g. watering of the incubation room to lower temperature and increase humidity). Flypapers were also placed to reduce sciarid numbers.

Figure 13. Open bags for fruiting induction

Figure 14. Oyster mushrooms on coco lumber sawdust

Conclusion and Recommendation

Sawdust from coco lumber is a possible substrate for the cultivation of *P. ostreatus*. Although the amount of yield is lower than with hardwood sawdust, growers with no available material other than coco lumber sawdust can make use of this agro-industry waste for oyster mushroom growing.

Further study should also be done to determine the amount of lignin and cellulose on coco lumber together with the effect of other organic nitrogen supplemented with the sawdust on the oyster mushroom cultivation.

The effect of biological and chemical pest control should also be noted. The newly introduced chemical called “Dimilin” (dflubenzuron) is now being used to reduce Sciarid infestation, but it was noted that when used at a normal rate it causes a reduction in yield of 7-8%. (L. Staunton *et al.*, 2002)

REFERENCES

- Buswell, John A., Yi Jin Cai, and Shu-Ting Chang. 1996. Ligninolytic Enzyme Production and Secretion in Edible Mushroom Fungi. *Proceedings of 2nd International Conference of Mushroom Biology and Mushroom Products.*
- Upadhyay, R.C., R.N. Verma, S.K. Singh, and M.C. Yadav. 2003. Effect of organic nitrogen supplementation in *Pleurotus* species, National Research Centre for Mushroom, Chambaghat, Solan, India, *Mushworld*
- Gibriel, A.Y., M. Ahmed, N. Rasmy, I. Rizk, and N.S. Abdelrehem. 1996. Cultivation of Oyster Mushroom: Evaluations of Different Media and Organic Substrate, *Proceedings of 2nd International Conference of Mushroom Biology and Mushroom Products*.
- Staunton, L., R.M. Dunne, T. Cornican, and M. Donovan. 2002. *Chemical and Biological Control of Mushroom Pests and Diseases*.