Oyster Mushroom Cultivation

Part II. Oyster Mushrooms

Chapter 5

Substrate

GROUNDNUT SHELLS

Emilia Masenda
Aidabase Technology, Zimbabwe

Though the cultivation of oyster mushrooms by smallholder farmers has only recently been introduced in Zimbabwe, it has become a very popular activity among many farmers. It has also caused direct competition for substrate material with the livestock industry. Zimbabwe citizens raise cattle and goats in many areas. During the dry season from May to November the cattle graze on dry veld grass and their diets are supplemented with various agricultural wastes including primarily maize and groundnut stover. Millet straw is also used for this purpose as is any other cereals that are grown. Farmers value their livestock more than the mushrooms so agricultural wastes are usually given to livestock.

Although groundnut shells (Fig. 2) are sometimes used for stock feed, they are not as popular as cereal straws and legume stovers. Therefore, they can be used as substrate for growing oyster mushrooms without much competition from the livestock industry. In some towns and centers, large quantities of groundnut shells can be obtained very cheaply from the companies that are involved in shelling groundnuts.

Figure 1. Groundnut

Figure 2. Groundnut shell

Nutritional Composition

According to analysis by the Animal Science department, groundnuts shells contain an average of 68% organic matter, 6.8% crude protein, 18.2% crude fiber, and 7.1% ash. Another nutritional composition analysis of

groundnut shells indicates that the shells contain 65.7% cellulose, 21.2% carbohydrates, 7.3% protein, 4.5% minerals and 1.2% lipids. Since the processed shells from shelling machines contain bits and skins of nuts, the actual protein and lipid contents of this waste material are probably much higher.

Substrate Preparation

Crushing shells

Shells from machine-shelled groundnuts do not need to be crushed further but those from hand-shelled nuts should be ground in a mill or by hand mortar. Before crushing, growers should pick out rotten or blackened shells.

Washing shells

Shells have to be washed to remove soil. Two methods are used for washing the shells. In the first method, the shells are placed on a plastic sheet and water is poured over them with a hose while they are being turned (Fig. 3). Then, the soil moves to the bottom and is carried away by the run-off water. In the second method, the shells are put in a plastic container and water is poured over them. The soil will fall to the bottom after agitation (Fig. 4). When the shells are clean, they are placed on a plastic sheet and left overnight to absorb moisture.

Figure 3. Washing with water

Fighre 4. Removing soil by agitation

Figure 5. Deeper color of groundnut shell after soaking

The substrate starts heating up and turns a deeper color after soaking (Fig. 5). Growers should observe the pile carefully for soil which might remain stuck on the shells even after washing. Growers should never use moldy shells and should collect shells before rainfalls and store them in a dry place.

Addition of supplements

The use of supplements is optional, but wheat bran (1%) and cottonseed hulls are added as supplements in the ratio 1 : 4 to make substrate more compact and increase yield. With cottonseed hulls supplemented, biological efficiency can be increased up to 200%. In winter, cottonseed hulls have additional advantage of keeping the bags warm and accelerate spawn run.

However, the bags can be overheated by cottonseed hulls in warm season, so addition of cottonseed hull is not recommended in those seasons. Lime (1%) and gypsum (3%) are also added. Lime is added to improve and maintain a favorable pH. Rapid drop of pH has been experienced after substrate fermentation if no lime is added. A high pH also discourages competitor molds. Gypsum is added to prevent stickiness and absorb excess moisture. Lime and gypsum can be added at spawning to avoid them being lost during steaming.

Heat Treatment of Substrate

The substrate is steamed using a drum for 2 hours and the temperature is maintained at 70 ℃ by controlling the

flow of steam. If the groundnut shells were not very clean, the time of steaming can be prolonged to 4-6 hours. Good indicators of proper steaming are the nut shells that become tender and cooked by the steam. If steaming time is too short, the substrate quickly develops contaminants after spawning. Another popular heat treatment method is to heat the substrate using the sun. This method is commonly used in some regions where firewood is very scarce and expensive. Some local white button mushroom growers also use this method to heat-treat their composts. The substrate is pre-wetted and then wrapped tightly with black plastic sheets and left in the sun for 4-6 hours. Condensation on the plastic keeps the substrate from drying and so does turning the bundle from time to time. After heat treatment, the substrate should retain 70% of its moisture.

Spawning

After the substrate cools down, it is packed into black plastic bags weighing 5kg each and spawned simultaneously. 100g of spawn is inoculated to 5kg bag, so spawning rate is 2% of wet weight of substrate. Roughly crushed shells should be tightly packed to avoid air spaces. Growers should make small holes in the bags using a pen through which fermentation gases can escape. The bags are then left for incubation in a dark room. It is recommended not to place the bags too closely together because that can cause overheating, and as a result, contamination.

Fruiting and Yield

When spawn run is complete, the bags are hung in the fruiting room and holes are made on the bags. Humidity in the room is kept at 85-90% by watering the floor and periodic spraying of water in the air with a hand spray. Usually 6-8 flushes are harvested.

When growing *P. salmoneo-straminieus*, 1kg of fresh mushrooms are harvested from a bag (5kg with 70% of water content) on average. In calculating biological efficiency (B.E. = fresh weight of mushroom / dry weight of substrate x 100%), the biological efficiency of this method is 67% (1kg / 1.5kg x 100% = 67%). With *P. pulmonarius*, B.E. is 120% and with *P. ostreatus* it is 150%. When the substrate is supplemented with cottonseed hulls, biological efficiency for *P. ostreatus* is on average 180%.