

# Oyster Mushroom Cultivation

## Part II. Oyster Mushrooms

### Chapter 9

#### Post-harvest Management

## RECYCLING OF SPENT OYSTER MUSHROOM SUBSTRATE

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Figure 1. Mushroom bed contaminated by green mold

Spent Mushroom Substrate (SMS) needs heat treatment before being removed from the growing chamber. But it takes extra cost, and thus, some mushroom growers want to throw away the contaminated SMS far from the farm in order to prevent re-contamination (Fig. 1). Without proper treatment, contaminated SMS can cause re-contamination. In opposition, recycle of SMS can increase sustainability and also help farm economy.

This article is excerpted from “Spent mushroom substrate around the world” (Danny Lee Rinker) and “Project report” (ZERI Foundation), and edited by Seung Woo Kang.

### A Brief Description of Spent Oyster Mushroom Substrate

At the end of several mushroom harvests, the growing material is considered spent. SMS contains enough digestible nutrition, primarily decomposed by mushroom, to be fed livestock (Table 1, 2). It will increase growers' income and protect environment to recycle SMS for feeding livestock or soil for other plants. As you can see in Table 2, *Pleurotus* compost contains high percentage of three primary nutrients (nitrogen, N; phosphorus, P or P<sub>2</sub>O<sub>5</sub>; potassium, K or K<sub>2</sub>O) as a fertilizer.

**Table 1. Characteristics of spent oyster mushroom substrate**

Ash	TSS*	C (%)	H (%)	N (%)	Mg (mg/L)	Ca	Na	K	Mn	Ni	Zn
72.92	830	23.6	4.06	5.99	7.72	30.13	1.32	4.47	2.2	nil	2.34

\* TSS: Total Soluble Solids

(Source: Chiu *et al.*, 1998)

**Table 2. Analysis of the fertilizer value of compost from the edible *Pleurotus ostreatus***

	N (%)	P <sub>2</sub> O <sub>5</sub> (%)	K <sub>2</sub> O (%)
<i>Pleurotus</i> compost	1.70	0.61	1.13
Human manure and urine	0.30	0.16	0.30
Pig manure	0.60	0.60	0.50
Cow manure	0.59	0.28	0.14

(Source: Zheng *et al.*, 2002)

For instance, a Thai mushroom grower recycles his spent substrate as a soil for other plants (Fig. 4, 5). He put the spent substrate for over one year under outdoor condition before reuse.



Figure 2. Spent sawdust substrate from bag cultivation



Figure 3. Spent cotton-waste substrate from shelf cultivation



Figure 4. Spent straw substrate during aging before reuse



Figure 5. Tropical plants grown on aged spent straw substrate

## SMS Recycling Cases in ZERI Projects

### Colombia: spent coffee-substrate for feeding cattle and pigs

The organic wastes from a coffee farm contain biochemicals, which do not permit their reuse as cattle feed. Therefore, they could at best be used for earthworm farming. However, enzymes of the tropical mushrooms are capable of neutralizing these biochemicals. Even better, the mushroom mycelia (roots) are rich in protein (up to 38%). This means that the waste from the coffee farm-after mushroom farming - becomes an excellent additive to cattle and pig feed.

4kg of vegetable or fungal protein produces 1kg of pig meat. In the case of cattle farming, the ratio is 7 : 1. Many consider this to be a very inefficient way for us to get protein. However, we usually do not consider the volume of energy pig or cow manure can produce in a digester. 100 pigs produce enough manure each day to generate a calorific energy value equivalent to 10L of petroleum. Manure energy (biogas), should be used first and foremost by the coffee farmer for the preparation of the substrate for mushroom farming. The coffee bush waste needs to be pasteurized, and for specific types of mushrooms sterilized, before being used as a mushroom growing substrate. And since this requires a continuous flow of energy, it is best to use a locally available renewable energy source - and pigs always produce waste.

### Africa: spent substrate of water hyacinth weed for cattle feeding and vermiculture

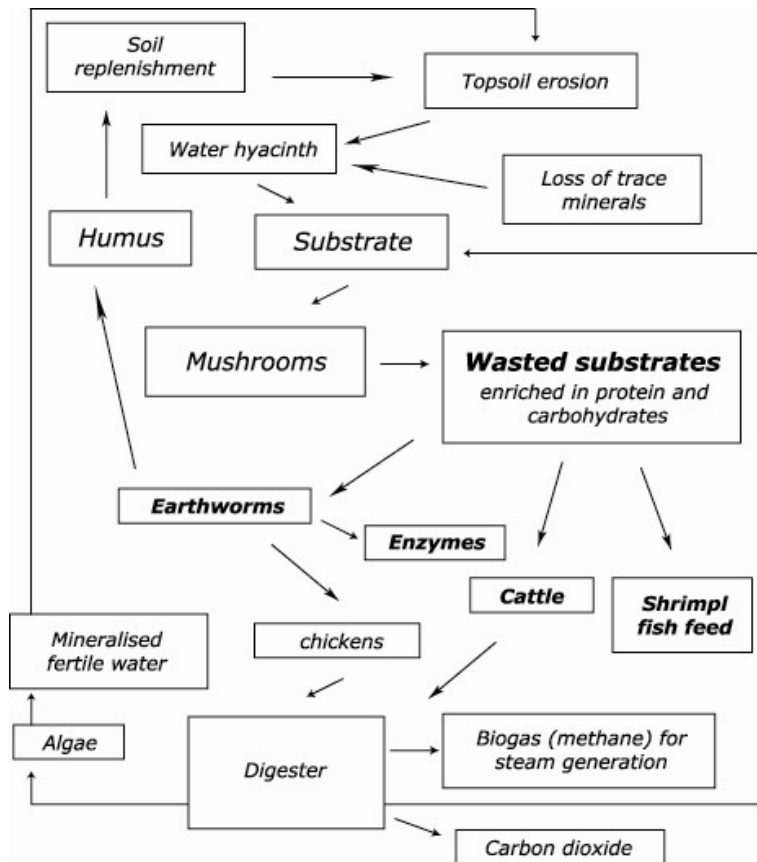


Figure 6. The integrated biosystem for the water hyacinth

1 ton of dried water hyacinth substrate generated 1.1 tons of mushrooms, thus generating more mushrooms than base material and out-performing traditional substrates such as sawdust. The residual substrate of water hyacinth after mushroom farming, is a rich food-base for cattle. Since nearly all the lingo-cellulose has been broken down by the enzymes of the mushroom, the rest of the material can also be used to farm earthworms, which will convert the material into a humus. The humus that is produced in the process would then be reapplied to the soils, recovering and replenishing some of the lost topsoil. Earthworms are also an excellent chicken feed.

## Some Studies on SOMS\* Recycling

### Bioremediation

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### Food for animals and fish

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