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Identification of a suitable substitute for polypropylene bags for Oyster mushroom cultivation

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ABSTRACT

The polypropylene bags as containers for cultivating Oyster mushrooms, recommended by the Department of Agriculture. After the cultivation period, polypropylene bags were thrown out because bags cannot be reused for the next season, which causes heavy environmental pollution. The present study identified a suitable container for the substrate used in Oyster mushroom cultivation. A study was conducted in the mushroom unit, Matale. As treatments, T1: 15 cm height and 8 cm diameter polypropylene bags, T2: 15 cm height and 8 cm diameter glass bottles, T3: environmental friendly $90\times40\times12$ cm^3 wooden trays, T4: $60\times40\times12$ cm plastic crates were used. Oyster mushroom spawns were prepared using Paddy seeds. Each of the polypropylene bags and glass bottles was filled with 350 g of wet substrate. Each wooden tray was filled with 15 kg of wet substrate. Each plastic crate was filled with 10 kg of wet substrate. A complete randomized design with five replicates was used for the experiment. After containers were filled with wet substrate, spawns were inserted. All containers were sealed and kept for 28 days in a dark room to complete the spawn run. After completing the spawn run, the treatments were transferred to the cropping room, and a temperature of 20 °C was maintained until fruiting body formation. In total, five flushes were harvested for the study. Data were analyzed using the ANOVA, and mean separation was done using Duncan's Multiple Range Test. The study revealed that the time taken for the first harvest was less than 53 days from inoculation in polypropylene bags and glass bottle containers. There was no significant difference between the polypropylene bags and the glass bottles on spawn running and pinhead formation. Therefore, glass bottles can be recommended as a substitute for polypropylene bags. Thus, the polypropylene bags and the glass bottle containers gave an excellent biological efficiency, then the wooden trays and plastic crates, which helps reduce the cost of production.

Keywords: Oyster cultivation, Plastic crates, Polypropylene bag container, Wooden trays.

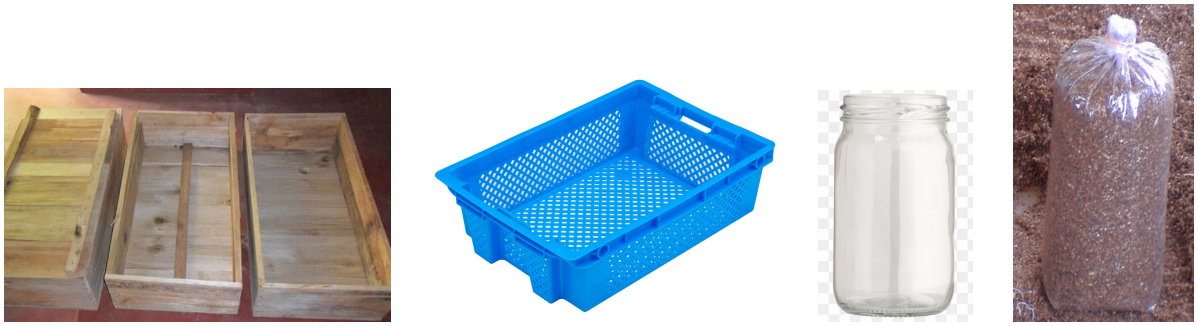
INTRODUCTION

Oyster mushroom (*Pleurotus* spp.) is a commercially important, predominantly grown mushroom variety in Sri Lanka. Polypropylene bags are recommended by the Department of Agriculture (DOA, 2014) to cultivate Oyster mushrooms. Polypropylene bags are thrown out at the end of the cultivation period, as bags cannot be reused for the next season. This practice causes heavy environmental pollution in Sri Lanka. Therefore wooden trays, heavy plastic crates or glass containers are the following options for oyster mushroom cultivation. The present study was carried out to identify a suitable container for substrate use for Oyster mushroom cultivation.

METHODOLOGY

The research was conducted in the mushroom unit, Matale. 15 cm height and 8 cm diameter polypropylene bags and 15 cm height, 8 cm diameter glass bottles, $90\times40\times12$ cm environmental friendly wooden trays, $60\times40\times12$ cm plastic crates (Figure 1) were used for the experiment.

The inoculum was prepared using a fresh fruiting body of the mushroom through the tissue culture method in Petri dishes, incubated at 28 °C room temperature. Oyster mushroom spawn was prepared using 1 kg of Paddy seeds. They were washed with detergent and boiled for 20 minutes until 25% of the paddy seed was split (Amarasekara et al., 2017). After cooling, 50 g of $CaCO_3$ and 200 g of $CaSO_4$ powder were mixed with boiled paddy seeds. They were filled into each polypropylene bag and sterilized for 20 minutes in a pressure cooker. A piece of mycelium tissue was inserted into sterilized paddy seeds bags under aseptic conditions and incubated at room temperature for seven days until the grains were covered with white mycelia. Oyster mushroom spawns were used as planting material for the treatments. The substrate for treatments (Islam et al., 2009), was prepared according to the DOA recommendation using 125 kg of sawdust, 12 kg of rice bran, 1.2 kg of soya bean, 1 kg of mung bean flour, 2.4 kg of $CaCO_3$, and 250 g of $MgSO_4$ for all 20 containers. The spawns were inserted into the substrate after being autoclaved for 3-4 hours under a sterilized environment inside the mushroom unit. The propylene bags, glass bottles, wooden trays, plas-



(a) (b) (c) (d)

Figure 1: Containers used for the substrate; (a) wooden trays, (b) heavy plastic crate, (c) glass containers, and (d) polypropylene bags

tic crates were sterilized using alcohol (surgical spirits). Each of the polypropylene bags and glass bottles was filled with 350 g of wet substrate. Each wooden tray was filled with 15 kg of wet substrate. Each plastic crate was filled with 10 kg of a wet substrate (Figure 2).

Figure 2: Containers used for the substrate; plastic crate

The experiment was laid according to a complete randomized design using four treatments with five replicates. Treatments were T1: polypropylene bags, T2: glass bottles, T3: wooden trays, T4: plastic crates. After containers were filled with spawns inserted wet substrate, all containers were sealed and kept for 28 days in a dark room to complete the spawn run (Figure 3).

Figure 3: Sealed wooden trays

After completing the spawn run, the treatments were transferred to the cropping room, and a 20 °C temperature was maintained for fruiting body formation. The humidity of bags was accomplished by spraying water on them twice a day (Figure 4).

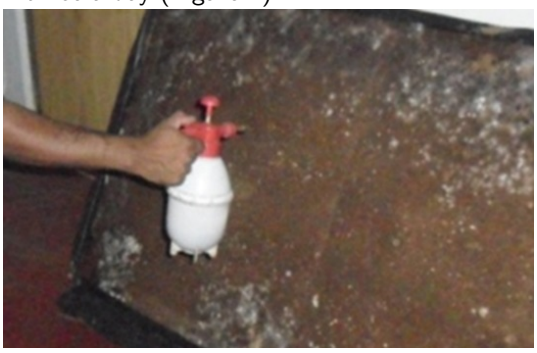


Figure 4: Spraying of water to the substrate in wooden trays

Natural air was used for mushrooms during fructification. The 85% of the humidity was maintained with water spray several times per day. When the pinhead had grown to 1 cm, the humidity was lowered the 75% bypassing fresh air through the room. Harvesting was done by twisting and pulling the mushroom from the substrate until the mycelium remains white and firm. In total, five flushes were harvested for the study. Mycelia growth rate, days taken from inoculation to spawn run, pinhead formation, and fruit body formation was measured. The first harvest and the total yield were recorded. Then the biological efficiency (BE) was calculated as:

$$\text{BE (\%)} = \frac{\text{Total weight of fresh mushrooms}}{\text{Wet weight of the substrate}} \times 100$$

Data were analyzed using the ANOVA, and mean separation was done using Duncan's Multiple Range Test (DMRT) at p=0.05 using the SAS procedure.

RESULTS AND DISCUSSION

This study discovered no significant difference among polypropylene bags and glass bottles on spawn running and pinhead formation. A significant difference was observed between polypropylene bags, wooden trays, and

(a) (b)

Figure 5: Containers used for the substrate; (a) wooden tray, and (b) glass bottle

plastic crates (Figure 5). The time taken for spawn running and pinhead formation of the above processes are as follows (Table 1). Values within a row followed by a common letter are not significantly different at p=0.05, according to DMRT.

Table 1: Time taken for spawn running and pinhead formation

Treatment	No. of days for spawn running	No. of days for pinhead formation
T1	22^a	27^a
T2	22^a	27^a
T3	25^b	30^b
T4	26^b	30^b

Formation of Monokaryon (haploid stage) occurs soon after basidiospore (spawn) germination was observed under the microscope. The short-lived monokaryon stage of the Basidiomycotina fused with a compatible monokaryon which form Dikaryon (diploid stage) after 20 days in regular cultivation of Oyster mushroom (Kirthisinghe et al., 2012a). The Dikaryon is the mycelium that produces the basidiocarp and basidiospore. Cellulosic substances degraded easily with growing mushrooms (Kirthisinghe et al., 2012b). The delayed harvesting resulted in the sawdust substrate as it is one of the lignin-containing substrates, which require an extended period for their decomposition (Pathmashini et al., 2008). The mycelia take the time to start pinning after ramification depends on the substrate used. Compared to the substrates with low nutrition value, the substrates with high nutrition value take a short time to colonize completely. The mycelia remain vegetative for a more extended period which can be cause late pinning. The harvest of the above processes is given in Table 2.

Table 2 shows that time taken for harvest is less than 53 days from inoculation in polypropylene bags and glass bottle containers. However, when reusing the glass bottles, growers will face the problem of cleaning the bottles. There was no significant difference between polypropylene bags and glass bottles on spawn running and pinhead formation. Therefore glass bottles are a better option to substitute polypropylene bags.

Table 2: Time taken for harvest, and BE%

	T1	T2	T3	T4
First flush (d)	52^a	50^a	55^b	57^b
First harvest (d)	54^a	52^a	58^b	59^b
BE %	40^a	40^a	30^b	32^b
CV %	23	24	23	24

Values within a row followed by a common letter are not significantly different at P=0.05, according to DMRT.

CONCLUSION

This study discovered no significant difference between polypropylene bags and glass bottles on spawn running and pinhead formation. Therefore, glass bottles can be recommended as a substitute for polypropylene bags to avoid environmental pollution. Thus, polypropylene bags and glass bottle containers gave better biological efficiency than wooden trays and plastic crates.

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