EVALUATION OF ALTERNATIVE GROWING MEDIUM FOR ENHANCED YIELD OF AMERICAN OYSTER MUSHROOMS (*Pleurotus ostreatus*)

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Oyster mushrooms (*Pleurotus spp.*) are widely cultivated in Sri Lanka. However, mushroom growers face challenges due to a lack of rubber sawdust, increasing costs, limited wood industry production, and other uses of rubber sawdust, which serve as their primary substrate. The study aimed to develop an alternative, growing medium which gives high yield using locally available materials. A Completely Randomized Design with seven treatments and three replicates was used in the study. 100% Rubber sawdust (Control T1), 100% Paddy straw (T2), 50% Paddy straw + 50% Rubber sawdust (T3),100% Dried banana leaves (T4), 50% Dried banana leaves + 50% Rubber sawdust (T5), 100% Coconut husks (T6), 50% Coconut husks + 50% Rubber sawdust (T7) used as treatments. Chopped paddy straw, dried banana leaves, and coconut husks were soaked in 1% $CaCO_3$ solution and dried. Rubber sawdust portions (T1, T3, T5, T7) were mixed with supplements to prepare the substrates according to the treatment composition. 1kg each of prepared substrates was packed, labelled, sterilized, and inoculated with *P.ostreatus* spawn. After incubation of 26 to 46 days, fruiting bodies developed. Mycelium growth(days), Number of mushrooms, weight of mushrooms, number of marketable mushrooms, weight of marketable mushrooms, and biological efficiency were analyzed for per bag. Analysis of variance and Least Significant Difference tests were used for statistical analysis. According to the results T1-100% Rubber sawdust, T2-100% Paddy straw, T4-100% Dried banana leaves, T7-50% Coconut husks + 50% Rubber sawdust showed the fastest mycelium growth. T2, T4, T5-50% Dried banana leaves + 50% Rubber sawdust yielded the highest number of mushrooms, and the highest number of marketable mushrooms was obtained by T1, T2 and T5. T2 – 100% Paddy straw (181g) and T5 -50% dried banana leaves + 50% rubber sawdust (196g), were both produced the highest weight of mushrooms(196g) per bag and highest weight of marketable mushrooms exhibited by T5(185g), T2 (158g), and T1(143g). The highest BE% was shown by T5 (19.4%) and T2 (18.14%) respectively. Nonetheless, overall yield was low due to high temperatures affecting humidity control. T5 and T2 showed exceptional yields and high biological efficiency, but further studies are needed to address temperature control and contamination before making recommendations.

Keywords: Alternative, Cost-effective, Oyster, Rubber Sawdust, Substrate

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INTRODUCTION

Oyster is a popular mushroom variety in Sri Lanka, and it have significant potential for revenue generation, alternative food production, income generation, and agricultural waste recycling (Tesfay *et al*., 2020). However, the traditional use of rubber sawdust for their cultivation poses challenges due to scarcity and competition with other industries (Bandaranayke *et al.* 2012). To increase the oyster mushroom production, identification of an efficient alternative growing medium is needed. Various agricultural byproducts, such as oil palm, bamboo sawdust, corn straw, sugarcane bagasse, rice husks, vegetable residues, paddy straw, wheat straw, and maize stalks, have been investigated as substrates (Taskirawati *et al*., 2020; Varghese & Amritkumar, 2020).

To address this issue, this study aimed to develop an alternative, high-yielding growing medium using locally accessible, low-cost materials such as paddy straw, dried banana leaves, and coconut husks.

METHODOLOGY

The experiment was carried out at the Sustainable Agricultural Research and Development Centre (SARDC) in Makandura using a Completely Randomized Design (CRD) with seven treatments. *Pleurotus ostreatus* spawn were collected from the research center. Rubber sawdust, chopped paddy straw, dried banana leaves, coconut husks, rice bran, CaCO3, dolomite ($CaMg(CO_3)_2$), $MgSO_4$, gypsum ($CaSO_4{\cdot}2H_2O$), 200-gauge polypropylene bags (14"×9"), cotton wastes, PVC pipes (1" width, 3/4" height), rubber bands, and papers were used as materials. Among the tools utilized were a sharp knife, boiler, chopping machine, and digital balance.

The substrates were made on a dry weight basis and soaked in 1% $CaCO_3$ containing tap water (excluding rubber sawdust) and dried. Rubber sawdust portion of media (T1, T3, T5, and T7) were supplemented with rice bran, dolomite, $MgSO_4$, and gypsum, and the prepared mixture was combined with other substrate materials. 1kg of prepared substrates was placed into labelled polyethylene bags, sterilized at 120 °C for 2 hours (Nuamah *et al*., (2017), and cooled to room temperature. Oyster spawns were added to each bag and incubated until fully colonized. The bags were opened for fruiting, misted daily, and provided good ventilation until harvesting. Bags showing pathogenic mould growth were isolated to avoid contamination.

Biological efficiency for each substrate was calculated using the formula below.

$$\text{B.E.} = \frac{\text{Fresh weight of mushroom}}{\text{The wet weight of the substrate}} \times 100$$

RESULTS AND DISCUSSION

The prepared bags were evaluated for number of days taken to complete mycelium growth, number of mushrooms per bag, weight of mushrooms per bag, number of marketable mushrooms per bag, and the weight of marketable mushrooms per bag over 2 months. Statistical analysis was performed using ANOVA in SAS University edition, with means compared using the Least Significant Difference (LSD) test.

As shown in Table 1, the number of days for complete mycelium growth was significantly different among treatments. According to the data – T1 (100% Rubber sawdust), T2 (100% Paddy Straw), T4 (100% Dried banana Leaves), T7 (50% Coconut Husks + 50% Rubber sawdust), had similar results, while T3 (50% Paddy straw + 50% Rubber sawdust) and T5 (50% Banana Leaves + 50% Rubber sawdust) took significantly greatest number of days to complete mycelium growth. *Pleurotus ostreatus* achieved complete spawn running on sawdust in 30 days, aligning with Dhakal *et al.* (2020) and Vetayasuporn (2006). Similar results were observed on paddy straw and banana leaves substrates, consistent with Gyeltshen and Dorji (2019). However, the mixed substrate of sawdust and banana leaves took 42 days for full mycelial growth, which is longer than the 24 days reported by Varghese and Amritkumar (2020).

Table 1: The effect of substrates on number of days taken to complete the mycelium growth

Treatment	No. of days taken to complete the mycelium growth
T1 Rubber sawdust (C)	$30^{c} \pm 0.39$
T2 Paddy straw	$27^{c} \pm 1.81$
T3 PS + RS	$46^{a} \pm 1.02$
T4 Dried banana leaves	$29^{c} \pm 0.48$
T5 DBL + RS	$42^{a} \pm 5.06$
T6 Coconut husks	$35^{b} \pm 2.22$
T7 CH + RS	$26^{c} \pm 0.59$

Means with the same letter in a column are not significantly different at p<0.05

T1- 100% Rubber sawdust, T2- 100% Paddy Straw, T3- 50% Rubber sawdust + 50% Paddy straw, T4- 100% Dried banana leaves, T5- 50% Dried banana leaves + 50% Rubber sawdust, T6- 100% Coconut husks, T7- 50% Coconut husks + 50% Rubber sawdust

There was a significant difference among treatments for the number of mushrooms per bag (Table 2). It has been observed from that T2- 100% Paddy straw (42), T4- 100% Dried banana leaves (41), and T5- 50% Dried banana leaves + 50% Rubber sawdust (36) were the most effective in producing mushrooms per bag. T6 yielded the lowest number of mushrooms per bag due to the contamination of green mould. Consistent with Biswas & Biswas (2015), paddy straw substrates performed superiorly. Nutrient absorption ability of mycelium determines the variation in mushroom yield between substrates (Taskirawati *et al*., (2020).

As depicted in Table 2, T5-50% Dried banana leaves + 50% Rubber sawdust (196g) and T2-100% Paddy Straw (181g) had the highest number of mushroom weight per bag. The significantly lowest mushroom weight per bag was recorded in T6 maybe due to contamination of other fungal species. T1 and T4 showed similar results (144 g). These findings contrast with Varghese and Amrit Kumar (2020), who found that the maximum yields when, used sawdust and minimum yields with banana leaves + sawdust substrates.

The number of marketable mushrooms across different substrates is presented in Table 2. The largest number of marketable mushrooms was produced by T2 – 100% Paddy straw (36), T5- 50% Dried banana Leaves + 50% Rubber sawdust (33) and control T1- 100% Rubber sawdust. However, T1, T2, and T5 significantly vary ($P < 0.05$) from other treatments. On the other hand, T6- 100% Coconut husks (1) and T7- 50% Coconut husks + 50% Rubber sawdust (16) were provided with fewer marketable mushrooms. Dhakal *et al*., (2020) and prior studies claimed that the growth of the mushroom is thought to be dependent upon the performance of the substrates.

The results (Table 2) revealed that T5-50% Dried banana leaves + 50% Rubber sawdust (185g), T2-100% Paddy straw (158g) and T1-100% Rubber sawdust (143g) produced the highest weight of marketable mushrooms (185g), statistically comparable to T3-50% Paddy straw + 50% Rubber sawdust (141g), T4-100% Dried banana leaves (112g), T6-100% Coconut husks (3.6g), and T7-50% Coconut husks + 50% Rubber sawdust (89g). However, T5 is significantly different from T1-100% Rubber sawdust. Notably, T6-100% Coconut husks yielded the lowest weight (3g) due to contamination, much lower than other treatments.

The biological efficiency percentages ranged from 0% to 19% across all substrates (Table 2). T5 - 50% with 50% Rubber sawdust and 50% Dried banana leaves (19.56%) and T2 - 100% Paddy straw (18.14%) showed the highest biological efficiency, surpassing T1-100% Rubber sawdust at 14.48%. However, T6-100% Coconut husk had the lowest efficiency (0.38%) due to contamination during incubation. Onyeka *et al*. (2018) observed better efficiency using sawdust and banana leaves, similar to the study's findings. However, these findings contrast with previous studies, which found substrates with over 40% biological efficiency, due to excessively dry weather conditions throughout the experiment.

Table 2: The effect of various substrates on the number of mushrooms, weight of mushrooms, number of marketable mushrooms, weight of marketable mushrooms and Biological Efficiency %

T	No.of mushrooms	Weight of mushrooms (g)	No.of marketable mushrooms	Weight of marketable mushrooms (g)	BE %
T1	$33.35^{bc} \pm 3.16$	$144.16^{c} \pm 14.35$	$33.00^{a} \pm 2.91$	$143.22^{b} \pm 11.16$	$14.48^{c} \pm 1.45$
T2	$42.29^{a} \pm 4.84$	$181.38^{ab} \pm 14.23$	$35.95^{a} \pm 4.41$	$158.26^{ab} \pm 18.11$	$18.14^{ab} \pm 1.42$
T3	$28.75^{c} \pm 1.84$	$151.71^{bc} \pm 12.19$	$27.44^{b} \pm 1.33$	$141.51^{bc} \pm 7.40$	$15.17^{bc} \pm 1.22$
T4	$40.74^{a} \pm 2.58$	$144.16^{c} \pm 16.70$	$32.04^{b} \pm 2.89$	$112.89^{cd} \pm 13.33$	$14.42^{c} \pm 1.67$
T5	$36.33^{ab} \pm 3.17$	$195.56^{a} \pm 22.18$	$33.27^{a} \pm 2.85$	$185.07^{a} \pm 23.46$	$19.56^{a} \pm 2.22$
T6	$1.44^{e} \pm 0.17$	$3.77^{e} \pm 0.79$	$1.20^{d} \pm 0.09$	$3.55^{e} \pm 0.32$	$0.38^{e} \pm 0.08$
T7	$18.22^{d} \pm 1.17$	$98.11^{d} \pm 10.12$	$16.31^{c} \pm 0.22$	$89.11^{d} \pm 9.78$	$9.81^{d} \pm 1.01$

Means with the same letter in a column are not significantly different at $p<0.05$

T1- 100% Rubber sawdust, T2- 100% Paddy straw, T3- 50% Rubber sawdust + 50% Paddy straw, T4- 100% Dried banana leaves, T5- 50% Dried banana leaves + 50% Rubber sawdust, T6- 100% Coconut husks, T7- 50% Coconut husks + 50% Rubber sawdust

CONCLUSION AND RECOMMENDATIONS

Based on the analysis of total yield and biological efficiency %, the results indicated that T5 (50% Dried banana leaves + 50% Rubber sawdust) and T2 (100% Paddy straw) showed the most productive alternative for Oyster mushroom growing in Sri Lanka. However, the total yield of all substrates was low due to high-temperature conditions. T6 (100% coconut husk) experienced greater contamination by mould lowering its yield. The study implies that further research is needed to address temperature control and contamination concerns before making suggestions. Addressing these aspects could lead to enhanced productivity and improved cost- effectiveness, leading to the advancement and sustainability of Oyster mushroom production practices in Sri Lanka.

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