



## The Influence of Leri Water Supplementation on the Growth and Production of White Oyster Mushrooms (*Pleurotus Ostreatus*)

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### ARTICLE INFO

*Keywords:* White Oyster Mushroom, Leri Water, Growth Medium

*Received :* 14, September

*Revised :* 12, October

*Accepted:* 20, November

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### ABSTRACT

This study aimed to investigate the influence of leri water supplementation on mycelium growth, primordial appearance, fruiting body count, fruit body diameter, and wet weight, as well as the production of white oyster mushrooms (*Pleurotus ostreatus*). The research employed a Completely Randomized Design (CRD) with four treatments: A0 (control without leri water), A1 (20 ml of leri water), A2 (40 ml of leri water), and A3 (60 ml of leri water), with a 95% confidence level F-test. The results revealed that leri water supplementation significantly affected all observed variables. The treatment with 40 ml of leri water (A2) produced the highest mycelium growth with an average weight of 10.45 kg, the earliest primordial appearance, the highest fruiting body count (15.67), and the highest wet weight (372 kg). Meanwhile, the treatment with 60 ml of leri water (A3) resulted in the largest fruit body diameter (17 cm). Among the treatments, A2 with a 40% leri water nutrient supplement in the growing medium outperformed others, as it provided the necessary nutrients for mycelium growth and overall mushroom development.

## INTRODUCTION

Forests are natural resources that can be utilized for human well-being, as they can provide significant natural yields to the nation. Moreover, forests can be harnessed by the communities living around them to fulfill their daily needs, including both wood and non-wood resources. Therefore, one of the benefits of non-wood forest products is white oyster mushrooms, which typically grow during the rainy season on decaying wood.

Communities use materials such as sawdust and agricultural waste as alternative substrates for the growth and production of high-quality white oyster mushrooms.

Mushrooms are non-chlorophyll-bearing plants commonly found in nature. They thrive on decaying wood, especially during the rainy season. Mushrooms are increasingly favored by many as a food source and for medicinal purposes.

White oyster mushrooms (*Pleurotus ostreatus*) are among the most consumed mushroom varieties due to their high nutritional value. This broad market demand has led to a continuous increase in white oyster mushroom product demand (Chazali and Putri, 2009).

Leri water is the residual water from washing rice, containing various dissolved nutrients. According to Puspitarini in 2011, leri water contains nutrients such as starch (carbohydrates) at around 89%-90%, glutelin proteins, cellulose, hemicellulose, sugar, and vitamin B, mostly found in the pericarp and aleurone layers that are washed off. Rice is a primary source of energy and protein, containing various minerals and vitamins. Leri water is readily available since rice is a staple food for the majority of the Indonesian population.

## METHODOLOGY

This research was conducted at East Timor Coffee Institute-ETCI, from May to August 2017. The materials used were White oyster mushroom (*Pleurotus ostreatus*) spores, sawdust (acacia wood), agricultural lime, rice bran, rice washing water (leri water), and clean water as the substrate for growing white oyster mushrooms or mushroom bags.

This study employed a Completely Randomized Design (CRD) consisting of 1 factor with 4 treatment levels and 3 replications as follows:

Factor I is the concentration of leri water with 4 concentration levels, namely :

A0: Control (no leri water supplementation)

A1: Leri water supplementation 20 ml/baglog

A2: Leri water supplementation 40 ml/baglog

A3: Leri water supplementation 60 ml/baglog

The concentration of leri water uses the first rice washing and is applied only once. The treatment is repeated three times, resulting in 36 experimental units.

Linear model:  $Y_{ijk} = \mu + \alpha_i + \beta_j + \gamma_k + \delta_{ijk}$  (Gaspers, 1995).

Where:

$Y_{ijk}$  = Observation value k in experimental unit j receiving treatment i

$\mu$  = Overall mean value (population mean)

$r_i$  = Effect of treatment  $i$

$\epsilon_{ij}$  = Error effect on observation  $k$  in experimental unit  $j$  receiving treatment  $i$

$\delta_{ijk}$  = Error effect on observation  $k$  in experimental unit  $j$  receiving treatment  $i$ .

## RESEARCH RESULT

The average results of White Oyster Mushroom (*Pleurotus ostreatus*) Growth and Production with increasing leri water and their variances. Meanwhile, the summary of variances is presented in table 1 and figure 1

Table 1. Summary of variances for White Oyster Mushroom (*Pleurotus ostreatus*) Growth and Production with leri water supplementation.

No	Observation Variable	Treatment
1	Mycelium Growth	**
2	Number of Primordia	**
3	Number of Fruiting Bodies	**
4	Fruiting Body Diameter	**
5	Wet Weight	**

Note : \* = significant effect and, \*\* = highly significant effect

The results of the analysis of variance for the Growth and Production of White Oyster Mushroom (*Pleurotus ostreatus*) with the addition of leri water on several observation variables (mycelium growth, number of primordial, number of fruiting bodies, fruiting body diameter, and wet weight) had a highly significant effect.

### 1. Mycelium Growth

The observed data for the average mycelium growth weight while its variance. The analysis of variance results indicates that leri water supplementation has a highly significant effect on mycelium length growth. Further Bonferroni test results and the average mycelium length growth graph.

Table 2. Bonferroni Post Hoc Test Results at a 95% Confidence Level for Average Mycelium Growth (kg).

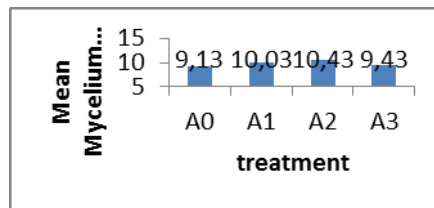
Treatment	Mean Mycelium Growth
A2	10.43a
A1	10.03ab
A3	9.43bc
A0	9.13c
BNJ 0.05%	(0.6449)

Note: Different letters in the same column indicate a significant difference at a 95% confidence level

The Bonferroni post hoc test results in Table 5 show that treatment (A2) with 40 milliliters of leri water significantly differs from treatments (A0 and A3) with 0 and 60 milliliters of leri water but has no significant difference from treatment (A1) with 20 milliliters of leri water.

The graph of the average mycelium length growth is presented in Figure 1

Figure 1. Graph of the average mycelium length (cm)



The graph shows the average mycelium length growth with leri water treatments of A0 = untreated (control), A1 = 20 milliliters of leri water, A2 = 40 milliliters of leri water, and A3 = 60 milliliters of leri water.

The average mycelium length presented in Figure 3. It is evident that treatment (A2) with 40 milliliters of leri water resulted in the highest average mycelium length growth, with a value of 10.43 cm, followed by treatment (A1) with 20 milliliters of leri water, which had a value of 10.03 cm. The lowest value was observed in treatment (A0) or the control treatment without leri water, with a value of 9.13 cm, followed by treatment (A3) with 60 milliliters of leri water, which had a value of 9.43 cm.

**2. Day of Primordial**

Appearance The observed data for the average number of days of primordial appearance while its variance. The analysis of variance results indicates that leri water has a highly significant effect on the average number of days of primordial appearance.

The Bonferroni post hoc test results at a 95% confidence level and the graph of the average number of primordial

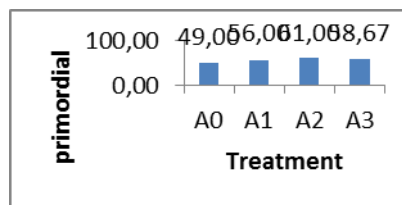
Table 3. Bonferroni Post Hoc Test Results at a 95% Confidence Level for Average Number of Days of Primordial Appearance

Treatment	Mean Number of Days of Primordial Appearance
A2	61.00 a
A3	58.67 ab
A1	56.00 ab
A0	49.00 b
BNJ 0.05%	10.886

The Bonferroni post hoc test results in Table 6 show that treatment (A2) with a leri water concentration of 40 ml significantly differs from treatment (A0) with a leri water concentration of 0 ml but does not significantly differ from treatments (A1) with a leri water concentration of 20 ml and (A3) with a leri water concentration of 60 ml. Meanwhile, treatment (A0) with a leri water concentration of 0 ml has no significant difference from treatments (A1) and (A3) but significantly differs from (A2).

The graph of the average number of primordial is presented in Figure 4.

Figure 2. Graph of the average number of days of primordial appearance (days)



The graph shows the average number of days of primordial appearance for white oyster mushrooms (*Pleurotus ostreatus*) subjected to leri water treatments of A0 = untreated (control), A1 = 20 milliliters of leri water, A2 = 40 milliliters of leri water, and A3 = 60 milliliters of leri water.

The average number of days of primordial appearance presented in Figure 4 indicates that treatment (A2) with a leri water concentration of 40 ml is the most favorable for primordial appearance, with an average value of 61.00. It is followed by treatment (A3) with a leri water concentration of 60 ml, which has an average value of 58.67, and treatment (A1) with 20 ml of leri water concentration, with an average value of 56.00. The lowest value is observed in treatment (A0) with a leri water concentration of 0 ml, having an average value of 49.00.

### 3. Number of Fruit Bodies

The analysis of variance results indicates that leri water has a highly significant effect on the number of fruit bodies. The Bonferroni post hoc test results at a 95% confidence level and the graph of the average number of fruit bodies.

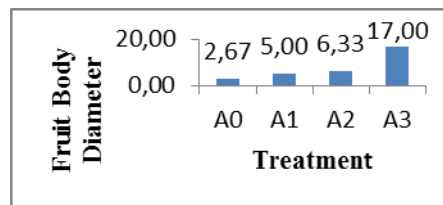
Table 5. Bonferroni Post Hoc Test Results at a 95% Confidence Level for Average Number of Fruit Bodies (fruit)

Treatment	Mean Number of Fruit Bodies
A2	15.67a
A3	6.67ab
A1	4.00b
A0	2.00b
BNJ 0.05%	(9.4877 )

Note: Different letters in the same column indicate a significant difference at a 95% confidence level.

The Bonferroni post hoc test results presented in Table 7 show that treatment (A2) with a leri water concentration of 40 ml significantly differs from treatments (A0) with 0 ml and (A1) with 20 ml of leri water concentration but does not significantly differ from treatment (A3) with a leri water concentration of 60 ml. The graph of the average number of fruit bodies is presented in Figure 5.

Figure 3. Graph of the average number of fruit bodies



The graph shows the average number of fruit bodies for white oyster mushrooms (*Pleurotus ostreatus*) subjected to leri water treatments of A0 = untreated (control), A1 = 20 milliliters of leri water, A2 = 40 milliliters of leri water, and A3 = 60 milliliters of leri water.

The average values in Figure 5 show that treatment (A2) with a leri water concentration of 40 ml yields the highest value at 15.67, while the lowest value is observed in treatment (A0), the control treatment with no leri water at 2. This is followed by treatment (A1) with a leri water concentration of 20 ml at 4 and treatment (A3) with a leri water concentration of 60 ml at 6.67

#### 4. Fruit Body Diameter

The analysis of variance results indicates that leri water has a highly significant effect on the fruit body diameter. The Bonferroni post hoc test results at a 5% confidence level and the graph of the average fruit body

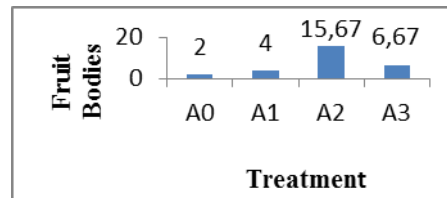
Table 6. Bonferroni Post Hoc Test Results at a 95% Confidence Level for Average Fruit Body Diameter

Treatment	Mean Number of Fruit Bodies Diameter
A2	6.33b
A3	17.00a
A1	A1 5.00b
A0	A0 2.67b
BNJ 0.05%	(7.2398)

Note: Different letters in the same column indicate a significant difference at a 95% confidence level

The Bonferroni post hoc test results presented in Table 8 show that treatment (A3) with a leri water concentration of 60 ml significantly differs from the other treatments. For a clearer view, the graph of the average fruit body diameter is presented in Figure 4

Figure 4. The graph of the average fruit body diameter



The graph shows the average increase in fruit body diameter for white oyster mushrooms (*Pleurotus ostreatus*) subjected to leri water treatments: A0 = untreated (control), A1 = 20 milliliters of leri water, A2 = 40 milliliters of leri water, and A3 = 60 milliliters of leri water.

## DISCUSSIONS

The observations on all the observed variables indicate that the provision of leri water has an effect on the growth and production of white oyster mushrooms (see Appendices 2a to 6a). The analysis of variance results indicates that leri water has a highly significant effect on the growth and production of white oyster mushrooms (see Appendices 2b to 6b). This indicates that leri water is a suitable element for the growth and production of white oyster mushrooms. The research results show that treatment A2 with a leri water concentration of 40 ml yielded mycelium length of 10.43 cm. This is likely because the media decomposed evenly, and the additional nutritional value of 40% leri water in the media is more beneficial compared to other treatments (A0, A1, and A3). These findings are consistent with the assertion by Winarni (2002) that abundant nutrition is required for mycelium to grow effectively. Leri water contains elements like N, P, K, C, and other nutrients. Mushrooms require carbon, nitrogen, vitamins, and minerals for their growth. Vitamins, such as thiamine (vitamin B1), nicotinic acid (vitamin B3), pantothenic acid (vitamin B5), biotin (vitamin B7), pyridoxine, and inositol, are essential for the growth of white oyster mushrooms.

The Bonferroni post hoc test results at a 5% confidence level in Table 4 indicate differences among treatments concerning the mycelium length of white oyster mushrooms. Each treatment has a different notation. Treatment A2 (40 ml of leri water) exhibits the highest effect, while treatment A0 (0 ml of leri water) shows the lowest impact. Among these four treatments, the heaviest mycelium is found in treatment A2 (10.43 cm), followed by treatment A1 (20 ml) with an average value of 10.03 cm, treatment A3 (60 ml) with an average value of 9.43 cm, and lastly, treatment A0 (0 ml) with an average value of 9.13 cm. These results are consistent with the statement by Ervina (2000) that adequate nitrogen can result in thicker and denser mycelium growth. The

presence of phosphorus in leri water (140 mg) leads to an increase in mycelium growth. According to Arif (1998), phosphorus plays a vital role in energy metabolism.

The results of the Bonferroni post hoc test in Table 5 indicate that the time of primordial emergence differs among treatments. Treatment A2 (40% leri water) exhibits the quickest primordial emergence. Conversely, treatment A0 (0% leri water) demonstrates the slowest primordial emergence. This is in line with Tutik (2004), who explained that the best mycelium growth affects the speed of primordial formation, initiated by mycelium formation because the time of primordial appearance is highly influenced by mycelium growth. Additionally, there is no additional nutrition or essential nutrients for mushroom growth. Regarding the number of fruit bodies, treatment A2 yields the highest number of fruit bodies. This is because the formation of fruit bodies generally depends on the number of primordial that grow. If there are many primordial, there will also be a significant number of fruit bodies formed. The number of fruit bodies that are not crowded results in the widest cap diameter. Treatment A2 produces a significant number of fruit bodies (15.67), while treatment A0 produces 2.00, treatment A1 produces 4.00, and treatment A3 yields fruit bodies totaling 6.67. Therefore, in mushroom cap growth, it can grow maximally without being crowded. This is reinforced by Rohmah explanation (2006), stating that the fewer the number of fruit bodies that grow, the larger (wider) the cap diameter. For the number of fruit bodies, treatment A2 (40 ml of leri water) produces the highest number of fruit bodies. This is due to the large number of fruit bodies produced by A2, resulting in smaller cap diameters. The abundance of mushroom cap growth, which is crowded together, hinders optimal mushroom cap growth.

Based on the results of the Bonferroni post hoc test at a 0.05% confidence level in Table 8, the parameter of wet mushroom weight indicates that treatment A2 (40 ml of leri water) yields the highest fresh weight of mushrooms. It is also assumed that the mushrooms have sufficient energy reserves for optimal fresh weight production because the elements present in the media can be evenly decomposed during fruit body formation, allowing the mushrooms to utilize them. Initially, mycelium absorbs the existing nutrients and subsequently converts other nutrients for its production. Suriawiria's study (2002), as cited by Tutik (2004), adds that the nutrients available in the growing medium that can be absorbed by mushrooms will increase the wet weight of the mushrooms.

## CONCLUSIONS AND RECOMMENDATIONS

From this research, the following conclusions can be drawn:

1. The addition of leri water has a highly significant impact on the growth of mycelium and the production of white oyster mushrooms.
2. Providing 40 ml of leri water (A2) as a nutrient yields the best results among all treatments.
3. The research results indicate that the addition of leri water has a highly significant effect on all observed variables. Treatment with 40 ml of leri water (A2) is the best treatment, resulting in the highest average mycelium

growth (10.45 kg), the earliest primordial appearance, the highest number of fruit bodies (15.67), and the highest wet weight (372 kg).

1. It is recommended that future researchers use autoclaving in the laboratory for better sterilization to avoid contamination of mycelium growth.
2. Optimal environmental conditions (temperature and humidity) for the growth of white oyster mushrooms need to be observed.
3. The diameter of large, medium, and small fruit bodies should be measured.
4. For future researchers, it is advisable to directly introduce leri water into the substrate mixture and sterilize it to prevent microbial contamination.
5. Measurement and weighing of the dry weight of white oyster mushrooms should be conducted.
6. Further research should be conducted to investigate the relationship between cap thickness and body width, as well as the use of different sawdust media.

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