Optimizing Quality of White Oyster Mushroom Seeds Through Systems Plant propagation

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Abstract. Quality seeds determine the productivity of white oyster mushrooms (Pleurotus ostreatus). The problem is the interaction between F0 seed inoculation (agar medium) and F1 seed media. The research objective of the two-factor correlation results produces high-quality seeds and optimal growth power. The research conducted at the Tissue Culture Laboratory of the Faculty of Agriculture, Merdeka University, Madiun. Two-factor experiments in the Factorial Randomized Design repeated three times:

A (inoculation of F0 seed media to make A1 potato extract and media to extract coconut water A2). B (F1 media growing grain) consists of B1 corn, B2 rice grain, B3 red beans, B4 soybeans, B5 corn seeds and rice grains, B6 red beans and soybeans, B7 corn and soybeans. Anova statistical analysis continued Duncan test 5%. Significant interaction at the time of mycelium appearance, mycelium growth rate and the percentage of mycelium spread ages 7, 14 and 21. The highest time of mycelium appearance (1.8 DAP) in the combination of A1 B7 (F0 seed media for potato extract with growing medium of corn seeds and soybean seeds) and A2 B3 (media F0 seedlings to extract coconut water on rice grain growing media). Increasing speed for mycelia is the highest combination of treatment A1 B2 (F0 seed media for potato extract with rice grains) = 2.2 HIS. Percentage of 100% mycelium spread at age 21 DAP in combination A1 B1 (A: F0 seed potato extract with B2 growing medium of corn seeds). A2 (F0 seed extract of coconut water) inoculated on the medium of corn seeds and corn seeds plus other seeds of rice, red beans and soybeans provide significant results.

1. Introduction
Mushroom cultivation is an application of biotechnology that uses practical and straightforward technology so that ordinary people in the countryside can do it. Mushroom cultivation can be an alternative to the use of natural resources, diversification of food and nutrition, environmental preservation and employment opportunities for the community[1]. The prospects of oyster mushrooms are quite bright, in addition to high-value nutrient, affordable prices, market demand continues to increase, but market needs have not met due to Oyster mushroom productivity is still low and limited. Quality seeds are one of the determining factors in the development of mushroom productivity. The problem faced in the field of low-quality seeds obtained by farmers from seed breeders [2.

White oyster mushroom (Pleurotus ostreatus) is currently a choice as a healthy food for consumption. The high nutritional content contains protein, fat, phosphorus, iron, thiamin, riboflavin and 18 kinds of amino acids. White oyster mushrooms do not contain cholesterol can neutralise toxins and substances radioactive substances in the soil and can be consumed as medicines.[3]. White oyster mushrooms have enormous benefits for health because it contains a lot of balanced nutrients, especially womb carbohydrates and proteins that are needed by the body [4]

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Oyster mushrooms contain 18 kinds of amino acids needed by the human body and do not contain cholesterol. These types of amino acids are isoleucine, lysine, methionine, cysteine, phenylalanine, tyrosine, threonine, tryptophan, valine, arginine, histidine, alanine, aspartic acid, glutamic acid, glycine, proline and serine. The composition and nutritional content of every 100 grams of oyster mushrooms...
contain: 367 calories, 10.5-30.4% protein, 56.6% carbohydrates, 1.7-2.2% fat, 0.20 mg thiamin, 4.7-4.9mg riboflavin, 77.2 mg niacin, 314.0 mg calcium, [1].

The results of research [6] showed that every 100 grams of oyster mushrooms contained a nutritional value in the formed protein (5.56%), fat (0.17%), carbohydrate (59%), fibre (1.56) other than that every 100 grams. Fresh oyster mushrooms contain 8.9 milligrams of calcium, 1.9 milligrams of iron, 17.0 milligrams of phosphorus, B vitamin 0.15 milligrams, 12.40 milligrams of vitamin C and produce 45.65 calories. Oyster mushrooms require nutrients that are relatively easily absorbed rich in vitamins, minerals to meet the metabolic activity of the cell. Supplements are relatively inexpensive and efficiently provided by mushroom farmers themselves. Therefore, it is necessary to conduct trials combining sawdust powder or bagasse as a growing medium with readily available supplements, namely bran and corn flour. [7].

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Quality seeds are a determining factor in the development of mushroom productivity. Problems faced in the field of low quality of seeds obtained by farmers from seed breeders. Factors that cause the economical production of oyster mushrooms are due to the viability of oyster mushroom seeds in the spread of mycelia. One alternative to improve the propagation of mycelia is to breed quality and viable seeds. To get high quality and viability seeds, combine raw material for mushroom seed media with the isolation of vegetative part implants from white oyster mushroom plants and F1.[2]. Rice seeds, red beans, and soybeans are used as innovations in the manufacture of mushroom growing media, as well as being an innovation in mushroom growing media, because of carbohydrates and proteins can support fungal growth and development. Based on this, this study aims to determine the growth of white oyster F0 mycelium in various types of F1 inoculation media (grains).

2. Materials and Methods

2.1. Time and Location Research
The study conducted for seven months (February to August 2018), at the Tissue Culture Laboratory of the Faculty of Agriculture, Merdeka University of Madiun, the height of the place is 63 m above sea level (asl).

2.2. Method of Data Collection and Analysis
The research was carried out in two phases, namely the first stage of making F0 to obtain the isolation media formulation and the growth velocity of mycelia. The second stage of making F1. Research using factorial experiments was arranged based on Randomized Block Design (RBD). The analysis consists of two factors. The first factor is the injection of F0 with the following treatments: A1 = F0 seeds (gelatin and potato extract), A2 = F0 seeds (gelatin and coconut water extract). The second factor is inoculation media material consisting of 7 kinds of media material, namely: B1 = Corn seeds, B2 = rice grain, B3 = red bean seeds, B4 = Soybean seeds, B5 = Corn seeds and rice grain, B6 = Corn seeds and Red bean seeds, B7 = Corn Seeds and Soybean Seeds.

2.3. Data analysis
Analysis of variance (ANOVA), Statistical Package for Social Sciences (SPSS), Test of Duncan range of 0.5

2.4. Data Observation and Analysis Parameters:
  a. Color
Table 1. Mycelium colour score

| Score | Colour       |
|-------|--------------|
| 1     | Yellow       |
| 2     | Yellowish white |
| 3     | Brownish white |

b. Time mycelium appears
c. Mycelium thickness

Table 2. Mycelium thickness scores

| Score | Thickness       | Description                              |
|-------|-----------------|------------------------------------------|
| 4     | Very thick      | Thick mycelium evenly distributed        |
| 3     | Thick           | Thick mycelium is uneven                 |
| 2     | Thin            | Thin mycelium                            |
| 1     | Very Thin       | The mycelium is almost invisible         |

Mycelial growth speed. Obtained by measuring growth length (cm / day) from the point of growth.

\[ V = \left( \frac{P_1 - P_2}{t_2 - t_1} \right) \]

\( V = \) Growing Speed  
\( P_1 = \) height of mycelia at \( t_2 \)  
\( P_2 = \) height of mycelia at \( t_1 \)  
\( t_1 = \) First observation time (day to)  
\( t_2 = \) Time of second observation (day to)  
Measurements are carried out at intervals of 6 days.  
Percentage of mycelium distribution in the media: measure the volume of mycelium distribution then compared with media volume.

2.5. Data analysis

Analysis of variance (ANOVA), Statistical Package for Social Sciences (SPSS), Test of Duncan range of 5%.

3 Result and Discussion

3.1. Observation results

3.1.1 Time mycelium appears and mycelium thickeners

The results of statistical analysis showed a significant interaction at the time of mycelium appearance, mycelium growth rate and the percentage of mycelium spread of ages 7, 14 and 21 DAP. The mean time of mycelium appearance and mycelium growth velocity presented in picture 1 and 2.
The highest mycelium appearing time (1.8 DAP), achieved in the combination of A1 B7 treatment (F0 seed potato extract medium with growing medium of corn seeds and soybean seeds) and A2 B3 (media F0 seedlings to extract coconut water on rice grain growth media). Soybean seed waste can do used as a substitute for rice bran on the white oyster mushroom growing medium. Soybean husk contains nutrients needed by the fungus for its growth such as carbohydrates 86%, protein 9%, ash 4% and fat 1%. Also, soybean seed husk also contains various amino acids such as glycine, aspartic acid, glutamic acid, lysine, serine, leucine, proline, tyrosine, valine, arginine, alanine, isoleucine, phenylalanine. [8]

Growing speed of the highest mycelia achieved combination treatment A1 B2 (seedlings of F0 media for potato extract with rice grains) = 2.2 DAP significant with the combination of A2 B3 (seedlings of F0 media to extract coconut water on rice grain growing medium) and combination of A2 B3 (seeds F0 media so that coconut water extract on corn-soybean growing media. Corn and soybean media are rich in carbohydrates which can support the growth rate of mycelia.

In the opinion [8] Soybean seed waste can do used as a substitute for rice bran in the white oyster mushroom growing medium. Soybean husk contains nutrients needed by the fungus for its growth such as carbohydrates 86%, protein 9%, ash 4% and fat 1%. Also, soybean seed husk also contains various amino acids such as glycine, aspartic acid, glutamic acid, lysine, serine, leucine, proline, tyrosine, valine, arginine, alanine, isoleucine, phenylalanine.

Nutrient-rich corn the content of the ingredients is 1% water; 356 calories; 9% protein; 8.5% fat; 64.5% carbohydrates; 200 mg Ca; 10 mg Fe; 500 mg P; 51 mg / 100 g of vitamin A; 1.2 mg of vitamin B and 89% of vitamin C [8].
3.1.2. The average rate of mycelium spread

The results of statistical analysis showed that there was a significant interaction between A (F₀ seed agar media and potato extract) on F₁ grain media (B) on the percentage of media mycelium distribution at the age of 7, 14, and 21 day after planting (DAP). The average rate of mycelium spread on Table 3.

Table 3. Average rate of mycelium spread

| Treatment | Age (7 DAP) | Age (14 DAP) | Age (21 DAP) |
|-----------|-------------|--------------|--------------|
| A₁B₁      | 3.7 bc      | 27.6 cd      | 89.7 c       |
| A₁B₂      | 2.0 a       | 20.2 b       | 56.6 b       |
| A₁B₃      | 2.1 a       | 13.3 a       | 33.5 a       |
| A₁B₄      | 2.2 a       | 16.1 a       | 34.7 a       |
| A₁B₅      | 2.4 a       | 17.5 a       | 37.3 a       |
| A₁B₆      | 2.3 a       | 13.8 a       | 39.8 a       |
| A₁B₇      | 2.5 a       | 12.1 a       | 40.1 a       |
| A₂B₁      | 4 d         | 39.6 e       | 100 c        |
| A₂B₂      | 3.5 b       | 28.3 cd      | 97.5 c       |
| A₂B₃      | 4.8 d       | 38.6 e       | 100 c        |
| A₂B₄      | 3.7 b       | 27.3 c       | 93.4 c       |
| A₂B₅      | 4.6 d       | 40.2 e       | 100 c        |
| A₂B₆      | 4.1 cd      | 35 de        | 100 c        |
| A₂B₇      | 2.3 a       | 17.8 a       | 58.9 ab      |

The percentage of mycelium spread at age 7 DAP. The highest average achieved in combination treatment A₂B₃ (media F₀ seedlings so that coconut water extract on soybean-corn growing medium) = 4.8% was significant with combination A₁B₂ (F₀ seed media to extract potatoes with rice grain growth media) and A₂B₅ (media F₀ seedlings so as to extract coconut water with corn growing media) and A₁B₅ (F₀ seed media to remove potatoes with corn and rice growing media). The percentage of mycelium spread at age 14 DAP was the highest average achieved in combination treatment A₂B₅ (media F₀ seedlings so that coconut water extract with corn and rice growing media) = 40.2% was significant with combination treatment A₂B₃ (media F₀ seed to extract coconut water with corn-soybean growing medium and A₂B₁ Combination (F₀ seed media to extract potato with corn seed growing media).

Percentage of mycelium spread 100% age 21 DAP. Combination A₁B₁ (F₀ seed potato agar medium with corn seed growing media). A₂B₁ (media F₀ seed agar extract coconut water on corn growing medium). A₂B₃ (media F₀ seedlings so coconut water extract on soybean-corn growing media. A₂B₅ (media F₀ seedlings so that coconut water extract with corn and rice grains growing medium) and A₂B₆ (media F₀ seedlings to extract coconut water with increasing media of corn seeds and red bean seeds).

Percentage of 100% mycelium spread is dominated by extra F₀ seeds of coconut water in the corn media, especially in the medium of corn with seeds of rice grains, red bean seeds and soybean seeds. In the opinion of [8]. Waste of soybean seed husk used as a substitute for rice bran in the planting medium of white oyster mushrooms. Soybean husk contains nutrients needed by the fungus for its growth such as carbohydrates 86%, protein 9%, ash 4% and fat 1%. Also, soybean seed skin also contains various amino acids such as glycine, aspartic acid, glutamic acid, lysine, serine, leucine, proline, tyrosine, valine, arginine, alanine, isoleucine, phenylalanine.[8] Corn nutrient content, the ingredients are 1% water, 356 calories, 9% protein, 8.5% fat, 64.5% carbohydrate, 200 mg Ca, 10 mg Fe, 500 mg P, 51 mg / 100 g vitamin A ingredients; 1.2 mg of vitamin B and 89% of vitamin C[8]. The content of soybean protein ranges from 35-45% per 100 grams of weight of soybeans [9].
3.1.3 Thickness Mycelium

The results of the analysis there is no interaction between A (F₀ agar substrate) with F₀ grain media. Treatment A (media F₀ seed agar) and F₁ grain media showed a significant difference between each treatment. The mean mycelium thickness score in table 4.

| Treatment  | Mycelium Thickness Score | Thickness level |
|------------|--------------------------|-----------------|
| Seed (F₀)  |                          |                 |
| A₁         | 2.9 a                    | Thin            |
| A₂         | 3.55 b                   | Thick           |
| Medium Factor |                      |                 |
| B₁         | 3.9 ab                   | Thin            |
| B₂         | 2.47 a                   | Thick           |
| B₃         | 3.4 b                    | Thick           |
| B₄         | 3.5 b                    | Thick           |
| B₅         | 3.2 ab                   | Thin            |
| B₆         | 3.25 ab                  | Thick           |
| B₇         | 2.7 a                    | Thin            |

Note: The numbers accompanied by different letters in the same column show significantly different in Duncan's test 5%

| Score | Thickness | Sample | Description |
|-------|-----------|--------|-------------|
| 1     | very thin | ![Image](1.png) | Mycelium grow very thin |
| 2     | thin      | ![Image](2.png) | Mycelium grow thin |
| 3     | thick     | ![Image](3.png) | Mycelium grow thick |
| 4     | very thick| ![Image](4.png) | The mycelium grows very thick covering the entire surface of the media |

The highest mean of mycelium thickness is A₂ (potato extract media F₀ seed) = 3.55 mm compared to A₁ (F₀ media seedlings so that coconut water waste seedlings) and B₁ (F corn media) = 3.9 mm (thick), B₄ (F₁ media corn grain rice) = 3.5 mm (thick), and B₅ (media F₁ red bean corn = 3.4 mm (thick). Planting media also affect the making of mushroom seeds. Media for F₂ (F₁ derivatives) which often used in nurseries usually use grain media.

Pure culture (F₀) is the origin of the seedlings obtained from the selection of edible fungi. The spores are then isolated from the spores in a sterile state. This isolation was carried out on Petri dishes containing PDA media. Spores then germinate and form hyphae, hyphae become more complex and then form mycelium[10]. The amount of waste around us has not been utilised properly, e.g. waste of
coconut water and Leri water (used laundry water) which is wasted just like that can doused for the formulation of ingredients. Liquid inoculum for oyster mushrooms supplemented with a mixture of coconut water and Leri water, using a modification of PD base media (Potato Dextrose without the addition of hardening ingredients) [2]

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A pure culture called F0 is the result of the isolation of the body of the best-selected mushroom fruit and purified from various contaminants. Separation by taking the tissue (mycelium) from the shape of the mushroom fruit planted on agar media (PDA) to produce mycelium. Pure culture (F0) can be cultured into seedlings of fungi or the first derivative (F1) of mushroom nurseries. F1 quality influenced by the pure culture of the fungus used. F1 seeds usually use media from wood or sawdust [10]

4. Conclusion
Analysis showed a significant interaction at the time of mycelium appearance, mycelium growth rate and the percentage of mycelium spread of ages 7, 14 and 21 DAP. The highest percentage of mycelium spread (100%) achieved in the combination treatment A2 B2 (F0 media agar seeds and coconut water waste with corn), A2 B3 (seeds of F0 agar media and waste of coconut water with the F1 medium of red beans), A1 B5 (seedlings of F0 agar media and waste of coconut water with F1 corn and rice grains), A2 B6 (Seedlings of F0 agar medium and waste of coconut water with F1 corn and red bean media) F0 seed inoculation the medium for the potato extract gave the best results for the initial growth of oyster mushroom seedlings while the F0 media seedlings, so that coconut water waste gave the best results in the percentage of mycelium spread.

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