Growth and productivity of mushroom oyster (*Pleurotus ostreatus*) on mixed planting media of cocopeat with sawdust

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Abstract. Mushroom oyster (*P. ostreatus*) is one of wood type fungus commonly consumed by the community. Mushroom oyster cultivation is usually performed by planting media of sawdust. The chemical composition of the cocopeat lignin (45.8%), cellulose (43.4%), hemicellulose (10,25%), and pectin (3.0%). The advantage of using cocopeat is high waters retention and light weight. The research design of Randomized Design (RAL) was used consisting of 6 treatments, control, 10% cocopeat, 20% cocopeat, 30% cocopeat 40%, and 50 consisted of 5 replications in which each replication consisted of one % cocopeat. Each treatment was applied on baglog of mushroom oyster seedlings. The data obtained was analyzed by one way analysis (ANOVA) with 95% confident of level. If any significant influence on the treatment was detected, then it was continued with Duncan’s Multiple Range Test (DMRT) with 95% level. The best planted treatment for mushroom oyster’s growth was P5 treatment with a composition of 50% cocopeat because it has a higher wet weight than all treatments. The environment also affected mold growth. If the air temperature is high then the production of mushroom oyster is higher, and when the moisture is high then the mushroom oyster production is also greatly increased.

1. Introduction

Mushroom oyster (*P. ostreatus*) is currently one of the common types of wood mushrooms consumed by people in Indonesia. The main nutrients needed by mushroom oyster include carbohydrates (cellulose, hemicellulose and lignin), proteins, fats, minerals and vitamins.

Sawdust is commonly used as mushroom oyster media is sengon wood which contains 49.40% of cellulose, 24.59% of hemicellulose, 26.8% lignin and ash as much as 0.60% [1]. Mushroom oyster is one type of non-timber forest products. According to Caral Dinesh [2] mushrooms oyster is one of the most popular edible mushrooms and belong to the genus *Pleurotus* and the family Pleurotaceae. They were was first cultivated in Germany as a subsistence measure during World War I and is now grown commercially around the world for food.

One of the food fungus that comes from the forest is mushroom oyster (*P.ostreatus*) which became one of the non-timber forest products. In relation to the management of forests, the cultivation of mushroom oyster has opportunity to be developed by the community around the forest with helping of the forest manager. Mushroom oyster are belongs to the fungus of consumption that live on the wood - the wood that has been decayed. Mushrooms oyster can also grow in sawdust, hay waste, cotton waste, cardboard paper, or other organic materials. Plant waste generally contains lignin, cellulose, and hemicellulose.
High hemicellulose content indicates high pectin and starch content which is highly favored as a growing medium of oyster mushrooms. If the cellulose content of the planting medium is too high, additional ingredients are needed to supplement the nutrients needed for the growth of mushroom oyster. Named mushroom oyster because they have flavor, texture and oyster shaped shapes with various hooded surface colors: white, gray, brown, yellow, orange, or pink [3].

The use of sawdust as a medium for the cultivation of mushroom oyster is a problem for farmers who want to cultivate mushroom oyster but in the region there is no the producer of sawdust. A study of substitution materials that can replace sawdust as the main ingredient of the mushroom oyster plant media needs to be done. The selected substitute material should have characteristics similar to that of sawdust and have sufficient nutrient content to support the growth of mushroom oyster.

Cocopeat is the largest part of the coconut waste processing is still very small. Cocopeat has a fairly high mineral content and can bind and store water strongly and hemicellulose, cellulose, and lignin content are quite a lot too [4]. The chemical composition of cocopeats lignin (45.8%), cellulose (43.4%), hemicellulose (10.25%), pectin (3.0%) [1]. Cocopeat can be used as a growth medium on the fungus lingzhi (Ganoderma lucidum) which is one type of wood fungus. This composition allows cocopeat to be used as an alternative to sawdust on the growth medium of mushroom oyster [5].

Purposed of this research were (1) The measuring the influence of cocopeat mixture with sawdust as planting medium to growth and productivity of mushroom oyster (P. ostreatus) (2) Getting the best planting media composition for growth and productivity of mushroom oyster (P. ostreatus).

2. Materials and Methods

Tools and materials

The tool used in this research is shovel, sand sieve, wood pieces to compress the media, sterilizer, bunsen, baglog ring size diameter 4 cm and length 3 cm, spatula, cutter, beko, hand sprayer, analytical scales, calculator and tools other supporting tools in this study. The materials used in this experiment are seed of mushroom oyster (P. ostreatus), sawdust, cocopeat, EM 4, bran, dolomite CaMg (CO3) 2, PP plastic (Polypropylene) size 30 cm x 18 cm with thickness 0.6 cm as an mushroom oyster planting media container, rubber band, 10 cm x 10 cm sheet of paper to cover baglog, sugar water, alcohol, water and other ingredients that support this research.

| Treatment | Media Formulation Planted per 1,000 g |
|-----------|--------------------------------------|
|           | Sawdust | Cocopeat | Rice bran | chalk |
|           | G | % | G | % | G | % | G | % |
| P0        | 850 | 85 | 0 | 0 | 100 | 10 | 50 | 5 |
| P1        | 750 | 75 | 100 | 10 | 100 | 10 | 50 | 5 |
| P2        | 650 | 65 | 200 | 20 | 100 | 10 | 50 | 5 |
| P3        | 550 | 55 | 300 | 30 | 100 | 10 | 50 | 5 |
| P4        | 450 | 45 | 400 | 40 | 100 | 10 | 50 | 5 |
| P5        | 350 | 35 | 500 | 50 | 100 | 10 | 50 | 5 |
Research Design

The research design used is Completely Randomized Design (RAL) which consists of six treatments, namely:

P0: The addition of cocopeat 0% or 100% sawdust used as control.
P1: The addition of cocopeat 10% from the weight of sawdust.
P2: The addition of cocopeat 20% from the weight of sawdust.
P3: The addition of cocopeat 30% from the weight of sawdust.
P4: Addition of cocopeat 40% from the weight of sawdust.
P5: The addition of cocopeat 50% from the weight of sawdust.

Each treatment consisted of five replications in which each replication consisted of one baglog of mushroom oyster seedlings.

The data of research were analyzed by variance with linear model as follows:

\[ Y_{ij} = \mu + T_i + \varepsilon_{ij} \]

Where :

- \( Y_{ij} \): The results of observations from the treatment of various media planting and replication
- \( \mu \): average value
- \( T_i \): The influence of various planting media
- \( \varepsilon_{ij} \): Effect of experimental errors from various media planting and replication

Data analysis

The data obtained was analyzed by one way analytical (ANOVA) with 95% confidence level. If there is a significant effect on the treatment, then proceed with Duncan’s Multiple Range Test (DMRT) with a 95% confidence level.

3. Results and Discussions

The results of the research as a whole by using several parameters can be seen in the table below.

| No | Parameter                          | Treatment                  |
|----|------------------------------------|----------------------------|
|    |                                    | P0 | P1 | P2 | P3 | P4 | P5 |
| 1  | Growth of mycelium (days)          | 59.40±0.490f                | 45.00±0.894d                | 39.20±0.784bc              | 38.00±1.095c               | 39.40±0.490c               | 38.20±0.400ab              |
| 2  | Age of Harvest (days)              | 77.20±1.720e                | 70.60±1.356e                | 68.60±1.356e               | 69.40±2.059e               | 71.20±1.327b               | 70.20±0.980ab              |
| 3  | Number of Fruit Hood (fruit)       | 10.40±3.611b                | 4.60±1.625e                 | 4.20±1.939e                | 4.80±1.470e                | 4.60±1.497e                | 6.80±1.166a                |
| 4  | Weight Wet (g)                     | 114.71±22.870f              | 76.68±17.426g               | 62.23±17.926f              | 74.87±17.260g              | 73.60±18.363g              | 101.16±11.488bc            |
| 5  | Diameter of Hood (cm)              | 7.95±0.792f                 | 10.02±2.366f                | 11.20±2.358f              | 10.56±2.629f              | 8.08±3.059f                | 6.99±0.868a                |
| 6  | Area of Hood (cm²)                 | 56.18±16.248f               | 83.91±35.156f               | 110.31±40.021f            | 88.07±30.947f             | 66.16±33.287f             | 47.59±6.217f               |
| 7  | Stalk length (cm)                  | 5.21±1.131f                 | 6.30±0.841f                 | 6.25±0.595f               | 5.75±0.992f               | 4.96±0.411f               | 4.60±0.566f                |

Note: The same notation (a, b, c) shows no significant effect between treatments based on the DMRT test of 95%
Time of Mycelium Growth

The growth of mycelium is characterized by the appearance of white mycelium on baglog that contained mushroom growing media. The growth time of the mycelium is observed until the entire baglog is white. The appearance of mycelium and baglog images that have been filled with mycelium can be seen in the picture below. The growth time of mycelium ranged from 38 to 59.4 days. Where the smallest growth time received P3 treatment and the largest was found in treatment P0.

![Figure 1. Distribution of growing mushroom oyster on cocopeat mixture planting medium](image)

Note: The record (a, b, c) showed that the influence is not real in significant between treatments based on the DMRT test of 95%.

Growing of mycelium caused by the composition on baglog is not too dense or with a mixture of 30% cocopeat that make growing of mycelium is fast. In the treatment of P4 and P5 with composition cocopeat 40% and 50% have a slightly longer growth compared to treatment P3 because the big composition cocopeat also can inhibit the growing of mycelium. In treatment P0 has a long growth from all treatments because of baglog density consisting of 100% sawdust.

Rahma and Purnomo [6] stated that at the time of compaction process, baglog with 100% cocopeat composition is too dense, so it can inhibit the growth of mycotic mushroom into the body of fruit, due to lack of oxygen concentration (O2) and too much carbon dioxide. Purmasari [7] stated that at the beginning of development, mycelium penetrates the wood cells in lignin and cellulose fibers of coconut and sengon wood with degrading enzymes, hemicellulose and lignin then use it as a source of nutrients for the fungus.

The result of variance analysis showed that the composition of planting medium with cocopeat mixture significantly affected the growth of mushroom oyster mycelium with 95% confidence interval. Duncan Multiple Range Test (DMRT) showed that the growth time of mycelium in P3 was significantly different from P0, P1, P2, and P4. In the measurement of growth time parameters of mycelium can be concluded the composition of planting medium with an optimal cocopeat for the growth time of mushroom oyster mycelium is 30% mixture. A balanced composition between cocopeat and sawdust will accelerate the growth of mycelium.
Age of Harvest

The harvesting age is calculated from the inoculation stage until the mushroom cap is completely open. When the mushrooms have shown the characteristics to be ready to be harvested then that's when mushrooms are taken from baglog. Mushrooms were usually harvested on the third or fourth day after the appearance of the fruit body on the baglog. Mushrooms that are ready to be harvested can be seen in the picture below.

Age of harvest ranged from 68.60 to 77.20 days. The age of harvest at the P2 treatment is faster than the other treatments and the treatment of P0 has a longer harvest age. In P3 treatment the harvest age is 69.40 days which is slightly longer than P2 treatment.

Note: The same notation (a, b, c) shows no significant effect between treatments based on the DMRT test of 95%.

![Bar graph showing age of harvest](image)

Figure 2. Average age begins to harvest white mushroom oyster on cocopeat planting medium

This was not in line with the time of mycelium growth. This was due to poor environmental conditions and also too wide opening of baglog so that the high content of carbon dioxide affected the emergence of the first fruit body. According Rahma and Purnomo [6] the formation of the fruit body will be hampered at high concentrations of carbon dioxide. Oxygen is needed in the process of formation and growth of mushroom oyster fruit. If there is oxygen deprivation (O2) or too much carbon dioxide in the air, then the stem of the fruit fungus body will elongate and the hood becomes less developed.

The result of variance analysis showed that the composition of planting medium of cocopeat mixture significantly affected the age of harvest mushroom oyster with 95% confidence interval. Duncan Multiple Range Test (DMRT) showed that harvest age on P2 was significantly different with P4 and P0. On the measurement of age parameters of harvest can be concluded that the composition of planting media with optimal straw mixture for the age of harvest start of mushroom oyster is 20% cocopeat mix. The more comparison the composition of cocopeat and sawdust added the longer the age of harvest.

Number of Fruit Hoods

The measured fruit hood is a fruit hood contained in a clump of mushrooms from small to large. The number of mushroom fruit holes ranges from 4.20 to 10.40. Figure the number of fruit hood can be seen in the picture below. The highest number of fruit hoods is found in the treatment of P0 and the least amount of treatment in P2 treatment. In the above graph treatment P0 has the highest number of hoods of all treatments.
The result of variance analysis showed that the composition of planting medium with cocopeat mixture significantly affected the number of mushroom oyster hose with 95% confidence interval. Duncan Multiple Range Test (DMRT) test results show that the number of P2 caps is significantly different with P0.

**Wet weight of fungus**

Wet weight is measured using an analytic scale. The weight calculated is the weight of a clump of fungus that grows on the baglog and can be seen in the picture below. The existing wet weight ranges from 62.23 to 114.71 g. The smallest weight can be encountered in the first treatment and the largest weight is found in the treatment of P0. This is because the smallest number of hoods is in the treatment of P2 and the largest number of hoods is in the treatment of P0.

Yuliani [4] stated physical condition on the body of the fungus is influenced by environmental conditions and nutrient content contained in the planting medium. Environmental factors that affect the growth of mycelium and the fungus body's bodies are moisture, temperature, O2, CO2, light and the influence of pests and diseases. While the nutritional factors that affect the growth of fungal fruit body
that is the water content, pH, extractive levels, hemicellulose levels, cellulose levels, lignin levels, and C / N ratio.

According to [8] from the previous journal results obtained data on average weight of mushroom oyster those are cultured on the peculiar sawdust and mixed of sawdust has a significant differentess. In a mixed of sawdust obtained 1.49 kg / 10 baglog, while the sawdust kemiri obtained 1.46 kg / 10 kg. This is due to the more nutrient content contained in the media such as phosphates, sugars, organic matter, cellulose, and lignin contained in sawdust so that the resulting wet mushroom weight higher.

The result of analysis in variances showed to the composition of planting medium with cocopeat mixture significantly affect the wet weight of mushroom oyster with 95% confidence interval. Duncan Multiple Range Test (DMRT) showed wet weight on P2 was significantly different from P5 and P0. On the measurement of wet weight parameter can be concluded that the composition of planting medium with cocopeat mixture 20% is less than optimal results.

**Diameter of the Hood**

The calculation of the hood diameter is done by calculating the longest part and the shortest part is divided by 2. All the hoods in one clump are calculated diameter and then averaged. Below is a drawing of diameter calculation. The largest diameter of the hood was found in the P2 treatment of 11.20 cm and the smallest diameter was in the P5 treatment of 6.99 cm. The results diameter of hood fungus can be seen in the graph below.

![Diameter of the Hood Graph](image)

**Figure 5. Average diameter of mushroom oyster caps on cocopeat planting medium**

The diameter of the hood affects the number of fruit hoods. Islami *et al* [9] stated that the number of mushroom caps that many will have a small diameter because it does not have a lot of space for the fungus hood is widened because of each other coincide with the other hood. The diameter results in the graph differs from [4] which states that mushrooms with 100% of the composition of the sengon (control) powder have the largest mass and length. Mushrooms with 50% cocopeat composition have the widest diameter of the hood. Mushroom with 25% cocopeat composition has the thickest hood and the most number of hoods. The result of variance analysis showed that the composition of planting medium with cocopeat did not significantly affect the diameter of mushroom oyster hose with 95% confidence interval.
Area of Hood
The area can be calculated through millimeter paper. The existing mushroom hoods are drawn on to millimeters of paper then the extent can be calculated. Broad calculation can be seen in the picture below. The extent of existing hoods ranges from 47.59 to 110.31 mm². The largest area of the hood is found in the P2 treatment and the smallest cap area is found in the P5 treatment. The results of the width of the hood can be seen in the picture below.

![Area of hood graph](image)

Figure 6. Average area of mushroom oyster caps on cocopeat planting medium

The width of the hood is also affected by the large diameter of the hood. The larger the mushroom hood the larger the mushroom hood diameter. Oxygen is needed in the process of formation and growing of mushroom oyster fruit. According to [6] if the lack of oxygen (O2) or too much carbon dioxide in the air, then the stem of the mushroom fruit body will elongate and the hood becomes less developed. The result of variance analysis showed that the composition of planting medium with cocopeat did not significantly affect the mushroom oyster cover with 95% confidence interval.

Length of Stalk
The length of the stalk was measured using a ruler and each hood produced from one baglog was calculated the length of the stalk and averaged. The image of the length of the stalk can be seen in the picture below. Stalk length ranges from 4.60 to 6.30 cm. The largest stalk length is in the first treatment is 6.30 cm and the smallest stem length is in the fifth treatment that is 4.60. Results of the length of the stalk can be seen in the graph below.

![Length of stalk graph](image)

Figure 7. Average length of mushroom oysterstalks on cocopeat planting medium
Note: The same notation (a, b, c) shows no significant effect between treatments based on the DMRT test of 95%.

The length of the mushroom oyster stalk with a mixture of cocopeat is different from the mixture of corn cobs. According to [10] mushrooms grown on planting media of cocopeat composition 25% has the best mushroom oyster stalk length of 14.67 cm while in the medium of planting the composition of 0% shows the lowest stem length of 12.13 cm. This shows that planting media 25% has optimal conditions to support the formation of elongated mushroom stems resulting in a large fruit body vertically. The result of variance analysis showed that the composition of planting medium with cocopeat effect significantly the length of mushroom oyster stalk with 95% confidence interval. The Duncan Multiple Rangge Test (DMRT) test shows the stem length on P5 is significantly different from P1 and P2.

4. Conclusion
The Conclusion of research are (1) Media planting mushrooms with cocopeat mixed effect on the growth of mycelium, age of harvest, the number of fruit hoods, wet weight, and the length of the stalk and (2) The best planting treatment for fungal growth is P5 treatment with 50% cocopeat composition. Treatment of P5 and has the greatest wet weight.

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