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Effect of gibberellin concentration and composition of baglog media on growth and yield of oyster mushroom (*Pleurotus ostreatus*)

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Abstract
The composition of baglog media greatly affects the yield and quality of oyster mushrooms. Then the use of growth regulators in the production of oyster mushrooms is rarely done. This research was to examine the effect of gibberellins concentration and baglog media composition on the growth and yield of oyster mushrooms. The results showed that the interaction between gibberellin concentrations and baglog media composition showed better results than the control treatment at harvest interval, total harvest, and dry weight. Then the concentration of gibberellins had no impact on increasing mycelium growth and biological efficiency. In the composition of baglog media, the use of bagasse and cocopeat can replace sawdust by up to 50%. With bagasse which was only able to give a good response on yield and biological efficiency, namely 42.82% and cocopeat, which only showed a good response on mycelium growth, namely 59.43% at 12 day after inoculation and 99.24% at 22 day after inoculation.

Keywords: *Pleurotus ostreatus*, gibberellins concentration, media composition

1. Introduction
Oyster mushroom is a species in the kingdom of fungi which is widely used as food or industrial material. The yield of oyster mushrooms is influenced by the composition of the baglog media because the oyster mushrooms which are classified as saprophytic creatures. One of the elements needed by oyster mushrooms to grow is the cellulose content which is found in many woody plants. Roosheroe *et al.*, (2014) [9] in the cultivation of oyster mushrooms, there is a lot of organic material that can be used as a growth medium for mushrooms such as sugarcane waste, coffee, sawdust, banana stems, cocopeat, tea waste, straw, etc. Then in cultivation, the media used only focuses on sawdust and does not utilize other potential media such as bagasse and cocopeat. Erlinda *et al*., (2021) [5] in his research said that adding bagasse to baglog media was able to increase the total harvest when compared without adding bagasse. In this research, the composition of 0% sawdust: 100% bagasse was able to produce a total yield of 148.11 g compared to 100% sawdust which was only 85.74 g. Astuti and Kuswytasari, (2013) [4] in their research said that the use of 50% cocopeat and 50% sawdust produced the highest wet weight, namely 128.25 g. In Indonesia, domestic oyster mushroom production is unable to meet national demand. This is because the national demand reaches 48.8 thousand tons (Ministry of Agriculture, 2020) while domestic production only reaches 3.3 thousand tons (BPS, 2020). So this encourages to accelerate the harvesting of oyster mushrooms in order to increase national production, namely using the hormone gibberellin. In practice, gibberellins are rarely applied to fungal growth. Whereas according to Andamon *et al*., (2021) [3] the application of the hormones gibberellin and auxin to oyster mushrooms can increase the number of fruiting bodies and the size of the cap. In the same research, Andamon explained that treatment with the hormones auxin, gibberellins, and cytokinins showed an increase in the number of fruiting bodies, stipe length, and cap size. Wiraatmaja, (2017) [11] said that gibberellin plays a role in germination, and its application to oyster mushrooms is known to encourage the germination of oyster mushroom spores. In another research conducted by Ambhure *et al.*, (2021) [2] giving a gibberellin concentration of 10 ppm significantly responded to an increase in total yield up to 856.81 g and a biological efficiency of 85.68%. This research aims to examine the effect of gibberellins concentration and composition of baglog media on the growth and yield of oyster mushrooms.

2. Materials and Methods

This research used a factorial randomized block design with orthogonal contrast with two factors. The first factor is the concentration of gibberellins (7.5; 15; and 22.5 ppm). Then the second factor is baglog media which uses a composition of 75% sawdust: 25% bagasse; 50% sawdust: 50% bagasse; 25% sawdust: 75% bagasse; 75% sawdust: 25% cocopeat; 50% sawdust: 50% cocopeat; 25% sawdust: 75% cocopeat. Each of these treatments was combined so that there were 19 samples with one of them without treatment (control) and repeated three times and each treatment contained 5 samples so that the total population observed was 285 samples. This research was conducted at the Unit Production of Oyster Mushroom, Tamnesia, University of Muhammadiyah Malang in August - December 2022. The tools used in this research included baglog media filling machines, steamer machines, vernier calipers, rulers, scale, and graduated pipettes. Then the materials used included F3 subculture seeds of white oyster mushroom (*Pleurotus ostreatus*), cocopeat, bagasse, and the hormone gibberellin (Agrogibb). The observed variables include:

2.1 Growth of mycelium (%)

Measurements were made three times, at 2, 12, and 22 day after inoculation using millimeter blocks (mm). The observed results are converted to percent form using the following formula:

$$= \frac{\text{mycelium lenght}}{\text{baglog lenght}} \text{ x } 100\%$$

2.2 Harvest interval (days)

Harvesting interval is measured by calculating the distance (days) of harvesting with the next harvest.

2.3 Total harvest (g)

Measurement of the total harvest includes the results of weighing the wet weight from the first to the seventh harvest using an analycal scale

2.4 Total dry weight (g)

Measurement of total dry weight includes weighing oyster mushrooms that have been dried in the sun from the first to the fourth harvest using an analytical scale

2.5 Biological efficiency (%)

The weight of the substrate for each baglog was calculated before inoculation. Then the total harvest is meaning the number of harvests in each baglog. Based on research from (Ambhure *et al.*, 2021) [2] biological efficiency is measured by the following formula:

$$= \frac{\text{total harvest}}{\text{substrate weight}} \text{ x } 100\%$$

3. Result and Discussion

Based on the results of the research, there was an interaction between the gibberellin concentration treatment and the composition of the baglog media, namely the variables of harvesting interval, total harvest and dry weight. Then separately, the treatment of gibberellin concentration on the biological efficiency variable showed unfavorable results when compared to the control. However, for the mycelium growth variable, gibberellin concentrations showed same results because gibberellins had not been sprayed during the inoculation phase. In the treatment of baglog media composition showed relatively good results on mycelium growth variables and biological efficiency.

3.1 The effect of baglog media composition on mycelium growth

The results of observations of mycelium growth in Table 1, on the composition of the baglog media given the treatment showed different results from the control. Of the six treatment levels of the baglog media composition, the 50% sawdust: 50% cocopeat treatment showed the highest mycelium growth yields, namely 59.43% at 12 days old and 99.24% at 22 days old. These results were different from the bagasse treatment at all levels which showed relatively the same results as the control. This indicates the use of cocopeat shows better results than bagasse in the mycelium growth phase.

Rambey *et al.*, (2018) [8] in his research also showed similar results. In the same treatment, namely 50% cocopeat, the average growth time until the media was evenly covered by mycelium was 38.20 days compared to 59.40 days without the addition of cocopeat.

Table 1: Average of mycelium growth (%) on the 2nd, 12th and 22nd day of observation

Treatment	Mycelium growth (%) on- day after inoculation		
	2	12	22
Orthogonal contrast			
Treatment	2,32 a	45.96a	85.24 b
Control	3,16 b	43.97a	78.75a
Gibberellin concentration			
Gibberellin 0 ppm	3,16 a	43.97a	78.75a
Gibberellin 7.5 ppm	2,17 a	45.71 a	84.91 a
Gibberellin 15 ppm	2.36 a	46.78 a	86.12 a
Gibberellin 22.5 ppm	2.44 a	45,40 a	84.70 a
Baglog media composition			
100% sawdust	3.16 c	43.97b	78.75a
75% sawdust: 25% bagasse	2.96 bc	44.75 b	80.03a
50% sawdust: 50% bagasse	2.47 b	41.24 a	81.43 a
25% sawdust: 75% bagasse	2.61 bc	40,48 a	80.51a
75% sawdust: 25% cocopeat	2.61 bc	44.07b	80.38a
50% sawdust: 50% cocopeat	0.00a	59.43c	99.24c
25% sawdust: 75% cocopeat	3.28 c	45.81b	89.87b

Note: numbers followed by the same letter in the same column show no significant difference in the DMRT test at the 5% level.

3.2 Effect of gibberellins concentration and composition of baglog media on harvesting interval, total harvests, and total dry weights

In observing the harvest interval (Table 2), the average yield in the treatment (15.71 days) was better compared to the control (20.44). The combined treatment with gibberellin concentration of 7.5 ppm with all levels of media composition showed relatively shorter harvesting intervals, ranging from 13.91 to 14.09 days. Research from Sarker and Chowdhury, (2014) [10] states that giving gibberellin concentrations of 10 ppm can stimulate the appearance and increase the number of primordia with an average of 80 pieces when compared to controls with an average of 30 primordia.

Then the total harvest observation (Table 2) which was harvested up to seven times showed that the results of the treatment given were lower than the control with a sequential

average of 360.74 g and 391.95 g. Among all treatments, gibberellin concentrations of 7.5 ppm and 22.5 ppm combined with 50% sawdust: 50% bagasse showed relatively higher yields than other treatments, with an average of 435.48 g and 446.85 g. Different to the combination of cocopeat media treatment, the observations showed a much lower average. With the lowest average, namely in the gibberellin treatment at all levels and combined with 25% sawdust: 75% cocopeat. This is thought to be due to the high C:N ratio of cocopeat, which is 136.8 (Hakim & Zulfatri, 2019) [6] when compared to bagasse which is only 20.4 (Mentari *et al*., 2021) [7]. A high C:N ratio indicates that the carbon content that is used as a constituent of fruiting bodies is more supplied than the nitrogen content used as nutrients to form fruiting bodies. So that it causes relatively large fruiting bodies but has a low total harvest.

Observations of dry weight obtained from the first to fourth harvests showed lower treatment results than the control with a sequential average of 30.33 g and 36.97 g (Table 2). Based on observations, the treatment of gibberellin concentrations of 7.5 ppm and 22.5 ppm combined with 75% sawdust: 25% bagasse showed relatively high dry weight results compared to other treatments, namely 42.92 g and 43.00 g. Then, if seen in Fig. 1 and Fig. 2, the treatment of the baglog height showed a lower and more wrinkled baglog conditions than the other treatments. According to Sarker & Chowdhury, (2014) [10] spraying gibberellins at 10 ppm gave the best dry weight results in the first harvest, namely 6.72 g.

Table 2: Average harvest interval (days), total harvests (g), and total dry weights (g)

Treatment	Harvesting Interval (days)	Total Harvest (g)	Total dry weight (g)
Orthogonal contrast			
Treatment	15.71 a	360.74 a	30,33 a
control	20.44 b	391.95b	36.97b
gibberellins 0 ppm + 100% sawdust (control)	20.44 e	391.95e	36.97c
gibberellins 7.5 ppm + 75% sawdust: 25% bagasse	14.98b	435.48 fgh	42.92 de
gibberellin 7.5 ppm + 50% sawdust : 50% bagasse	14.09 ab	435.38 fgh	45.01e
gibberellin 7.5 ppm + 25% sawdust : 75% bagasse	13.98a	400.09 ef	29.83 b
gibberellin 7.5 ppm + 75% sawdust : 25% cocopeat	13.98a	339.89c	38.13 c
gibberellin 7.5 ppm + 50% sawdust : 50% cocopeat	13.98a	339.89c	20.58 a
gibberellin 7.5 ppm + 25% sawdust : 75% cocopeat	13.91 a	237.02 a	18.35a
gibberellin 15 ppm + 75% sawdust : 25% bagasse	15.93c	370.41 cdes	39.86 cds
gibberellin 15 ppm + 50% sawdust : 50% bagasse	15.89c	394.69 ef	31.17b
gibberellin 15 ppm + 25% sawdust: 75% bagasse	16.00c	381.87 de	31.13b
gibberellin 15 ppm + 75% sawdust : 25% cocopeat	16.20c	384.64 de	30.75 b
gibberellin 15 ppm + 50% sawdust: 50% cocopeat	16.02c	296.76b	19.77a
gibberellin 15 ppm + 25% sawdust : 75% cocopeat	15.82c	224.23 a	18.00 a.m
gibberellins 22.5 ppm + 75% sawdust : 25% bagasse	17.00 d	367.52 cdes	43.00 de
gibberellins 22.5 ppm + 50% sawdust : 50% bagasse	16.98d	446.85h	37.23c
gibberellins 22.5 ppm + 25% sawdust : 75% bagasse	16.93d	443.86gh	30.02b
gibberellin 22.5 ppm + 75% sawdust : 25% cocopeat	17.09d	400.74 efg	31.83 b
gibberellin 22.5 ppm + 50% sawdust : 50% cocopeat	17.00 d	344.72 cds	18.82 a
gibberellin 22.5 ppm + 25% sawdust : 75% cocopeat	17.04d	249.26 a	19.51a

Note: numbers followed by the same letter in the same column show no significant difference in the DMRT test at the 5% level.

Fig 1: Comparison of baglog media after the last harvest in the treatment of gibberellin concentrations with: (a) control, (b) 7.5 ppm gibberellin + 75% sawdust: 25% bagasse, (c) 15 ppm gibberellin + 75% sawdust : 25% bagasse, (d) 22.5 ppm gibberellin + 75% sawdust: 25% bagasse.

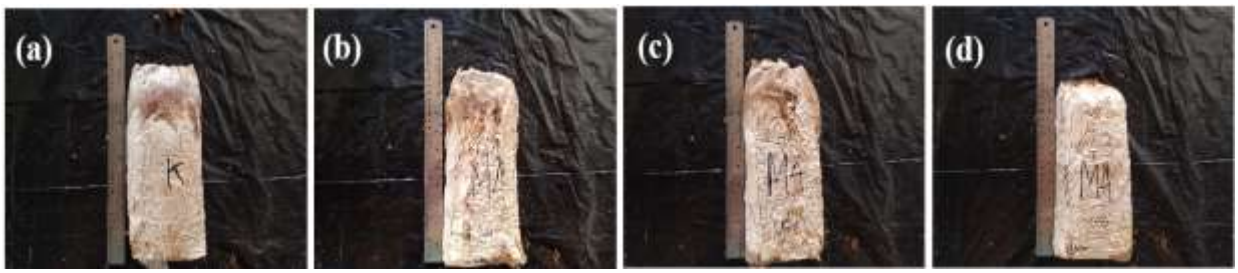

Fig 2: Comparison of baglog media after the last harvest in the treatment of gibberellin concentrations with: (a) control, (b) 7.5 ppm gibberellin + 75% sawdust: 25% cocopeat, (c) 15 ppm gibberellin + 75% sawdust : 25% cocopeat, (d) 22.5 ppm gibberellin + 75% sawdust: 25% cocopeat

3.3 Effect of gibberellin concentration and composition of baglog media on biological efficiency

The results of observations of biological efficiency showed that the treatment given was lower than the control with a sequential average of 36.15% and 42.63% (Table 3.). Treatment of gibberellin concentrations at all levels showed lower results than the control. Then in the treatment of the composition of the baglog media, it showed that the composition of 50% sawdust: 50% bagasse had a relatively high biological efficiency result compared to other treatments, namely 42.82%. However, these results were not significantly different from the control. Figure 3 also shows that the height of baglog with a composition of 50% sawdust: 50% bagasse is shorter than other media compositions. In contrast to the research of Ambhure *et al*., (2021) [2] which showed the results of spraying a gibberellin concentration of 10 ppm gave a higher biological efficiency value (85.68%) than without spraying gibberellin (68.49%). In another research, the biological efficiency of 100% sawdust (56.3%) was higher than that of 50% sawdust: 50% bagasse (44.8%) (Ahmad Zakil *et al* ., 2020) [1].

Table 3: Average of biological efficiency (%)

Treatment	Biological efficiency (%)
Orthogonal contrast	
Treatment	36,15 a
control	42.63 b
Gibberellin concentration	
Gibberellin 0 ppm	42.63c
Gibberellin 7.5 ppm	36.73 b
Gibberellin 15 ppm	34.07a
Gibberellin 22.5 ppm	37.65b
Baglog media composition	
100% sawdust	42.63e
75% sawdust: 25% bagasse	42.16 de
50% sawdust: 50% bagasse	42.82e
25% sawdust: 75% bagasse	39.36c
75% sawdust: 25% cocopeat	39.80 cds
50% sawdust: 50% cocopeat	30,47 b
25% sawdust: 75% cocopeat	22,28 a

Note: Numbers followed by the same letter show no significant difference in the DMRT test at the 5% level

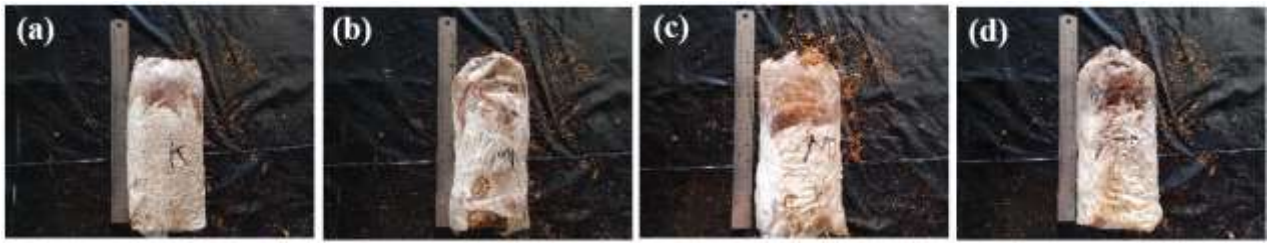

Fig 3: Comparison of baglog media conditions after the last harvest with: (a) control, (b) 75% sawdust : 25% bagasse, (c) 50 % sawdust : 50% bagasse, (d) 25 % sawdust : 75% bagasse.

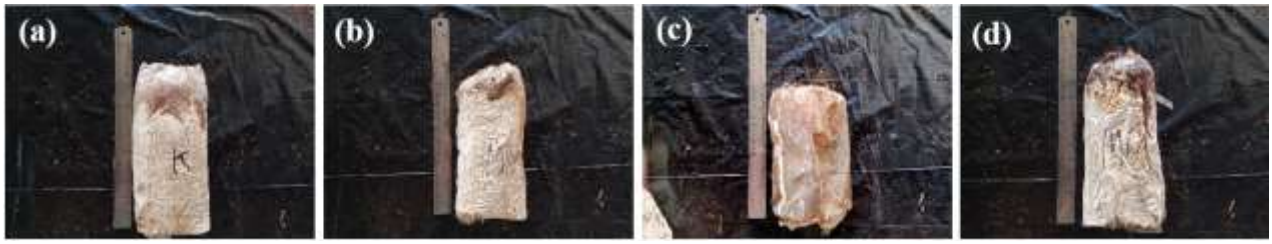

Fig 4: Comparison of baglog media conditions after the last harvest with: (a) control, (b) 75 % sawdust: 25% cocopeat, (c) 50 % sawdust : 50% cocopeat, (d) 25 % sawdust : 75% coconut husk

4. Conclusion

The combination of gibberellin concentration treatment with baglog media composition showed better results than the control treatment at harvest interval, total harvest, and dry weight. Namely, the total harvest variable was shown at gibberellin concentrations of 7.5 ppm and 22.5 ppm with a combination of baglog media 50% sawdust: 50% bagasse with an average of 435.48 g and 446.85 g and variable dry weight at gibberellins concentration 7 .5 ppm and 22.5 ppm with a combination of baglog media 75% sawdust: 25% bagasse with an average of 42.92 g and 43.00 g. Then the concentration of gibberellins had no impact on increasing mycelium growth and biological efficiency. However, in the baglog media composition, the use of cocopeat was able to replace sawdust up to 50% and gave a good response to mycelium growth, namely 59.43% at 12 day after inoculation and 99.24% at 22 day after inoculation. As well as the use of bagasse is also able to replace sawdust up to 50% and provide a good response to the biological efficiency of 42.82%.

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