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Waste Mixture Utilization as Oyster Mushroom (*Pleurotus ostreatus*) Growing Media

Tjatur Priyo Rahardjo[1], Mariyono[1], Aptika Hana Prastiwi Nareswari[1*], Aristasari[4], Andreas Zulkarnain[2]
[1]Program Studi Agroteknologi, Fakultas Pertanian, Universitas Kadiri
[2]Program Studi Agribisnis, Fakultas Pertanian, Universitas Kadiri
[*] *Corresponding author* : aptika@unik-kediri.ac.id

ABSTRACT

Growth media composition needs to be considered because it can affect the growth and development of white oyster mushroom (*Pleurotus ostreatus*). Wood factory waste in the form of sawdust is commonly used as oyster mushroom's growth media. However, problem arises when the source of growing media is difficult to access from the cultivation location. There's a need for an alternative mushroom growing media that is cheap and accessible. Some of them are rice bran, soybean husk, and bagasse which are agricultural wastes. Therefore, this study aimed to obtain the best media composition for oyster mushroom's growth and production. This study was compiled using one factor completely randomized design (CRD) namely, (M1) 1 kg of sengon sawdust and 1 ounce rice bran; (M2) 1 kg of sengon sawdust and 1 ounce soybean husk; (M3) 1 kg of sengon sawdust and 1 ounce bagasse; (M4) 1 kg of sengon sawdust, $\frac{1}{2}$ ounce rice bran and $\frac{1}{2}$ ounce soybean husk; (M5) 1 kg of sengon sawdust, $\frac{1}{2}$ ounce rice bran and $\frac{1}{2}$ ounce bagasse; and (M6) 1 kg of sengon sawdust, $\frac{1}{3}$ ounce rice bran, $\frac{1}{3}$ ounce soybean husk and $\frac{1}{3}$ ounce bagasse. Result showed that M2 and M4 media composition with soybean husk as one of the constituents was able to increase mushroom's stem diameter, number of mushroom caps, and the fresh weight of the mushroom. More than $\frac{1}{2}$ ounces of rice bran and soybean husk was more optimal for supporting oyster mushroom growth than $< \frac{1}{2}$ ounces dosage.

Keywords : fresh weight, oyster mushroom, production, soybean husk, waste

INTRODUCTION

White oyster mushroom is classified as a heterotroph plant which depends on the environmental conditions of its growth in withered wood. Some of the environmental factors that influence this mushroom growth include water, acidity (pH), humidity, temperature, and nutrient ability (Cahyana, 2005). Chemical elements such as nitrogen, phosphor, sulfur, potassium, and carbon needed by mushroom. Carbon can be obtained from sawdust while nitrogen is obtained from rice bran (Kalsum *et al*., 2011; Shifriyah *et al*., 2012; Syafiih, 2015).

Growing media composition is very important to note because it can interfere mushroom growth and development phase. Sawdust with high carbohydrate content and low lignin is commonly used as mushroom's growing media. It comes from sengon (Chinese albizia), sapwood, and shorea woods because they are considered low in preservatives (Rochman, 2015). High content of cellulose and lower in lignin causes sengon sawdust to meet the requirements of mushroom's growing media particularly white oyster mushroom. In addition, this wood is not gummy, absorbs water and is easy to store, has a relatively fast molting time (Atmosuseno, 1998).

Sawdusts are classified as a waste, an easy to obtain waste, so the cultivation of white oyster mushroom relatively easy to do at low cost (Aini & Kuswytasari, 2013). Ginting *et al.* (2013) reported the use of sengon sawdust as a growing medium can increase the average value of fresh weight of white oyster mushrooms.

Problem occurred in the cultivation process when the sawdust source is located far away from the production house. Finding alternative mushroom growing media that are easily obtained around the production site become the main solution. Substituents that can be used are soybean husk and bagasse. Based on Ginting *et al.* (2013), bagasse is obtained from the processing of sugarcane into sugar. 32% of bagasse obtained from sugar processing. So far, bagasse is used for boiler fuel, animal feed mixtures, and even discarded by sugar factories. The use of bagasse as an alternative medium for growing oyster mushrooms plays a role in transporting water and nutrients during growth period.

Rice bran is also used as a growing medium, acting as a source of nutrients in the form of carbohydrates, nitrogen, and carbon elements. Rice bran is indicated rich in vitamins B, plays a role in the process of forming fruit bodies (Fatmawati, 2017). In Indonesia, this material known as *dedak* or *bekatul*, can speed up the fresh weight formulation and mycelium filling time (Muchsin *et al.*, 2018).

Various substrates are used as part of white oyster mushroom growing medium are the main source of nutrients for mushroom growth. Growing medium with the right composition need to be considered in increasing white oyster mushroom productivity. Therefore, the aim of this study is to obtain the best composition of growing media for white oyster mushroom (*Pleurotus ostreatus*) growth and production.

MATERIALS AND METHODS

Experimental site

The research was conducted at the Oyster Mushroom Production House, Ketanon Village, Kedungwaru District, Tulungagung Regency with an altiture of 400-800 m asl. This research was conducted in January-April 2017.

Sampling

The materials needed for the research include white oyster mushroom seedlings, sawdust form sengon (Chinese Albizia) wood, rice bran, bagasse, soybean husk, calcium ($CaCO_3$), and water. The tools used include conventional farming tools, buckets, sprayers, sieves, stoves, tweezers, agro tubs, alcohol (70%), plastic bags, paralon rings, and newsprint.

Statistical analysis

The study was arranged using a completely randomized design (CRD) with one factor in the form of growing medium composition consisting of 6 levels, namely; M1 : 1 kg of sengon sawdust and 1 ounce rice bran , M2 : 1 kg of sengon sawdust and 1 ounce soybean husk, M3 : 1 kg of sengon sawdust and 1 ounce bagasse, M4 : 1 kg of sengon sawdust, $\frac{1}{2}$ ounce rice bran and $\frac{1}{2}$ ounce soybean husk,
M5 : 1 kg of sengon sawdust, $\frac{1}{2}$ ounce rice bran and $\frac{1}{2}$ ounce bagasse, M6 : 1 kg of sengon sawdust, $\frac{1}{3}$ ounce rice bran, $\frac{1}{3}$ ounce soybean husk and $\frac{1}{3}$ ounce bagasse.

Each treatment was repeated 4 times, so there were 24 experimental units. Each ecperimental unit includes two plants as sample.

Data from the observations were analyzed using analysis of variance (ANOVA). If the results show that the treatment has a significant effect on the observation parameters, then proceed with least significant difference (LSD).

RESULTS AND DISCUSSION

Growth and production indicate the ability of plants to grow and develop both vegetatively and generatively. The observed growth of white oyster mushrooms included stem diameter, number of mushroom caps and hood area based on harvest ages, while the observed production parameters were fresh weight and dry weight of mushrooms.

Table 1. White Oyster Mushroom Stem Diameter based on Harvest Age

Treatment	White Oyster Mushroom Stem Diameter at-... (cm)		
	45 DAP	66 DAP	81 DAP
M1	0.94b	0.88ab	0.85ab
M2	1.31ab	1.11a	0.97ab
M3	0.64b	0.62b	0.60b
M4	1.72a	1.24a	1.31a
M5	0.68b	0.66b	0.71b
M6	0.76b	0.68b	0.53b
F test	*	**	*

Description: Numbers in the same column followed by different letters, significantly different in LSD (α = 5%); DAP = days after planting.

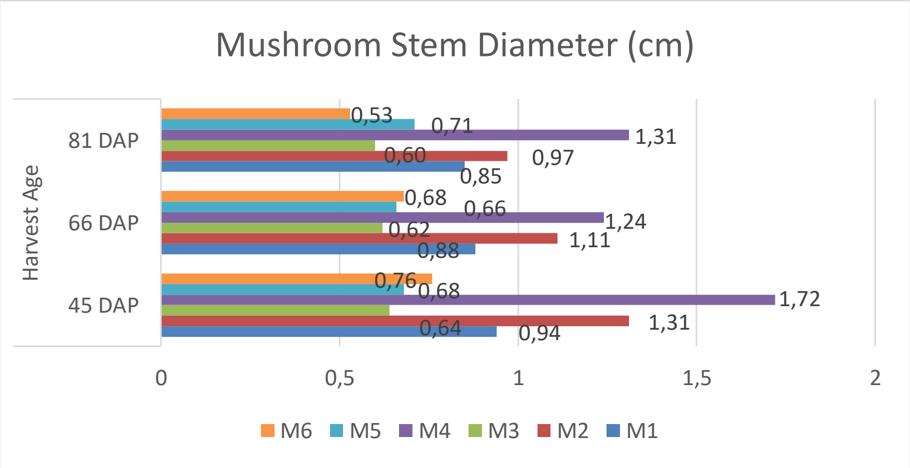

Figure 1. White oyster mushroom stem diameter based on harvest age

Table 1 showed that mixed growth medium treatment resulted in different mushroom stem diameter based on harvest age. Mushroom that growth in M2 composition of 1 kg of sengon sawdust and 1 ounce soybean husk were not significantly different from M4 compotion 1 kg of sengon sawdust, $\frac{1}{2}$ ounce rice bran and $\frac{1}{2}$ ounce soybean husk at 45, 66, adn 81 DAP. Nutrient content of M2 and M4 media is believed to be sufficient to form a fruit cap so s to produce maximum stem diameter (Indriyani *et al.*, 2021). M2 and M4 treatment used soybean husk as one of the mixture compostions. It is referred to as an alternative medium for growing oyster mushrooms because it is easy to find, especially in East Java, and can be obtained from underutilized agricultural and household waste. In addition, this material contains nutrients in the form of macro nutrients such as C, H, O, N, S, P, and K as well as micro nutrients such as Fe, Mg, Co, and Mn which are very suitable for mushroom growth. There are 86% of carbohydrates, 9% of protein, 4% of ashes, and 1% of fat in soybean husk which is also found in rice bran, allowing these two to be exhanged to meet the needs of oyster mushroom growing media (Sadad *et al*., 2014).

Overall, white oyster mushroom size seen from stem diameter parameter shows a decrease in diameter size at the advanced harvest age (Fig. 1). When the stem diameter decreases in the increase in harvest time, it is estimated that mushroom growing medium is no longer able to supply nutrients for mushroom growth.

Growth medium composition consist 50% sawdust of the overall contains higher nutrients than <50% sawdust (Hariadi *et al.*, 2013). This due to the presence of 49,40%

cellulose content in sawdust per dry weight of wood. The high composition of sawdust is equivalent to its cellulose content. High cellulose is considered sufficient to support mycelium growth.

The rapid spread of mycelium greatly affects the formation of fruit bodies. Wardani (2014) said, the required time for mycelium to fill the baglog varies from 30 to 50 days, but at the first harvest, mushroom fruiting bodies usually begin to grow 30 days after the baglog is opened. Observation results of oyster mushroom hoods number based on harvest age are presented in Table 2 below.

Table 2. Oyster Mushroom Hoods Number based on Harvest Age

Treatment	Oyster Mushroom Hoods Number at-… (sheets)		
	45 DAP	66 DAP	81 DAP
M1	16.75a	10.00abc	9.25ab
M2	15.25ab	12.50ab	11.75a
M3	7.25c	5.75c	5.00b
M4	17.00a	14.75a	13.00a
M5	10.00abc	9.50bc	7.50ab
M6	7.50bc	6.25c	4.50b
F test	*	**	*

Description: Numbers in the same column followed by different letters, significantly different in LSD (α = 5%); DAP = days after planting.

Table 2 showed that M4 media composition able to produce the most mushroom caps at each harvest age. The oyster mushroom cap comes from well-developed part of the mushroom that forms fruiting body because nutrient have been distributed to every part of the mushroom (Indriyani *et al*., 2021). M4 media formulation contains soybean husk which is thought to contain crude fiber, a source of nutrients needed by mushroom to form cell walls (Zulkifliani, 2017). Rahmawati (2017) in her research stated that cellulose and hemicellulose contained in growing media function to encourage tissue formation so as to increase the number of mushroom caps. Kalsum *et al*., (2011) added a statement that nitrogen in rice bran is useful for accelerating growth.

Mushroom harvesting is done when the mushroom cap has fully bloomed. if harvesting activities are not carried out immediately, the mushroom cap will be damaged and marked by hood shrinking (Hadiyanti *et al*. 2020). Mushroom hood harvests based on hood area are presented in Table 3.

Tabel 3. Mushroom Cap Area based on Harvest Age

Treatment	Mushroom Cap Area at-… (cm)		
	45 DAP	66 DAP	81 DAP
M1	7.20ab	5.66abc	6.00ab
M2	7.85ab	7.93ab	6.01ab
M3	4.75b	5.15bc	3.93b
M4	9.22a	8.21a	8.13a
M5	5.12b	4.12c	4.10b
M6	4.68b	4.00c	4.71b
F test	*	**	**

Description: Numbers in the same column followed by different letters, significantly different in LSD (α = 5%); DAP = days after planting.

M2 and M4 media composition have no differences in mushroom cap area (Table 3). These media compositions have basic ingredients containing high carbohydrates, namely rice bran and soybean husk. There are 84% and 86% carbohyrates contain

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respectively, are used by mushrooms as an energy source to form cells and metabolize (Indriyani *et al.*, 2021). This study showed that media with ½ ounces soybean husk composition produced wider mushroom caps than media composition of <½ ounces soybean husk.

Table 4. White Oyster Mushroom Fresh Weight based on Harvest Age

Treatment	Mushroom Fresh Weight at-... (g/baglog)		
	45 DAP	66 DAP	81 DAP
M1	105.09ab	86.52ab	81.79ab
M2	107.97ab	90.62a	86.16ab
M3	71.51c	62.47c	56.39bc
M4	117.42a	96.16a	91.95a
M5	76.27bc	64.86bc	58.55bc
M6	88.41abc	77.48abc	48.26c
F test	*	*	*

Description: Numbers in the same column followed by different letters, significantly different in LSD (α = 5%); DAP = days after planting.

Sulistyowati and Wibowo (2016) also stated based on their studies that mushrooms fruit cap diameter was influenced by the provision of phosphorus obtained from soybean husk which was applied in the form of tofu dregs. It has 0%-40% concentration of the baglog weight. Lubis and Harianja (2021) supports the results of this study, where a large muhroom cap was obtained when applying 85 g or >½ ounces soybean husk as to produce a mushroom cap diameter of 10,53 cm.

During fruiting bodies formation, elements contained in the growing media will decompose uniformly and the mushrooms store energy to produce optimal fresh weight (Istiqomah & Fatimah, 2014). Nutrients in growing media are absorbed by the mushroom and can increase its fresh weight. Oyster mushrooms fresh weight is related to nutrients absorption into the substrate. Each growing media composition already contains nutrients needed by the mushrooms. Besides media composition, environmental factors also have an important role in mushrooms growth. When the temperature inside the baglog is low, fruiting bodies will evaporate, shrinks and dries, thereby reducing mushrooms fresh weight (Djarijah, 2001). Fresh weight was measured by weighing the total weight of mushroom cap on each baglog. This study resulted that mushrooms fresh weight tends to be better and more efficient if the nutrients are combined with 1 kg of sengon sawdust, $\frac{1}{2}$ ounce rice bran and $\frac{1}{2}$ ounce soybean husk (M4) (Table 4).

Table 5. White Oyster Mushroom Dry Weight based on Harvest Age

Treatment	Mushrooms Dry Weight at-… (g/baglog)		
	45 DAP	66 DAP	81 DAP
M1	7.89ab	7.57ab	4.68
M2	10.40a	10.17a	7.02
M3	6.85ab	6.38ab	4.30
M4	10.22a	9.79a	8.52
M5	5.66b	5.42b	4.75
M6	4.52b	4.23b	3.45
F test	**	*	tn

Description: Numbers in the same column followed by different letters, significantly different in LSD (α = 5%); DAP = days after planting.

Meinanda (2013), stated that fresh weight, stem length and diameter of mushroom hood are influenced by nutrient content in baglog, seedling quality, cleanliness, maintenance, temperature, and humidity. Cahya *et al.* (2014) added that the water content in oyster mushrooms is quite high (80-95%) due to regular watering so that the water vapor falling on mushrooms surface increases fruit body water content. This can increase mushrooms fresh weight. Mushrooms dry weight (g/baglog) was obtained from the drying of all parts of the mushrooms except the root which had been oven-baked at 120 ^{o}C for 24 hours. Analysis of variance (ANOVA) through Table 5 showed that media composition treatment had a significant effect on the dry weight at harvest age of 45 and 66 days after planting (DAP). M2 and M4 media composition resulted in better mushrooms dry weight than other treatments.

Mushrooms dry weight variable aims to see the nutritional content of fruiting body. Oyster mushroom contains 128 calories, 16 g of proteins, 0,9 g of fat, 64,6 mg of carbohydrates, 51 mg of calcium, 6,7 mg iron, and 0,1 mg B vitamins per 100 g of dry weight (Astuti, 2013; Nasution, 2016).

CONCLUSION

The best media composition to grow white oyster mushroom (*Pleurotus ostreatus*) is 1 kg of sengon sawdust, $\frac{1}{2}$ ounce rice bran and $\frac{1}{2}$ ounce soybean husk (M4). Media composition with $\geq\frac{1}{2}$ ounces of soybean husk was more optimal in supporting mushroom growth compared to $<\frac{1}{2}$ ounce of soybean husk of the overall.

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