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To cite this article: Riris Risnawati *et al* 2021 *IOP Conf. Ser.: Earth Environ. Sci.* **755** 012066

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The Effect of Adding Kepok Banana Peels (*Musa paradisiaca*) to Powder Media on the Growth of White Oyster Mushrooms (*Pleurotus ostreatus*)

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Abstract. This study aims to see the effect of Kepok banana peel on the growth of white oyster mushroom (*Pleurotus ostreatus*). The research was conducted in the white oyster mushroom kumbung Sawangan, Depok between February and July 2018. The research method used was an experimental method with a research design using a completely randomized design (CRD). The study was conducted by giving 6 treatments and five replications where there were 3 parameters used, namely fresh weight, dry weight and number of oyster mushroom fruit bodies. The treatments referred to were treatment A (control), B (1 gram of Kepok banana peels), C (3 grams of Kepok banana peels), D (5 grams of Kepok banana peels), E (7 grams of Kepok banana peels), and F (9 grams of banana peel kepok). The results showed that the growth of white oyster mushrooms with D treatment had the most effect on mushroom weight and dry weight with an average of 62.38 grams and 6.35 grams. Whereas the number of fruiting bodies that had the most influence on treatment F was 16.9 grams. The results of the analysis of variance of one white oyster mushroom growth factor on the fresh weight parameter shows that $F_{hitung} (9.46) > F_{table (0,01)} (3.90)$. This means that oyster growth was very significant and the dry weight parameter indicates that $F_{hitung} (2.79) > F_{table (0,05)} (2.62)$, which indicates that the growth of oyster mushrooms was significant. The parameter of the number of fruiting bodies showed that $F_{hitung} (5.06) > F_{table (0,01)} (3.90)$, which indicates that the oyster mushroom growth was significant. This proves that offering Kepok banana peels affects the growth of white oyster mushrooms (*Pleurotus ostreatus*).

1. Introduction

This white oyster mushroom (*Pleurotus ostreatus*) or white mushroom is one of the most popular types of edible mushrooms cultivated and the most often consumed by Indonesians. It has high nutritional value as well (Widyastuti et al., 2015).

White oyster mushrooms are consumed mushrooms with a delicious and savory taste, These mushrooms are usually processed into a variety of dishes such as stir fry, capcay, flour fried mushrooms, mushroom chicken noodles and many more (Rizki & Tamai, 2011). White oyster mushrooms can be easily found in markets or supermarkets because it is a fungus that is in high demand in Indonesia (Bao, et al., 2004).

According to Sumarsih (2011), the demand for mushrooms reaches 6,158,000 tons or 14.2% of the world market. This makes oyster mushrooms ranked third. This figure is predicted to continue to increase. Therefore, several types of mushrooms have been cultivated for consumption, one of which is white oyster mushrooms. The growth and development of white oyster mushrooms requires a source



of nutrients or food in the form of chemical elements such as Nitrogen, Phosphorus, Sulfur, Potassium and Carbon (Mendeel, et al. 2005). These elements are already available in the wood network even though in small amounts. Therefore, other additions are needed; for example in the form of fertilizers used as a mixture for the manufacture of substrates or white oyster mushroom growing media (Mahadi et al., 2016).

One of the fertilizers that can be added to the planting medium to meet the nutritional needs of white oyster mushrooms is a variety of organic wastes that have nutrients for the growth of oyster mushrooms, one of which is the peel of banana Kepok. According to Nasution (2014), banana peels are 1/3 part of a banana. Banana peels that have become waste are usually only used for animal feed and are now starting to be used as an ingredient in making fertilizer (Gonzalez, et al., 2011). These efforts are made to reduce or anticipate the impact that will occur if banana peels with large production yields will only become a heap of garbage which will eventually have an impact on air pollution and sources of diseases (Girman, et al., 2016). The contents contained in banana peels are protein, calcium, phosphorus, magnesium, sodium and sulfur, making them to have good potential to be used as organic fertilizer and as an alternative to adding nutrients for the growth of oyster mushrooms.

2. Methodology

The research was conducted at Mr. Dwi's Mushroom Kumbung which is located at Jalan Mandor Tajir, Sawangan, Depok in February-July 2018. The research method used was an experimental method using a completely randomized design (CRD). The research was carried out by giving 6 treatments and 5 replications. The intended treatments were treatment A (control), B (1 gram of Kepok banana peels), C (3 grams of Kepok banana peels), D (5 grams of Kepok banana peels), E (7 grams of Kepok banana peels), and F (9 grams of Kepok banana peels).

The research methods involved preparing 30 pp of 17 x 25 x 0.05 plastics containing wood powder and banana peel waste substrate based on the treatments. The parameters studied were fresh weight, dry weight and body number of white oyster mushrooms. Data were recorded at 56 days after inoculation (HSI). After the data was collected, the parameters were analyzed using the normality test and the homogeneity test as a prerequisite test for the ANAVA test. Afterwards, the LSD test was carried out to determine the difference in the effect between treatment pairs if the ANAVA test showed a significant effect.

3. Result and Discussion

The results of adding Kepok banana peel waste to wood powder media for the growth of white oyster mushrooms showed that there were differences in treatment as can be seen in the table below.

Table 1. Results of Average Wet Weight, Dry Weight and Body Number of White Oyster Mushrooms at 56 DAI

Treatment	Fresh weight (g)	Dry weight (g)	Number of fruit bodies
A (Control)	43.06 ^a	3.54 ^a	9.4 ^a
B (1 gram)	45.98 ^a	4.51 ^c	9.8 ^a
C (3 gram)	54.19 ^{bc}	5.74 ^d	11 ^{ab}
D (5 gram)	62.38 ^d	6.35 ^d	13.9 ^{abc}
E (7 gram)	55.58 ^c	4.37 ^{bc}	16.2 ^{bc}
F (9 gram)	48.50 ^{ab}	3.99 ^{abc}	16.9 ^c

Fresh Weight

Based on Table 1, it can be seen that giving 5 grams of Kepok banana peel waste (*Musa paradisiaca*) obtained the highest average yield of 62, 38 grams and the lowest average was the control treatment,

namely 43.06 grams. Overall, adding Kepok banana peel waste on wood powder media had a significant effect on the fresh weight of white oyster mushroom (*Pleurotus ostreatus*).

The normality test showed that the data was normally distributed. The Bartlett homogeneity test of fresh weight of white oyster mushrooms had homogeneous variance. ANAVA test showed that the treatment of Kepok banana peel waste had a significant effect on the fresh weight of white oyster mushrooms. The BNT test giving of Kepok banana peel waste showed that treatment A (control) was very significantly different with treatments D and E, significantly different with treatment C, but not significantly different with treatments B and F. Treatment B was not significantly different with treatment D, significantly different with treatments C and E, but not significantly different to F. Treatment C was significantly different with D, but not significantly different with treatments E and F. Treatment D was very significantly different in treatment F and significantly different to treatment E. Treatment E was significantly different from treatment F.

Dry Weight

Based on Table 1, it can be seen that giving 5 grams of Kepok banana peel waste (*Musa paradisiaca*) obtained the highest average yield of 6.35 grams and the lowest average yield was in the control treatment, namely 3.54 grams. Overall, adding kepok banana peel waste on wood powder media had a significant effect on the fresh weight of white oyster mushroom (*Pleurotus ostreatus*).

The normality test showed that the data was normally distributed. The Bartlett homogeneity test of dry weight of white oyster mushrooms had homogeneous variance. ANOVA test showed that the treatment of Kepok banana peel waste had a significant effect on the dry weight of white oyster mushrooms. The results of the BNT test of adding Kepok banana peel waste showed that the effect of the Kepok banana peel treatment on treatment A (control) was significantly different to treatment D, but not significantly different to treatments B, C, E, and F. Treatment B was significantly different from treatment D, but not significantly different from treatments C, E, and F. Treatment C was not significantly different from treatments D, E and F. Treatment D was significantly different from treatment F and significantly different from treatment E. Treatment E was not significantly different from treatment F.

The number of fruit bodies

Based on Table 1, it can be seen that giving 9 grams of Kepok banana peel waste (*Musa paradisiaca*) obtained the highest average yield of 16.9 fruit and the lowest average yield was in the control treatment, namely 9.4 fruits. Overall, adding kepok banana peel waste on wood powder media had a significant effect on the number of fruit bodies of white oyster mushroom (*Pleurotus ostreatus*). Normality test showed that the data was normally distributed. The Bartlett homogeneity test of the number of white oyster mushroom fruit bodies had a homogeneous variation. ANAVA test showed that the treatment of adding Kepok banana peel waste had a significant effect on the number of white oyster mushroom fruiting bodies.

The results of BNT test of adding of Kepok banana peel waste showed that the effect of Kepok banana peel treatment on treatment A (control) was significantly different to treatments E and F, but not significantly different to treatments A, B, C, and D. Treatment B was significantly different from treatments E and F, but not significantly different to treatments A, B, C, and D. Treatment C was significantly different from treatment F, but not significantly different to treatments D and E. Treatments D and E were not significantly different from treatments E and F.

Statistically, the application of banana peel waste (*Musa paradisiaca*) on sawdust media vis-a-vis the growth of white oyster mushroom (*Pleurotus ostreatus*) can affect the three parameters, namely fresh weight, dry weight and the number of white oyster mushroom fruit bodies. Treatment D with the addition of kepok banana peel as much as 5 grams showed the best results on the parameters of fresh weight and dry weight of white oyster mushrooms. Meanwhile, the parameter number of fruit bodies was found in treatment F with the addition of 9 grams of banana peels. The growth of oyster mushrooms using additional substrates containing nutrients in the form of kepok banana peel waste

produced optimal fresh weight with an average of 62.38 grams. This is probably due to the balance of mineral elements contained in the oyster mushroom media, namely the wood powder contains cellulose, lignin and hemicellulose. Furthermore, the banana peels contain Ca, Mg, K, Na, P, Zn, Cu, Pb, and Fe, making the growth of oyster mushrooms to have complementary content (Okorie., Et al 2015). Besides that, there is a possibility of maximum nutrient absorption which causes its growth to increase. In accordance with the results of Putri and Titik (2014)'s research, the highest growth and yield of white oyster mushrooms was treatment with the addition of 25 grams of bagasse and 15 grams of banana peels where banana peels contain 18.5% carbohydrates, 68.9% water content, protein. 0.32%, calcium 715 mg, phosphorus 117 mg, iron 1.6 mg, vitamin B 0.12 mg and vitamin C 17.5 mg.

According to Afriadi., et al., (2015) cellulose is a polysaccharide type of carbohydrate, where this cellulose is broken down by extracellular cellulase enzymes into glucose which will be absorbed by fungi as energy for the formation of mycelium. The efficiency of absorption of nutrients and minerals affects the metabolism of oyster mushrooms to produce high energy in the form of ATP for their growth (Putri and Titik 2014).

Treatment F had the lowest average yield with the addition of more treatments compared to other treatments. The growth of oyster mushroom mycelium requires organic material as a source of nutrition. Adding excessive Kepok banana peels will prevent the mycelium from absorbing organic matter in the growing medium so that its growth becomes stunted. This is in accordance with Shifriyah et al., (2012) who discovered that increasing nutrition will reduce the lignocellulose content needed for fungal growth. The growth of oyster mushrooms using additional nutrients in the form of Kepok banana peel waste produced optimal oyster mushroom dry weight with an average of 6.35 grams. This is probably because dry weight is the accumulation of all nutrients and fungal hyphae.

The cellulose contained in the dry weight is obtained from media carbohydrates (Howard et al., 2003). The nutrients obtained by the mushrooms from the growing media are all dissolved in water, which indicates that the mushrooms absorb water and nutrients simultaneously. When they are dried to get the dry weight of the oyster mushrooms, evaporation occurs by water, but the nutrients remain in the mushroom fruiting body. The lack of nutrients in the oyster mushroom growing media causes the yield of fresh weight and dry weight only high in the first harvest and lower in the second harvest.

The growth of oyster mushrooms using additional substrates containing nutrients in the form of banana peel waste resulted in an optimal number of fruit bodies with an average yield of 16.9 grams. Treatment F produced the highest average, possibly because the amount of nutrients given was sufficient for the growth and development of white oyster mushrooms, so that it could affect the number of mushroom caps produced. Fruit bodies that are formed usually depend on the number of primordia that grow. If there are many primordia, then the number of fruit bodies that are formed is also large because the nutrients contained in the planting medium are distributed to each primordia that forms the fruit body. Mushrooms have sufficient energy reserves to produce optimal fresh weight because the elements contained in the media can be decomposed evenly during the growth of the fruiting body. According to Mufarrihah (2009), if the nutrients are not all decomposed evenly, the mushrooms must play a more active role to decompose existing organic materials such as C, N, P, K and others into simpler elements that are used by mushrooms to meet their daily needs.

According to Suparti and Lismiyati (2015) Nitrogen functions to accelerate the mycelium and also helps the formation of the hood. Phosphorus functions to form vegetative parts such as hoods and stalks. Potassium functions in the formation of the fruiting body, as an enzyme activator and the development of primordia. Media nutrition plays a very important role in the process of growth and development of the fruit bodies of oyster mushrooms. While the growth of oyster mushrooms that did not use additional nutrients in the form of kepok banana peel waste resulted in the lowest number of fruit bodies shown in treatment A, namely the control treatment (160 grams of sawdust + 31 grams of rice bran + 6 grams of corn flour + 3 grams of lime). The possibility of this happening is due to the inadequate nutritional content for the growth of the fruiting body because some of the nutrients are absorbed for mycelium growth.

According to Okorie et al. (2015), Kepok banana peels have a potassium (K) content of 9.83 mg where the growth of oyster mushrooms requires 3.93 mg. If there is a lack of potassium, many processes do not go well in its growth, so that certain compounds will be accumulated because the process is stopped. This causes the fungus unable to obtain energy, making the formation of primordia inhibited (Istiqomah, Nurul and Siti 2014). Therefore, the more elements that are in this Kepok banana peel, the more optimal amount in the oyster mushroom fruiting body. In treatment B, treatment C, treatment D and treatment E, there was an increase in the yield of the fruiting body where in each treatment the composition of the addition of banana peel of Kepok was greater than treatment A (control).

This was probably also because in treatment F there was a tight competition, making the nutrition only focused on increasing the cell content which caused a large number of fruit bodies. Meanwhile, the fresh weight and dry weight of treatment F were low compared to treatment D which was the best treatment.

The competition that occurs can also cause primordia to be eliminated so that they cannot continue their growth and development to form the fruiting body. All of the energy produced is used for the growth of mycelium, causing disruption in the generative development of mushrooms, namely producing a small number of fruiting bodies and automatically producing low fresh weight of mushrooms. Treatment F was the penultimate average after control for the probability of absorption of nutrients being decomposed for fruiting growth. Based on the results of the study, of all the parameters both fresh weight, dry weight, and number of fruit bodies, the highest yield was treatment D (fresh weight and dry weight) and treatment F (number of fruit bodies). This is because the need for mushrooms is fulfilled because the banana peel contains the elements needed by oyster mushrooms.

4. Conclusion

Based on the research and the statistical tests that have been carried out, it can be concluded that the addition of nutrients from Kepok banana peel waste to the growth of white oyster mushrooms has an effect on fresh weight, dry weight and number of white oyster mushroom fruit bodies with the best results found in treatment D with average fresh weight of 62.38 grams and dry weight of 6.35 grams. Meanwhile the number of fruit bodies in treatment F with an average yield of 16.9 fruits.

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