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THE EFFECT OF REEDS AND WASHED RICE WATER ON THE GROWTH AND PRODUCTION OF WHITE OYSTER MUSHROOM (PLEUROTUS OSTREATUS)

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ABSTRACT
This study aims to determine the effect of reeds as a planting medium and washed rice water on the growth and production of white oyster mushroom. The research was conducted in April-July 2021 in Polopadang, Kapala Pitu District, North Toraja Regency.The research was carried out in the form of a factorial experiment with 2 different factors arranged in a randomized block design (RBD), namely: As the treatment used Imperata and washed rice water. Imperata (reeds) as 1st factor consists of three treatment levels, namely R0 = control, R1 = 10% Reeds, R2 = 20% reeds, while washed rice water as 2nd factor consists of five treatment levels, namely W0 = control, W1 = 10 ml of washed rice water, W2 = 20 ml of washed rice water, W3 = 30 washed rice water, W4 = 40 ml of washed rice water. The results showed that the treatment of 10% Imperata (L1) and 10 ml water leri (L2) gave the best results on the growth and production of white oyster mushrooms in this case, namely: number of mushroom pin head, fresh fruit body weight, and mushroom diameter. Number of pin head and diameter of mushroom hood have a positive and significant correlation to weight of mushroom, each with a correlation coefficient 0.799 and 0.807. This research implies that the use of reeds and rice washing water in the cultivation of white oyster mushrooms has promising potential. This combination can promote mold growth, reduce production costs, and contribute to financial sustainability.

Keyword: white oyster mushroom, growth regulator, washed rice water, reeds.

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INTRODUCTION

Indonesia is a country that has considerable potential to develop food and horticultural products. One type of horticultural product is white oyster mushroom which can be developed and directed to increase people's income, as well as improve nutritional conditions through diversification of types of food ingredients. Oyster mushroom is a food mushroom that comes from the Basidiomycetes group, called oyster mushroom because its cap is shaped like a circle like an oyster shell (Maulidina et al., 2015). White oyster mushroom (*Pleurotus ostreatus*) contains 9 essential amino acids with a protein content of 19-35% and vitamins such as B1, B2, niacin, biotin, and vitamin C. In addition, there are minerals K, P, Ca, Na, Mg and Cu.

Mushroom production in Indonesia in 2016 reached 40,914,331 kg, in 2017 mushroom production decreased to 3,201,956 kg. but in 2018 mushroom production increased again, namely 31,051,571 kg, this was in line with the increasing demand for mushrooms, considering that mushrooms are an alternative food that is liked by all levels of society (BPS, 2022). According to reseacrh currently mushrooms are very popular for consumption by the wider community, including oyster mushrooms and straw mushrooms, which have high economic value and are prospective as farmers' income (Suprapto et al., 2017).

North Toraja is a very potential area for oyster mushroom cultivation when viewed in terms of climate and temperature and if viewed from the economic aspect North Toraja is the main tourist destination after Bali. With so many tourists, the development of restaurants and hotels as supporting suggestions also increases. Therefore, mushrooms are needed by hotels and restaurants because tourists who come prefer to consume processed menus made from mushrooms.

The main medium used in mushroom cultivation is generally wood sawdust waste which can be obtained from sawing wood. Wood powder generally used as a growth medium for white oyster mushrooms is sengon wood powder which is of good quality and contains organic ingredients and active extracts. Organic materials (lignocellulosic) and active extracts (resins, tannins) can be used as a medium for fungal growth. Due to the increasing demand and limitations in nature, alternative media have begun to be sought as a substitute for sengon sawdust. Reeds are an alternative because they contain lignocellulose and are abundantly available in the environment as waste (Puspaningrum, 2013); (Utami & Susilawati, 2017).

Mushrooms need food in the form of chemical elements such as nitrogen, phosphorus, sulfur, potassium, carbon which are available in wood tissue, even in small amounts for life and development (Syawal et al., 2018); (Roshita et al., 2017) and (Girmay et al., 2016). Therefore, external additions are needed, for example in the form of fertilizer used as a mixed ingredient for making plant substrates or mushroom growing media (Ishartati et al., 2017).

Rice is a source of energy and protein, contains various elements of minerals and vitamins. Washed rice water is also easy to obtain because most Indonesian people use rice as a staple food. Washed rice water is water used for washing rice which has not been widely used by the community. This is because the community does not know the benefits of washed rice water. Washed rice water contains the elements N, P, K, C and other elements (Suprapto et al., 2017). Mushrooms need carbon, nitrogen, vitamins, and minerals for their growth. Types of vitamins that are very necessary for the growth of oyster mushrooms are thiamin (vitamin B1), nicotinic acid (vitamin B3), pantothenic amino acid (vitamin B5), biotin (vitamin B7), pyrrodoxin, and inositol.

The aim of the study was to determine the effect of the composition of the reeds in the growing medium and the dosage of washed rice water as a growing medium on the growth and production of oyster mushrooms as well as to determine the composition of the reeds and the dosage of washed rice water which affected the growth and production of white oyster mushroom.

Based on the background, a study will be carried out to determine the effect of reeds in growing media and washed rice water on the growth and production of white oyster mushrooms.

METHOD

Time and Place of Research

This research was conducted in Polopadang, Kapalapitu, North Toraja Regency. This research takes place from April-July 2021.

Materials and tools

1. The materials used in this study were oyster mushroom seeds, sawdust, reeds, rice bran, dolomite lime, milled corn, clean water, alcohol, cotton, paper and spirits.
2. The tools used in this study were clear plastic, (17X35cm), machetes, paralon pipes, rubber bands, drums, gas stoves, sprayers, litmus paper, scalpel, Bunsen burner, scales, sigmat, ruler and knife.

Research methods

This research was conducted using a factorial randomized block design (RBD) with two factors. The first factor is reeds and the second factor is washed rice water.

Imperata/ Reeds :	Washed rice water :
R0 = control	W0 = control
R1 = 10% reeds	W1 = 10 ml washed rice water
R2 = 20% reeds	W2 = 20 ml washed rice water
	W3 = 30 ml washed rice water
	W4 = 40 ml washed rice water

So there were 15 treatment combinations, each repeated 4 times – 60 plots and 240 baglogs.

Preparation of Planting Media

Basic media: 200 g of bran, 200 g of corn, 16 g of dolomitic lime
R0W0 : basic media 1000 g sawdust
R0W1 : basic medium + 20 ml washed rice water
R0W2 : basic medium + 40 ml washed rice water
R0W3 : basic medium + 60 ml washed rice water
R0W4 : basic medium + 80 ml washed rice water
R1W0 : basic medium + 875 g sawdust + 125 g reeds
R1W1 : basic medium + 875 g sawdust + 125 g reeds + 10 ml washed rice water
R1W2 : basic medium + 875 g sawdust + 125 g reeds + 20 ml washed rice water
R1W3 : basic medium + 875 g sawdust + 125 g reeds + 30 ml washed rice water
R1W4 : basic medium + 875 g sawdust + 125 g reeds + 40 ml washed rice water
R2W0 : basic medium + 750 g sawdust + 250 g reeds
R2W1 : basic medium + 750 g sawdust + 250 g reeds + 10 ml washed rice water
R2W2 : basic medium + 750 g sawdust + 250 g reeds + 20 ml washed rice water
R2W3 : basic medium + 750 g sawdust + 250 g reeds + 30 ml washed rice water
R2W4 : basic medium + 750 g sawdust + 250 g reeds + 40 ml washed rice water

Before planting (inoculation) of seedlings into the planting medium, the following preparations are made:

Prepare tools and materials to be used.

Before sawdust is used, sawdust is sifted first to get fine powder. After that the sawdust is washed to reduce the sap content in the sawdust because wood sap can suppress mycelium growth. Then the reeds were cut into pieces with a size of approximately 5-8 cm. Mix sawdust with other ingredients such as rice bran, dolomite lime, corn flour and reed leaves to be used according to the treatment, add about 50-60% of the amount of the ingredients, mix the ingredients until completely smooth and smooth so that it is easy clenched.

Composting needs to be done beforehand, so that it can decompose into simpler compounds that are easily digested by oyster mushrooms. The composting process is carried out by covering the tarpaulin dough for 4 days. Putting the media that has been mixed into a clear plastic bag (baglog) and compacting it then the top of the plastic bag is given a paralon ring and covered with newspaper and then covered with plastic and tied with a rubber band. Furthermore baglog sterilization, wet sterilization using drums. The baglog wet sterilization process is carried out by steaming the media

at 100°C using a furnace. Sterilization lasts for 8-10 hours, it is hoped that the intruding microorganisms can be suppressed.

Cultivating Oyster Mushrooms

After the oyster mushroom planting media has been cooled and sterilized both the materials and tools used, planting is done by removing the seeds from the bottle using a scalpel then the mushroom seeds are planted into the growing media (baglog) after that it is covered using paper, this process is very important because where must maintain sterility because oyster mushroom seeds are easily contaminated.

Incubation

Incubation is the storage stage of baglog which has been inoculated into the incubation chamber until all of the baglog is covered with white mycelium. The incubation period usually lasts 30 days. Certain arrangements should be made so that the mushroom mycelium can grow quickly. Things that must be arranged in the incubation room include the room and incubation place must be clean from contaminants, dry, (with humidity 60%) good air circulation, should not be exposed to direct sunlight, and room temperature is maintained at 28-30°C. During this incubation period routine monitoring must be carried out, during this incubation period problems in the form of contamination and pest attacks usually begin to arise. Contaminated media must be separated and discarded immediately so as not to infect other baglogs.

Mushroom Maintenance

The maintenance that must be considered is the temperature required in the range of 23-28°C, with the optimum air temperature at 25°C. Maintenance can be done by watering jamjur 3 times a day. To avoid pests and diseases in mushroom cultivation, it is carried out from the start of making media, places or locations with sterile conditions or locations that are clean from contaminants such as insects, rodents, microbes and harmful compounds.

Harvest Oyster Mushrooms

White oyster mushrooms are harvested when the growth of the fruiting bodies has been maximized. This growth period is marked by the maximum and perfect size and shape of the fruit body. The most appropriate harvest time is 4-5 days from the formation of the fruit body candidates

Observational Variables

Observations were made on the growth of oyster mushrooms which include:

1. Number of fruiting bodies, counting the number of fruiting bodies formed is carried out at harvest time with an interval of 2 weeks until crop production decreases.
2. The wet weight of the mushroom fruiting bodies (g), was weighed at each harvest with an interval of 2 weeks until the harvest production decreased.
3. Diameter of the fruit cap (cm), measurement of the fruit cap is carried out at harvest time with an interval of 2 weeks until crop production decreases.

Data analysis

Data were analyzed using variance (ANOVA) and if it had a significant effect it would be continued with the Least Significant Difference (LSD) test at 5% level.

RESULTS AND DISCUSSION

Analysis of Variance number of pin head, diameter of mushroom hood and weight of mushroom (Table 1), showed that the application of reeds had no significant effect on the variable number of pin head, diameter of mushroom hood and weight of mushroom.

This is due to the insufficient availability of nutrients namely cellulose and lignin in Imperata so that they are less able to support further fungal growth as indicated by the addition of cap diameter which was not significantly different for each level of treatment. This is because the reeds contain cellulose, hemicellulose and lignin. For optimum growth of mushrooms requires a number of nutrients obtained from the planting medium.

The results of lignocellulosic analysis showed that reeds had higher cellulose than sawdust of sengon wood. Cellulose is a group of polysaccharides that will be broken down into monosaccharide groups, namely glucose which serves as a carbon source which is a macro element as a constituent of the structure of fungal cells (Mudakir & Hastuti, 2015). Lignin is degraded into glucose and other compounds, glucose and these compounds are used as energy reserve nutrients to produce optimal fresh fruit (Nurafles, 2015). The correct composition of lignin and cellulose in the combined treatment of sawdust of sengon wood and reeds is urgently needed to obtain maximum growth of white oyster mushrooms (Fatmawati, 2017); (Ali et al., 2023); (Tafzi et al., 2021).

Table 1. Analysis of Variance for number of pin head, diameter of mushroom hood and weight of mushroom

Source of Variation	Number of pin head		Diameter of mushroom hood		Weight of mushroom	
Block	1.44	ns	3.16	*	2.22	ns
Treatment	7.27	**	5.42	**	11.81	**
Reeds (R)	0.05	ns	0.04	ns	0.01	ns
Washed rice water (W)	16.99	**	14.08	**	23.44	**
Interaction (R x W)	4.02	**	2.30	*	8.91	**

Description: **= significant at F 1%, *= significant at F 5 %, ns = non significant

The results of the analysis of variance on the total number of fruit showed that the rice washing water had a very significant effect. This is presumably because rice washing water contains nutrients, carbohydrates, protein, minerals and vitamins needed for mushroom growth (Igile et al., 2020); (Oktavianus Mandi, n.d.). High carbohydrates can form the hormones auxin and gibberellin which function as a stimulant for shoot growth , emergence of shoots and stimulate root growth (Wahidah & Saputra, 2015).

The results of the LSD test on the total number of fruiting bodies gave the best results in the administration of rice washing water (W2) 20 ml per baglog, which was significantly different from the other treatments (Table 2). This is presumably because baglog requires more nutrients for mushroom growth.

The results of the analysis of variance on the total fruit bodies showed that the administration of rice washing water (W2) had a very significant effect. This is presumably because rice washing water contains vitamin B1 as a form of auxin hormone, which when this auxin hormone is combined with cytokinin hormones can induce budding, besides auxin leri water also contains gibberellin hormone which can induce dormant buds.

The results of the test of variance showed that giving 20 ml of rice washing water (W2) per baglog produced total fresh fruit bodies (122.78 g), which was significantly different from the treatment without rice washing water. This is presumably because baglog requires more nutrients for mushroom growth.

The results of the LSD test on the length of the mushroom stalks showed that the provision of rice washing water had a significant effect, presumably because the nutrients needed must be sufficient and should not be too moist. The main factors in mushroom stalk length are environmental factors, especially temperature and humidity. The water content in the media greatly influences the growth and development of the mushroom mycelium. Too little water will result in growth and development being disrupted, even stopping altogether. However, if there is too much water, the mycelium will rot and die. Mushrooms grow well in moist conditions, but do not want standing water (P, 2017). Mushrooms that are too dry are of low quality due to insufficient temperature and humidity so that the mushroom stalks are longer and thinner (Normalia Lambe'Toding, n.d.).

Table 2. Number of Pin Head, Diameter of Mushroom Hood, and Weight of Mushroom

Treatment	Number of pin head		Diameter of mushroom hood (mm)		Weight of mushroom (g/baglog)	
R0 W0	15.67	a	9.87	a	205.43	a
R0 W1	16.33	ab	10.17	a	355.90	bc
R0 W2	28.67	c	16.00	c	541.87	e
R0 W3	16.00	a	10.87	a	352.53	bc
R0 W4	17.67	ab	10.47	a	430.30	cd
R1 W0	19.67	ab	10.87	a	352.77	b
R1 W1	16.67	ab	10.47	a	334.90	b
R1 W2	21.67	b	12.93	b	492.10	de
R1 W3	16.00	a	10.83	a	366.33	bc
R1 W4	15.67	a	10.43	a	349.37	b
R2 W0	16.00	a	10.33	a	332.50	b
R2 W1	15.33	a	10.23	a	353.43	bc
R2 W2	21.33	b	12.33	b	385.30	bc
R2 W3	20.67	ab	11.70	ab	458.87	de
R2 W4	16.00	a	10.73	a	326.80	b
LSD 5%	5.28		2.63		90.56	

Description: The average value followed by the same letter in the column and the interaction is not significantly different at the 5% LSD test level.

The results of observations on the total fruit body weight and its variance in the table 1 show that the application of Imperata and rice washing water has a very significant effect on fruit body weight. The results of the 5% LSD test on total fruit body weight showed that 10% Imperata (R1) application resulted in a total fruit body weight significantly different from other treatments. The best rice washing water (W2) was 20 ml per baglog resulting in a total fruit weight significantly different from other treatments. The results of observing the diameter of the mushroom caps at harvest I and their variances indicating that Imperata and the interaction between rice washing water had a very significant effect on the diameter of the mushroom caps.

The results of the 5% LSD test on the diameter of the mushroom showed that the application of 10% Imperata (R1) produced the widest fruit cap and the application of 20 ml rice washing water (W2) produced the widest diameter which was different significant with other treatments. Analysis of variance on the variable number of pin head, diameter of mushroom hood and weight of

mushroom shows that the interaction between the provision of reeds and rice washing water has a very significant effect on the number of pin head, and weight of mushrooms and has a significant effect to the variable diameter of mushroom hood. This is in line with the results of (Simorangkir et al., 2018); (Lavenia et al., 2021) and (Nasution et al., 2022).

The LSD test at 5% test level (Table 2) shows that the R0W2 treatment combination produced the highest number of pin heads, significantly different from all other treatment combinations. The R0W2 treatment combination also produced the largest mushroom head diameter which was significantly different from all other treatment combinations. Treatment R0W2 produced the highest weight of mushrooms, but not significantly different from R1W2 and R2W3, but significantly different from the other treatment combinations. This shows that the addition of reeds in the mushroom medium is not suitable for the growth of white oyster mushrooms, especially in the variable number of pin heads, diameter of moshroom hood and mushroom weight (Puadi et al., 2022); (Wati & Yuliani, 2012); (Naila & Purnomo, 2016).

Table 3. Correlation Analysis Between Number of Pin Head, Diameter of Mushroom Hood and Weight of Mushroom

Variable	Number of pin head	Diameter of mushroom hood	Weight of mushroom
Number of pin head	1		
Diameter of mushroom hood	0.960 **	1	
Weight of mushroom	0.799 **	0.807 **	1

Description: ** significant pada r 1%.

Mushroom need food in the form of chemical elements such as nitrogen, phosphorus, sulfur, potassium, carbon which are available in wood tissue, even in small amounts for life and development (Kalsum et al., 2011); (Pribady et al., 2018); (Rochman, 2018). The amount of mushroom fruit body was affected by the absorption of nutrients in the media (Wahidah & Saputra, 2015); (Khan et al., 2013); (Alfarizi et al., 2021) and (Simorangkir et al., 2018).

Correlation analysis between number of pin head, diameter of mushroom hood and weight of mushroom is presented in Table 3. Table 3 shows that number of pin head and diameter of mushroom hood have a positive and significant correlation to weight of mushroom, each with a correlation coefficient 0.799 and 0.807. This means that the more the number of pin heads and the diameter of the mushroom head, the higher the weight of the mushroom. The number of pin heads has a positive and significant correlation with the diameter of the mushroom hood, meaning that the greater the number of pin heads, the greater the diameter of the moshroom hood. The results of this study are in line with the results of previous studies that the number of pin heads is directly related to the diameter of the mushroom hood (Girmay et al., 2016), as well as the weight of the mushroom fruit bodies (Nasution et al., 2022).

CONCLUSION

Based on the results of the research that has been done, it can be concluded that the application of reeds and rice washing water has a different response by white oyster mushroom plants. The composition of 10% reeds and 90% basic medium responded well by white oyster mushrooms, especially in the total number of pin heads, total fresh fruit body weight, and mushroom cap diameter. The interaction between 20 ml rice washing water and 10% reeds + 90% basic medium had a good effect on the total number of pin heads, total fresh fruit body weight, and mushroom cap diameter. Number of pin head and diameter of mushroom hood have a positive and significant correlation to weight of mushroom, each with a correlation coefficient 0.799 and 0.807.

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