

The Use of Bagasse and Rice Straw as Alternative Growth Media for White Oyster Mushroom

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Abstract

White oyster mushroom (*Pleurotus ostreatus*) is one of fungi widely cultivated in Indonesia. Generally, white oyster mushroom is cultivated in sawdust media that has limited abundance in Indonesia. The purpose of this research is to search for alternative media other than sawdust to grow white oyster mushroom in Indonesia. White oyster mushroom has been grown in rice straw media and bagasse as well as on media combination of sawdust, straw, and bagasse. The parameters studied were fresh weight, cup diameter, and fruiting body morphology. The results showed that highest fresh weight white oyster mushroom obtained from media combination of sawdust, straw, and bagasse while the lower fresh weight yielded from the 100%-straw media. There was no significant difference observed in the mushroom cap diameter as well as in the fruiting body diameter among variation composition of the media. The study concluded that the mix of sawdust, straw, and bagasse might serve as an alternative media for white oyster mushroom growth.

Keywords: *Pleurotus ostreatus*, oyster mushroom, rice straw, bagasse

Introduction

Edible mushrooms are widely consumed in Indonesia where the climate is suitable for the natural growth as well as the cultivation of certain mushrooms. White oyster mushroom (*Pleurotus ostreatus*) is one of the most commonly cultivated edible mushrooms in Indonesia (Suriawiria, 2002). The cultivation process of white oyster mushroom usually makes use of a sawdust baglog as a substrate for the mushroom growth. Nowadays, the availability of sawdust tends to be limited, hampering the oyster mushroom cultivation in general. Therefore, search efforts for alternative substrates providing sufficient nutrition for the mushroom growth have gained a big interest.

According to Cahyana et al. (2006), the necessary nutrient composition for oyster mushroom growth more or less includes 27% lignin, 70% karbohidrat (selulosa dan glukosa), protein, nitrogen, fiber, and vitamins

like tiamin at 100µg/L. All those nutrients are available in sawdust (Senyah, 1989). Rice straw and bagasse are examples of agricultural solid waste obtained easily in huge amount in agricultural countries like Indonesia. They are used so far only as mix components for making fertilizer. The carbohydrate content in rice straw and bagasse has been reported to be high enough, making them potential as alternative growth substrates for mushroom growing on sawdust.

This work aimed to evaluate the capacity of those materials in substituting the sawdust portion in the common growth substrate. Their percentage in the total baglog composition was varied to see the influence on the fresh weight and morphology of the fresh mushroom yielded.

Materials and Methods

The experiment was carried out at the Laboratory of Microbial Biotechnology, University of Surabaya, Indonesia, between September 2014 and February 2015. Sawdust was collected from the different sawmills in Mojokerto, East java. Rice straw and bagasse used as substrate mixture were collected from Surabaya. They were grinded before usage. The experiment was laid out in a completely randomized design with 7 treatments and replicated 10 times.

Substrates preparation and spawn inoculation

Each sawdust (30% of volume) was supplemented with rice straw and bagasse at certain ratio as written in Table 1, also mixed with calcium carbonate (0.02%) and water (50%) and thoroughly mixed.

Polypropylene bags (22.5 × 30 cm) were filled with 1 kg of each substrate, sterilized once at 121°C and 1 atm pressure for 3 h and for several hours allowed to cool down to the desired inoculation temperature in a dark room. Each baglog was stood up, the mouth was opened and the spawn (3% w/w) was placed into each bag at the approximate center using a sterilized metal implement. Bags were closed with paper.

Cultivation conditions

The bags were subsequently placed, longside down, into a spawn running room at 25 - 30°C in the dark and 65 - 70% relative humidity until completion of spawn running (approximately 30 days after spawn inoculation). After completion of spawn running the temperature and relative humidity was changed to 19 to 25°C and 80 - 90% RH, respectively. The baglogs were slit and the paper cover was removed. Water was sprayed for maintaining moisture up to the desired level in the form of fine mist from a nozzle.

Fructification and Harvest

During the fruiting process, temperatures of 19 to 25°C and 80-90% RH were maintained in almost total darkness. All mushroom fruit was harvested by pulling out the stalk and the yield was calculated based on the cumulative fresh weight of the mushroom fruits harvested from each baglog. In general, fresh weight, diameter of carps and the morphology of the mushroom fruits were observed. Production in each bag will gradually decrease until there is no more fructification because of degradation in the mycelium.

Results and Discussion

Days to complete mycelium running

No remarkable differences were observed in mycelial running rate on spawn packets of the different substrates used, except for composition of rice sawdust:straw (0.5kg:0.5kg). It ranged from 5-6 days, while others for 7 to 8 days. Variation in the time might be due to variations in log texture, where the rice straw lowered the hardness and compactness of the logs. The result might be different if the rice straw would have been grinded as small as the size as the sawdust before used as a substrate mix component.

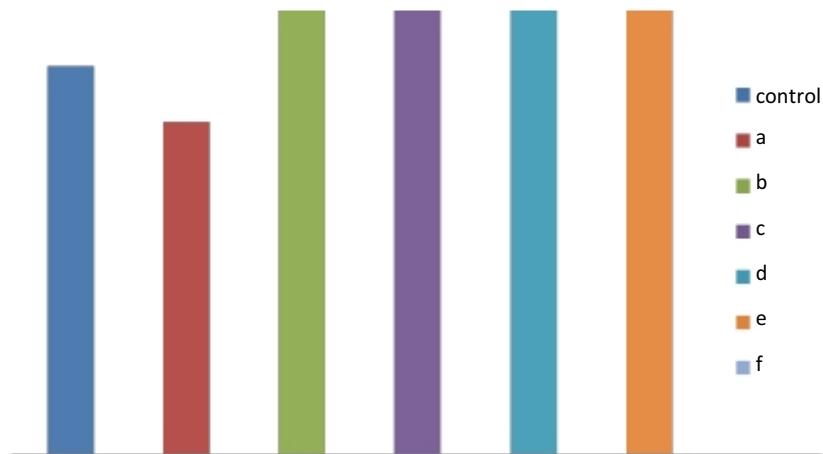


Figure 1. Time to complete the mycelium running affected by substrate composition

Control = 100%(1kg) sawdust, a = sawdust : rice straw (0.5kg:0.5kg), b = 100%(1kg) rice straw, c = rice straw : bagasse (0.5kg:0.5kg), d = sawdust : bagasse (0.5kg:0.5kg), e = sawdust : crice Straw : bagasse (0.5kg:0.25kg:0.25kg), f = 100%(1kg) bagasse.

Fresh weight of harvested mushroom fruits

Analysis of data reveals no significant effect of the substrate composition to the cap's diameter. Yet, in terms of fresh weight, it was clearly shown that the bagasse alone was not suitable for growing the mushroom, while the composition of (sawdust:rice straw 0.5kg:0.5kg) performed as well as the control (sawdust) did.

Number and morphology of effective fruiting bodies

Number of well-developed fruiting body was recorded and presented in Table 1. Dry and pin headed fruiting body was discarded but twisted and tiny fruiting body was included during counting. The percentage of effective fruiting body did not vary significantly in different substrates. They were rather similar in numbers, size, color and also cap's diameter.

Table 1. White oyster mushrooms growth on various media/substrate compositions

Substrate composition			Average of	Number of	Average cap	Color, size
Saw- dust	Rice Straw	Baga- sse	mushroom fresh weight (g/baglog)	fruiting body*	diameter (cm)	
1 kg	-	-	235.7 _a ± 28.8	many	6.9 ± 0.943	white. normal size
0.5 kg	0.5 kg	-	70.4 _c ± 17.3	many	6.7 ± 2.899	white. normal size
-	1 kg	-	102.9 _c ± 31.6	many	6.8 ± 1.076	-
-	0.5 kg	0.5 kg	89.3 _c ± 33.2	many	6.2 ± 0.882	white. normal size
0.5 kg	-	0.5 kg	202.5 _{ab} ± 40.8	many	7.3 ± 1.056	white. normal size
0.5 kg	0.25	0.25 kg	179.2 _b ± 36.5	many	6.9 ± 1.088	white. normal size
-	-	1 kg	-	-	-	white. normal size

*1-6 caps per baglog was identified as 'few', while >6 caps was identified as 'many'

Yield per packet

Significant variation was found in yield of white oyster mushroom grown on different substrates used. The maximum biological yield was recorded with control (1kg sawdust) and also with the composition of saw dust:bagasse (0.5kg:0.5kg). The lowest biological yield was observed in composition of 100% bagasse (1kg). Chaudhary et al. (1985) explained the process of break-down of lignin. There is an apparent correlation between the ability to degrade lignin and the production of phenolases. Which oxidize phenolic compounds to simple aromatic compounds that can be absorbed by mushroom mycelium and is used for its growth. The product of cellulolytic action in simple and soluble carbohydrates and the end products being glucose was absorbed by the fungal mycelium for growth and energy. Therefore, cellulose rich organic substrates are good for the cultivation of mushroom (Gerrits and Muller. 1965; Quimio, 1987). High cellulose content in wood results in enhanced cellulose enzyme production and increased yield of mushroom (Ramasamy and Kandaswary. 1976). The substrates with high lignin and phenolic content should decrease the activity of the enzyme, hence slow growth and low yield.

Conclusions

Variation on substrate composition did not give different results on the morphology (color, size and the cap's diameter) of white oyster mushroom, except the fact that the bagasse alone did not show any growth of mycelia. Yet, in terms of fresh weight, it was clearly shown that the composition (sawdust:bagasse 0.5kg:0.5kg) performed as well as the control (sawdust) did. Thus, that composition can be considered as an alternative growth media for white oyster mushroom.

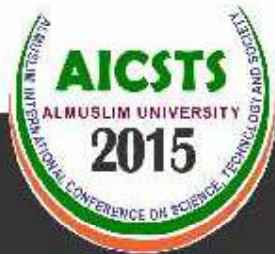
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Message from the Rector

Assalamu'alaikum Wr. Wb.

Greetings.

Ladies and gentlemen,

It is an honor indeed to open this conference, the 1stAlmuslim International Conference on Science, Technology, and Society (AICSTS). On behalf of Almuslim University (Umuslim), I would like to extend a warm welcome to all participants and our speakers who are with us to make this a notable and exciting event a success.

At Almuslim University, we emphasize the best possible achievements in education and research and are also committed to innovation and technology. Today, we are faced with more challenges in these spheres, and therefore, as members of the academic community, we have a duty to find innovative research solutions for them. Hence, this conference is an excellent forum for experts, professionals, researchers, and students as well, to present, share, and discuss their knowledge and experiences with all of us. In line with such idealism, it is really a privilege for us to host you, not just this year, but for years to come, to give and provide opportunities to contribute lasting and practical solutions to the challenges that confront us from time to time. This conference includes keynote speeches, oral and poster parallel sessions on topics in the field of sciences, life sciences, engineering, social sciences and humanities.

Finally, we know that in the origination of this conference there may be some shortcomings, for which we would like deeply apologize in advance to all of you. This is the University's first experience in organizing an international conference like this. With deepest sincerity hereby we would also like to thank all the keynote speakers for your contribution, time and support for this conference. Our heartfelt appreciation goes to all the authors of the selected papers for their effort and hard work. I also would like thank the organizing committee of the conference for their hard work in making this event a success. I wish to encourage them to continue organizing more events and to take other initiatives as well in future. To support and sustain important research linkages for dialogue and facilitate exchanges of ideas such as this will certainly generate more new discoveries and innovations in years to come. It is everyone's optimism that all we will learn from this first international conference in 2015 will be used as a reference for the development of research, as well as guidance for the readers in education and in academic profession.

I am sure the committee of this conference has served you in the best way they can to make your brief stay with us a lasting memory.

Thank you.

Dr. Amiruddin Idris, SE, M.Si

Message from the Committee Chairman

Assalamu'alaikum Wr. Wb.

Greetings,

Ladies and Gentlemen,

I would like to take this occasion to cordially welcome all participants of the 1stAlmuslim International Conference on Science, Technology, and Society (AICSTS). This conference is held at our beloved campus of Almuslim University (Umuslim), Bireuen, from November 7th to November 8th, 2015. Almuslim University, the home of 7 faculties, is one of the major private universities in Aceh. We are assured that the 416 scientific participants will contribute to productive discussions and exchanges of scientific experiences that will bring about success to this conference. Participants from 9 countries, Indonesia, Malaysia, Thailand, Philippines, United States, India, Taiwan, England, and Qatar, have optimally marked an international scope to the conference.

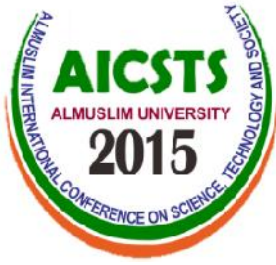
I would like to express my gratitude to the Coordination of Private Higher Education Regional XIII Aceh, the Institute of Research and Community Services of Almuslim University and the committee members for helping us in organizing the conference. The conference and proceedings are a credit to a large group of people and everyone should be proud of the outcome.

We are delighted with the vast responses of 152 submissions from researchers and practitioners. The knowledge bases that we are aiming to generate in the conferences topics are overwhelming due to the involvement of these experts from various fields of studies. Their papers will be published in the proceedings to provide permanent records of what has been presented. The proceedings are divided into four, Life Sciences, Engineering, Social Sciences and Humanities (Science Educations), and Social Sciences and Humanities (Economics, Social and Arts), and the papers published here will exhibit the current state of development in all aspects of important topics that are instrumental to all researchers in the various fields. They have succeeded in bringing together various aspects of developments and innovations in knowledge and technology that will benefit not only the academic community, but the society itself as well.

We realize that there are still many shortcomings in the implementation of the arrangements of this conference. Therefore at this opportunity we also expect criticism and constructive suggestions from all stakeholders so that the conference arrangements in future will be more successful. Finally we would like to thank you all for all the support and assistance you have contributed to making this conference and its proceedings successful.

Thank you,

Drs. Marwan Hamid, M.Pd



KEYNOTE SPEAKERS

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