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Potential of Oil Palm Empty Fruit Bunch (EFB) as Media for Oyster Mushroom, *Pleurotus ostreatus* Cultivation

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Abstract

Oil palm is one of the most important oil crops in Indonesia. Oil palm empty fruit bunch (EFB) could serve as an alternative and cheap media for edible mushroom cultivation. This study investigated the possibility of using EFB for cultivating edible mushroom *Pleurotus ostreatus*. The objectives of this research are to formulate best media for *Pleurotus ostreatus* cultivation, to give alternative for palm oil Industries to use EFB for mushroom cultivation, and to support Indonesian government policy to increase food security. The experiment, which covered the media preparation, inoculation, incubation and harvesting used different EFB media composition. Media formulation consisted of EFB, rice bran, CaC_2, mineral fertilizer (TSP 12-12-12), and sawdust. The starter was added to the sterilized media. The experiment was done in three replicates. Data were collected on mycellium growth and weight of mushroom yield. Variation 3 showed the fastest growth of mycelium among other variations. Variation 1 yield the highest weight with 289.7 g in the first harvest.

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Keywords: empty fruit bunch, oyster mushroom, *Pleurotus ostreatus*, media, cultivation,

1. Introduction

A total of 76.9 million tonnes of empty fruit bunch (EFB) is produced in 2012, and the number keeps increasing according to the increasing number of CPO oil production. The empty fruit bunch are commonly either applied to the field or incinerated. EFB contains cellulose, hemicellulose, and lignin which are similar to rice straw, sawdust

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and some woods from various plants mostly used as media for edible moshroom cultivation. Aside from that, EFB does not contain sap, a wood component that may suppress mushroom growth.

Commercial cultivation of *Pleurotus ostreatus* in Indonesia utilizes sawdust from various plants as the base medium. However, the high demand of sawdust leads to increasing price and has become a serious problem to the mushrooms growers, in particular the oyster mushroom. Therefore, a new alternative media must be exploreed to overcome the shortage of sawdust. One of the potential alternative media is EFB. Unfortunately in Indonesia, it had not been applied as madia cultivation, especially as a sole based media. Aside from that, there is no fixed formula of additional nutrient for mushroom media cultivation.

Some research showed that edible mushroom cultivation had been done by using EFB as a media[2], unfortunately the media formula still consist of sawdust. Researcher[5] reported that substrates which composed of 50% of palm pressed fibres (PPF) and 50% of rubber tree sawdust produces the highest yield of *Pleurotus ostreatus* fruit bodies[4]. Other research described that *Pleurotus sp.* can grow on *Paraserianthes falcataria* sawdust, empty fruit bunches (EFB) and mixture of both substrates with proportion 1:1 respectively[3].

Pleurotus ostreatus was chosen in this study because an increase of market demand in Indonesia. By 2015, it is assumed that with 5% increase of market demand, Indonesia must increase the *Pleurotus ostreatus* production of 21,900 tonnes/year. Meanwhile, oyster mushroom growers can only provide 10,000 – 12,500 tonnes/year. Based on the data, it confirmed that oyster mushroom cultivation is a good prospects.

The reseach was part of a comprehensive research and was done under a laboratory scale. The objectives of this research were 1.) to formulate the best media for *Pleurotus ostreatus* cultivation, 2.) to give alternative for palm oil Industries to use EFB for mushroom cultivation, and 3.) to support Indonesian government policy to increase food security.

1. Experimental proceedures

The empty fruit bunch was obtained from PTP VIII, Cikasungka, West Java. The fresh empty fruit bunch were cut into smaller pieces, dried and then shredded using a shredder. Three different media formulation were prepared as shown in Table 1 with a total of 3 replicates prepared for each different media.

Table 1. Media Formulation for Cultivation

COMPONENT	MEDIA FORMULATION			
	Control (g)	Variation 1 (g)	Variation 2 (g)	Variation 3 (g)
EFB	-	750	848.22	937.5
Rice bran	133.9	89.39	133.9	44.64
Calcium carbonate	13.39	13.39	13.39	13.39
Mineral Fertilizer (TSP)	4.47	4.47	4.47	4.47
Sowdust	848.22	-	-	-
Peurotus ostreatus Starter	1/10	1/10	1/10	1/10

The EFB was mixed thoroughly with rice bran, calcium carbonate and mineral fertilizer according to the media fermulation. Then, the mixture was stirred again until no calcium carbonate was visible. Water (80% of the total weight of mixture) was then added to increase the moisture content. The media were mixed again until all the water was absorbed. 1kg of media was then placed in a polyethylene bag, compressed and closed with PVC necks which were covered with cotton plugs and sterilized at 121 °C for about 1 hour in the autoclave.

After sterilization, the baglogs were left to cool and then inoculated with 100 g of starter. The baglogs were subsequently placed vertically in a spawn running room maintained at 25 °C and relative humidity at 85%. This is done by spraying water on the floor of the room periodically. The baglogs were left in a hut covered with nets specifically designed so as to allow only 70% sunrays for mycelium to grow throughout the baglogs.

Analysis were done on the growth of mycellium every week and weight of the fruit body according to its growth. Harvesting time might take different time for each baglog, based on the mushroom growth. After the fruit body were harvested, they were weighed using weighing scale commonly used in the lab.

3. Result and Discussion

Growth of mycelium of *Pleurotus ostreatus*. Based on this results, the mycelium could grow and produce fruit body on all medium. Table 2 described the growth of mycelium of *Pleurotus ostreatus* each week. Variation 3 showed the fastest growth of mycellium among other variations as illustrated in Table 2. The slowest growth was the control that did no contain EFB. This result explained that the least rice brand added in the medium the more mycelium growth.

Rice bran is used as a source of nitrogen especially during the formation of fruiting bodies. High amount of rice bran may hinder the mycelium growth, the starting phase of mushroom growth. According to other sources[1,4] rice bran can be added up to 15% of the EFB.

As for the time required to grow the mycelium, it took 28-35 days to fill the whole baglog. This result is according to the result done by other researchers[1,4], but not[5] that needed 49-60 days for the mycelium to fully colonize the bag.

Table 2. Growth of mycelium of *Pleurotus ostreatus*.

TIME (day)	MYCELIUM GROWTH			
	CONTROL	VARIATION 1 MEDIA	VARIATION 2 MEDIA	VARIATION 3 MEDIA
0	Innoculum on the surface	Innoculum on the surface	Innoculum on the surface	Innoculum on the surface
3	Mycelium start to grow	Mycelium start to grow	Mycelium start to grow	Mycelium start to grow
7	Mycelium fills ¼ baglog	Mycelium fills <¼ baglog	Mycelium fills ¼ baglog	Mycelium fills >¼ baglog
14	Mycelium fills ¼ baglog	Mycelium fills <¼ baglog	Mycelium fills >¼ baglog	Mycelium fills almost ½ baglog
21	Mycelium fills almost ½ baglog	Mycelium fills almost ½ baglog	Mycelium fills ½ baglog	Mycelium fills ½ baglog
28	Mycelium fills almost all part of baglog	Mycelium fills almost all part of baglog	Mycelium fills almost all part of baglog	Mycelium fills almost all part of baglog
35	Mycelium fills all part of baglog	Mycelium fills all part of baglog	Mycelium fills all part of baglog	Mycelium fills all part of baglog

The yield are based on weighed of the successfully produces *Pleurotus ostreatus* fruit bodies harvested from each baglog. As shown in Table 3, for variation 1 (EFB 1.3), yield the highest weight with 289.7 g in the first harvest. It weighed more than 50% of the total yields were produced during growth of the fruit body obtained in the second, and third harvest. As for comparison, the highest yield was above the result of other research[5]. This might be cause by various aspects such as environmental conditions, nutrient content and the mushroom starter.

The Table 3 bellow also illustrated the total yield for all replicates as well as the average of each medium variation. The highest total yield was variation 3 with 1,310 g and the everage was 436.67g. This result is relevant to

the previous result on growth of mycelium. The result also showed a higher yield and average compare to other research result[5].

As for the control, it yielded the least weight compared to other media variation. This result showed that EFB has a high potential to be used as media for cultivating oyster mushroom replacing the sawdust.

Table 3. Weight of *Pleurotus ostreatus* based on Variation of Media

Media Variation	Harvest								SUM (g)
	Day	Yield (g)	Day	Yield (g)	Day	Yield (g)	Day	Yield (g)	
Control	54	**0**	76	**53.5**	90	**42.4**			**95.9**
Variation 1									
EFB 1.1	54	**199.8**	78	**122.5**	99	**45.2**			**367.5**
EFB 1.2	64	**115.2**	79	**62.3**	102	**80.0**			**257.5**
EFB 1.3	69	**289.7**	83	**86.3**	115	**177.4**			**553.4**
Total									**1,178.4**
Variation 2									
EFB 2.1	54	**128.9**	78	**140.3**	98	**68.4**	108	**180**	**517.6**
EFB 2.2	61	**155.4**	93	**50.5**	103	**50.0**	108	**100**	**355.9**
EFB 2.3	74	**139.6**	85	**97.8**	112	**83.5**	-	**-**	**320.9**
Total									**1,194.4**
Variation 3									
EFB 3.1	40	**204.2**	65	**120.7**	75	**32.2**	105	**120.4**	**477.5**
EFB 3.2	42	**178.5**	67	**117.7**	80	**60.2**	110	**160.0**	**516.4**
EFB 3.3	43	**134.5**	68	**86.3**	90	**47.7**	124	**47.6**	**316.1**
Total									**1,310.0**

Bellow, Figure 1. illustrates the growth of mycelium and the fruit body over time from the same baglog. It showed that after two weeks the mycellium growth covered ¼ of the baglog and continued to grow up to 4-5 weeks, then started to form the fruit body after 6 weeks

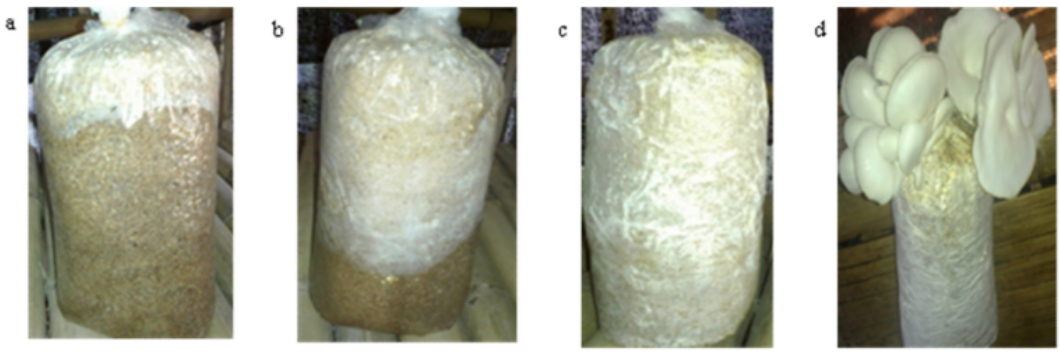

Fig. 1. (a) Mycelium growth after 2 weeks; (b) Mycelium growth after 3 weeks; (c) Mycelium growth after 4 weeks; (d) Fruit body growth after 6 weeks

4. Conclusion

Shredded empty fruit bunch can replace sawdust as a substrate for mushroom cultivation of *Pleurotus ostreatus*. Variation 3 with the composition of 750 g of EFB, 89.39 g of rice bran, 13.39 g of lime and 4.47 g of mineral fertilizer showed the fastest growth of mycelium among other variations. Variation 1 media with the composition of

937.5 of EFB, 44.64 g of rice bran, 13.39 g of lime and 4.47 g of mineral fertilizer produced the highest yield of *Pleurotus ostreatus* fruit bodies compared to the other mediun. It weighed 289.7 g for the frst harvest after 69 days cultivation. The result can be applied for pilot plant scale of mushroom cultivation to support mushroom growers in Indonesia.

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