Effects of steaming period and EM-Bokashi on yields of mushroom (*Volvariella volvaceae*)

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Abstract

This research was determined by the effects of steaming period and EM-bokashi treatments on yields of mushroom (*Volvariella volvaceae*). Research was carried out at the mushroom house. West Java. Rice straw, cotton waste from textile industry and EM-bokashi were used as culture media. The experiment was conducted in split plot design with 4 replications. steaming period as the main plot (P l was 4 hours steaming period and P 2 was 8 hours steaming period) as the subplot was EM-bokashi with levels (B0 as control, B1 was 200 kg/ha, B2 was 400 kg/ha and B3 was 600 kg/ha). Effects of steaming period was significantly different on yield (kg/m^2), Biological Conversion Efficiency (%) of mushroom. The combination between 8 hours of steaming and 400 kg EM-bokashi/ha have the highest yield (3.402 kg/m^2) however the lowest yield (2.591 kg/m^2) was due to the combination between 4 hours of steaming and no EM-bokashi. The plot treated with 8 hours of steaming and 400 kg/ha EM-bokashi gave the maximum Biologcal Conversion Efficiency of 5.443(%).

Introduction

Until now research on straw mushroom in Indonesia is scarcely carried out as a result of the development of straw mushroom cultivation technique is relatively slow if compared to the other horticulture plants. Besides mushroom have a high nutrient value and protein, no fat and can reduce cholesterol forming. The effort of making the mushroom growing media better gives the opportunity of increasing the production. Yield of straw mushroom are strongly dependent on the substrates and culture method used. In Indonesia It is usually cultured on rice straw media. However, It is also known that mushroom could grow well on other media. Some materials can be made as a media from organic wastes such as coconut waste, and cotton waste.

The addition of supplement originated from other organic materials may increase the production of straw mushroom. One method which is hoped to increase the availability of essential nutrients for the growth of mushroom on culture media is the application EM-bokashi which is mostly consisting of useful substances for the growth of straw mushroom.

It has been reported that the application of EM-bokashi, a new technique of nature farming resulted in the increasing of the growth and yield. However, the rate of EM-bokashi on the mushroom cultivation system are still largely unknown. Thus the research on the EM-bokashi activities should be further studied.

The objectives of this study was to investigate the effect of steaming period and EM-bokashi

applications on yields and Biological Conversion Efficiency of mushroom.

Materials and Methods

The studies were carried out at the mushroom house in West Java , Indonesia. The experiments was a split plot design with a steaming period in 2 main plots and EM-bokashi in 4 sub plots and 4 replications.

The period of steaming treatment consist of 4 hours (P1), and 8 hours (P2). The EM-bokashi treatments consisted of a control 0 kg/ha (B0), and 3 levels of EM-bokashi: 200 kg/ha (B1), 400 kg/ha (B2), and 600 kg/ha (B3). The brief description of the treatments can be clarified as follows:

P1B0:4 hours steaming without EM-bokashi
P1B1:4 hours steaming + 200 kg/ha EM-bokashi
P1B2:4 hours steaming + 400 kg/ha EM-bokashi
P1B3:4 hours steaming + 600 kg/ha BM-bokashi
P2B0:8 hours steaming without EM-bokashi.
P2B1:8 hours steaming + 200 kg/ha EM-bokashi
P2B2:8 hours steaming + 400 kg/ha EM-bokashi
P2B3:8 hours steaming + 600 kg/ha EM-bokashi

Substrates used in this experiment were rice straw, cotton waste, calcium carbonate and EM-bokashi which were given appropriately to the treatments. EM-bokashi was composed of rice bran, oil cake, and fish meal mix in ratio 10:1:1 with EM_4 and molasses mixed into the mixture and allowed to stand for 5 days before using.

Ten days after planting, fresh market mushroom were usually harvested daily. Data on total yields (kg/m^2), mushroom diameter (cm) and harvest period were obtained.

On measuring the value of substrate conversion into biomass (straw mushroom) thc Biological Conversion Efficiency (BCE) was used. According to Wuest (1983) in Ouimio (1985) what is meant by Biological Conversion Efficiency is clarified in percentage as:
Biological Conversion Efficiency =(Flesh weight of mushroom / Dry weight of substrate) X 100

Results and Discussions

The major effects of the experimental treatments was on yields (kg/m^2). Mushroom diameter and harvest periods were little affected

Table l: The effects of steaming period and EM-bokashi on yield, Biological Conversion Efficiency, diameter dan harvest period of mushroom

Treatment	Yield (kg/m2)	Biological Conversion Efficiency (%)	Diameters (cm)	Harvest period (days)
4 hours steaming				
B0	2.591 b	4.146 b	2.77 a	14 a
B1	2.670 b	4.272 b	2.74 a	15 a
B2	3.042 a	4.867 a	2.80 a	14 a
B3	2.921 a	4.674 a	2.81 a	14 a
8 hours steaming				
B0	2.790 b	4.464 b	2.93 a	14 a
B1	3.112 a	4.979 a	2.90 a	14 a
B2	3.402 a	5.443 a	2.88 a	15 a
B3	3.291 a	5.266 a	3.02 a	15 a

Mean separation within Columns by Duncan's multiple range test, P=0.05

Table 1 shown that the high yields obtained for the combinations of 8 hours steaming and 400 kg EM-bokashi / ha or 600 kg EM-bokashi / ha. Mushroom yield at 4 hours steaming treatments was always lower compared to the 8 hours steaming treatment. EM-bokashi treatment has a significant different result compared to the one without EM-bokashi for all steaming treatment, except for the combination of 4 hours steaming and 200 kg EM-bokashi / ha. Although, the treatment of EM-bokashi application had a tendency to produce the longest mushroom diameter and harvest period, there were no significant differences in mushroom diameter and harvest period (Figure1). In addition, 600 kg/ ha EM-bokashi treatment produced the maximum mushroom diameter.

Figure 2 shown the yield of mushroom which is produced from treatment 4 hours and 8 hours steaming were always higher if they were each applied an EM- bokashi supplement. The similar results can be seen on Figure 3 that the application of EM-bokashi supplement may enlarge the Biological Conversion Efficiency. This condition is thought as a result of the straw mushroom which grew with the EM-bokashi treatment received the supply of nutrient much greater from the substrate degradation being used. As it is known that at end of the result of the process of organic materials degradation is the result of the stabilization of organic material on substrate which is signed by the ending of Metana CO_2, water and mineral form. According to Bels Koning (1962), at the process of degradation, the carbon complex substances and inorganic nitrogen is transformed into carbon and nitrogen source which is available for mushroom, such as pentosa and ligno-nitrogen complex. The mushroom Biological Conversion Efficiency is also affected by the supply of nutrients for the growth of mushroom such as the nitrogen and phosphor elements (Chang and Quimio, 1982). In such a case nitrogen and phosphor substances were found more in substrate which were added en EM-bokashi.

The existence of a very significantly different between the treatment of 4 hours and 8 hours steaming is showing that the duration of steaming period holds a very important role. In this condition the ammonia and pathogenic microorganisms of the mushroom decreased as well as the useful microorganisms such as Actinomycece which is thought to he helpful in activating the growing of straw mushroom, as well as continuing the process of the substrate media degradation which have formed simple substances which were ready to use for the growing of the straw mushroom.

In this research, have a capable result of good mushroom production. The local farmer usually produce 2.0-3.0 kg/m^2, whereas in this research was produced the yield average of between 2.8–3.4 kg/m^2.

Conclusion

The steaming period and the level of EM-bokashi application is evident towards yield and biological conversion efficiency of straw mushroom. The treatment of steaming period for 8 hours was much better compared to 4 hours. The combination between 8 hours steaming period and 400 kg / ha had the highest yield and Biological Conversion Efficiency. The application of EM-bokashi may increase the yield of straw mushroom. Although we do need a further research of the EM-bokashi application on straw mushroom because this kind of research is still rare or may not exist.

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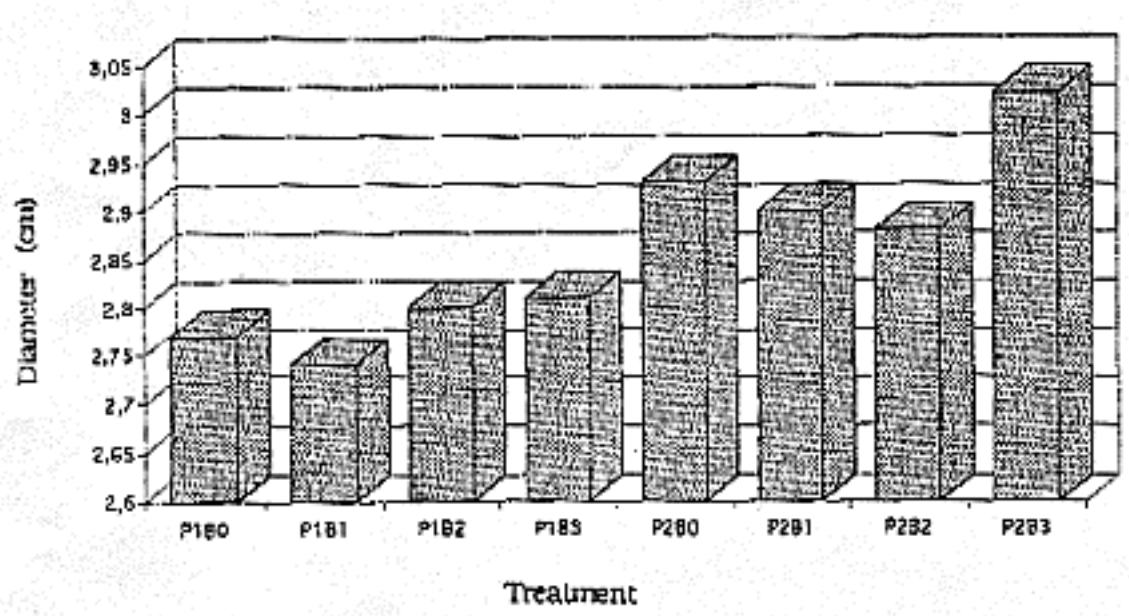

Figure 1: Effect of steaming period and EM-bokashi on diameter of mushroom

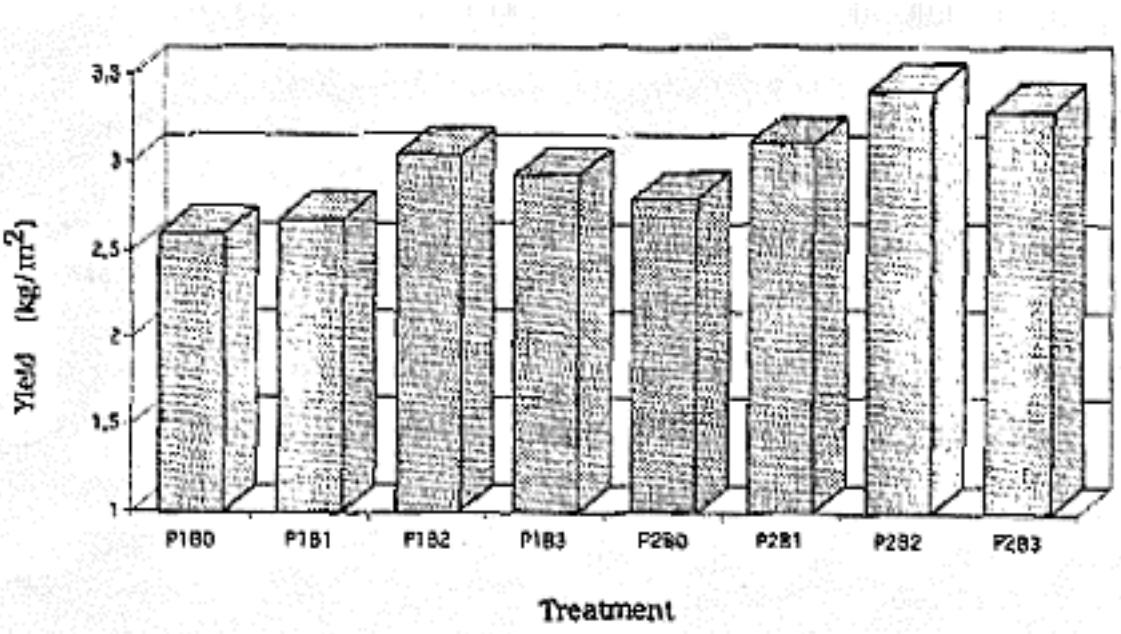

Figure 2: Effect of steaming period and EM-bokashi on yield of mushroom

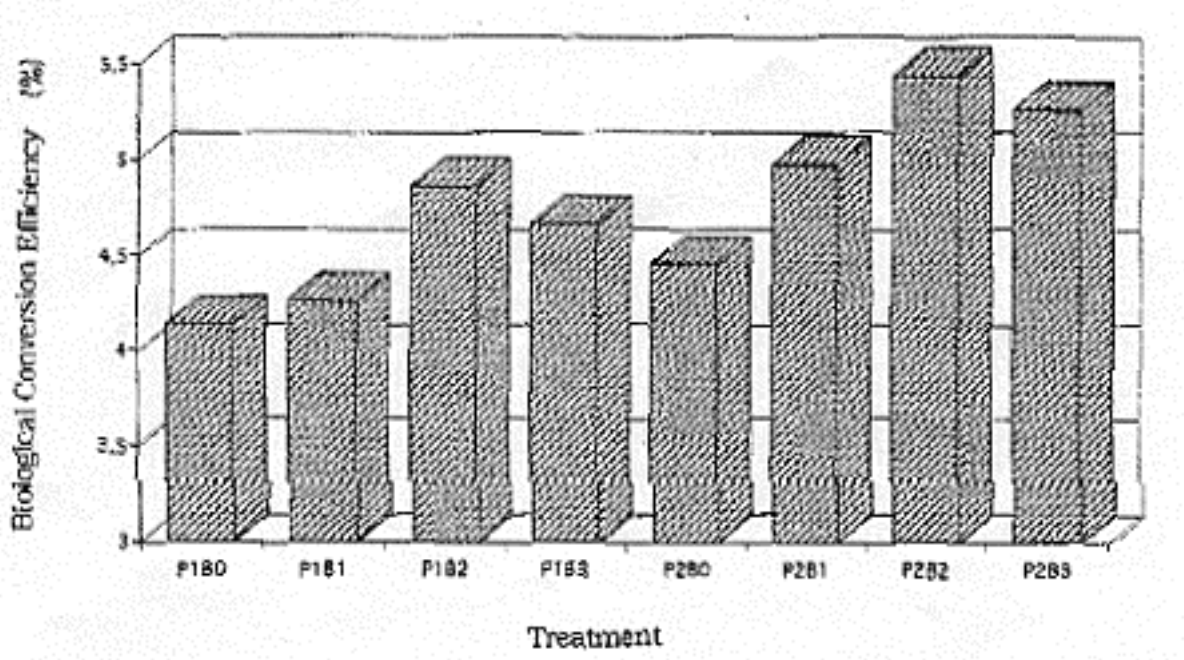

Figure 3: Effect of steaming period and EM-bokashi on Biological Conversion Efficiency of mushroom