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Rice Straw Addition as Sawdust Substitution in Oyster Mushroom *(Pleurotus ostreatus)* Planted Media

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Abstract. Oyster mushroom is favorite by the people because of the high nutrients. The oyster mushroom cultivation usually using sawdust. The availability of sawdust become difficult to find. It makes difficulties of mushroom cultivation. Rice straw as an agricultural waste can be used as planted media of oyster mushroom because they contain much nutrition needed to the mushroom growth. The aims of this research were to analysis the influence of rice straw addition in a baglog as planted media and to analysis the concentration of rice straw addition which can substitute sawdust in planted media of oyster mushroom.This research used 4 treatment of sawdust and rice straw ratio K = 75 % : 0 % , P1 = 60 % : 15 % , P2 = 40 % : 35 % , P3 = 15 % : 60 %. The same material composition of all baglog was bran 20%, chalk 5%, and water 70%. The parameters used in this research were wet weight, dry weight, moisture content and number of the mushroom fruit body. Data analysis was used ANOVA test with 1 factorial. The results of this research based on statistical analysis showed that there was no influence of rice straw addition in a planted media on the oyster mushroomgrowth. 15% : 60% was the concentrationof rice straw additionwhich can substitute the sawdust in planted media of oyster mushroom.

INTRODUCTION

Mushrooms classified as heterotrophic organisms which get their food from decaying material or other living things. Public prefer to consume white oyster mushroom (*Pleurotusostreatus*) from Basidiomycota because this mushroom contains nutrients such as vitamins, phosphorus, iron, calcium, carbohydrates, and proteins. Oyster mushrooms also contain important vitamins, especially vitamin B, C, and D, vitamin B1 (thiamine), vitamin B2 (riboflavin), niacin and provitamin D2 (ergosterol) [1]. Oyster mushrooms yield active secondary metabolits which inhibit the growth of *E. coli*. In addition, oyster mushrooms consumed by the public because of many nutrients and its benefits. Due to the high interest in oyster mushrooms, people are cultivating the oyster mushrooms to meet the market demand [2].

High nutrients substrate required in oyster mushroom cultivation. The oyster mushroom substrate usually uses sawdust. Oyster mushroom producers usually use sawdust as a planted media. Alternatively, rice straw has the same nutrients as sawdust. Rice straw contains 27% hemicelluloses, 39% cellulose, 12% lignin, and 11% dust. Hemicelluloses and cellulose are composed monomers of sugar such as glucose[3]. The rice straw is considered as compost heap that interferes with tillage and the next planting. The rice straw is vegetative parts of rice plants which formed by stems and leaves and potentially used as a white oyster mushroom planting media. This can be usefull in reducting the composting heap [4].The aims of this research were to analysis the influence of rice straw addition in a baglog as planted media and to analysis the concentration of rice straw addition which can substitute sawdust in planted media of oyster mushroom.

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METHODS

Baglog Making Preparation

The straw and sawdust that used must be dry and sterile. The composition of each baglogwas 5% chalk and 20% and mixed it with 70% water levels.

TABLE 1.The each baglog composition

Composition	Treatments							
	Control		P 1		P 2		P 3	
	(%)	g	(%)	g	(%)	g	(%)	g
Chalk	5	50	5	50	5	50	5	50
Bran	20	200	20	20	20	200	20	200
Sawdust	75	750	60	600	45	450	15	150
Straw	0	0	15	150	30	300	60	600
Total	100	1000	100	1000	100	1000	100	1000

Furthermore, the composting media was carried out in 2 days until the composition of the mixture was evenly mixed with media. After the composting process, put the media into the plastic bags with a total weight of the planted media was 1000 g and the minimum thickness of plastic bag was 0.003 mm. There was no mixture of straw in the control media. Then, the media sterilization usedan oven-shaped room with high temperatures. Sterilization was carried out at 121˚C for 5 hours. Inoculation was done in a room which already sterilized by spraying 1% formalin and left it on for 24 hours. All baglogwere placed on wooden shelves in a horizontal position and remained until the growth of the white oyster mushrooms mycelium filled the whole baglog. The incubation room was set with 20-35˚C of temperature and approximately 80-90% of humidity. The incubation terminated after about 5 weeks and marked by the presence of mycelia which looks like white mist envelop in the entire surface of the planted media. Harvesting was done at 1-2 weeks after it slashed. The criteria of harvested mushrooms werewhite, already cracking, and fresh.

The Proximity Test

The proximity test on mushrooms planted media in baglog included a moisture test by a *thermogravimetric* method or drying for 3 hours using an oven at 100 °C, dust analysisby drying dust method, the fat content test by the *soxhletation*method. The protein test (total N) used the *kjehdahl* method, rough fiber test used the weighting reduction due to dust method, the carbohydrates measurement based on the calculation of % carbohydrate = 100%-% (protein + fat + dust + water) and the energy levels measurement used the bomb calorimeter method. The proximitytest was done in Chemix laboratory.

RESULT AND DISCUSSION

The water content of each baglog was 70%. The water absorption of mixed straw and sawdust on each treatment was different, as a result, the moisture content in baglog showed any differentiation [5]. The rice straw absorbed a lot of water [6]. The moisture content in baglog was used by the mushrooms as a nutrient reserve during the incubation period. The moisture content would decrease after the mushroom harvested. The rice straw media structures were hollow and contain pores where mushroom mycelium could grow properly [7]. The presence of the pores in the media would be provided enough oxygen (O2) required by the mushrooms in the early growth of the mycelium [8].

The nutrients needed for the oyster mushroom growthwas carbohydrates, lignin, and fibers [9]. The P2nutrients contentwere very influential in the oyster mushroomgrowth. Lignin, cellulose, carbohydrate, and fiber degraded by mushrooms into simple carbohydrates which could be used for protein synthesis [10]. The P2 had a high content of carbohydrates although the addition of straw was only 30%. That was because the lignin, cellulose, carbohydrate and fiber contribute to providing simple carbohydrates [11]. The complex compounds that were present in the media, composted for 2 days to unravelwith the help of microbes retrieved into simple compounds that can be digested by a mushroom [12]. Cellulose would be parsed into simple ingredients that could be used as nutrients that could be absorbed into the cells [13]. These compounds would be used as a nutrient reserve while lignin was resistant to decomposition consequently weathering process and was slower and takes a long time. Therefore, the more cellulose content of the media could increase the speed of the mushroom mycelium growth but the lignin levels of the media could inhibit the mushroom mycelium growth [14].The complete results of the white oyster mushrooms baglog analysis could be seen in Table 4.1.

TABLE 2 White Oyster Mushrooms Baglog Analysis

Treatment	Analysis						
	Moisture content (%)	**Dust (%)**	**Protein (%)**	**Fat (%)**	**Fiber (%)**	**Carbohydrate (%)**	**Energy (ATP)**
K	73,8	5,7	0,1	1,4	17,8	1,2	1799,7
P1	71,6	6,7	1,2	0,7	17,3	2,5	2117,8
P2	71,3	6,7	0,6	0,8	16,9	3,9	2394,7
P3	74,4	6,1	0,1	0,8	16,5	2,1	1595,6

Information: K: 75% sawdust, P1: 60% sawdust + 15% rice straw, P2: 45% rice straw + 30% rice straw, P3: 15% sawdust + 60% rice straw

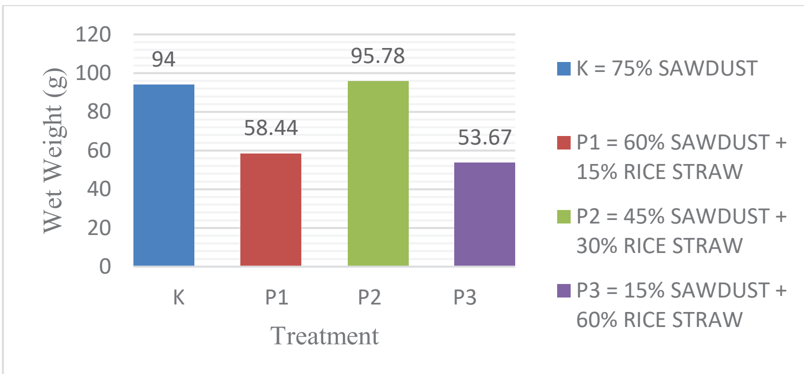

FIGURE 1. The oyser mushroom wet weight

Fig 1. showed P2 as the highest wet weight. The factor that affected the highest wet weight of P2 was caused by the mushroom hypha which helped to absorb nutrients faster [15]. Therefore, it could increase the efficiency of nutrient absorption. The wet weight depended on the number of the mushroom fruit body. The media texture of the P2 also caused nutrients in the water remained and stored in baglog.

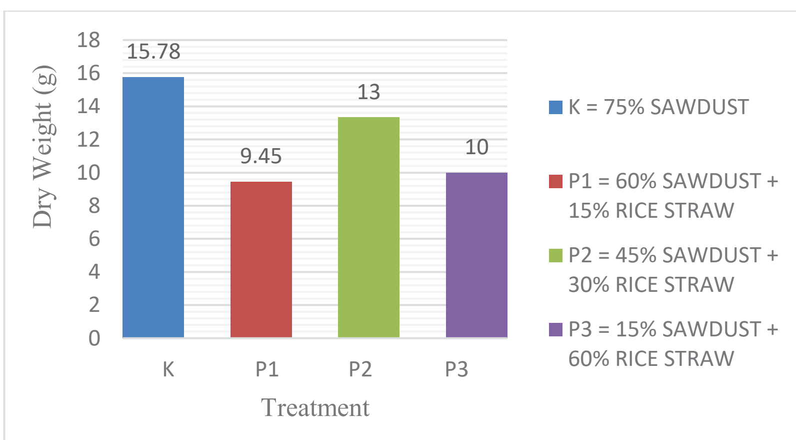

FIGURE 2. The oyser mushroom dry weight

The K treatment showed the highest dry weight (Fig 2.) because the fat content and coarse fibers of thisbaglogwas higher than the other baglog [16]. The mushroom cells composed the hypha by absorbing organic molecules by the hydrolytic enzyme synthesis, then used the nutrients to hyphal growth to increase the dry weight [17].

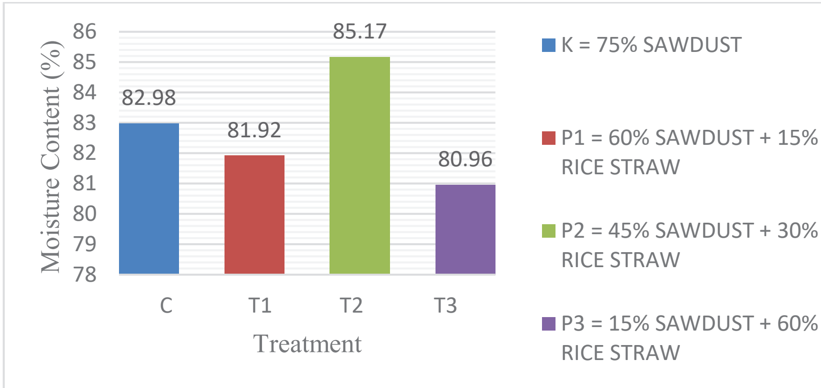

FIGURE 3. The oyser mushroom moisture content

During the incubation time, white oyster mushroom mycelium spread among substrate particles, therefore,it increased the contact surface of the substrate and the mycelium. The increase of the contact surface caused the optimum nutrient absorption of the substrate. The myceliumdegraded the coarse fiber components in the media as a source of energy which was taken through the degradation of cellulose and lignin. P2 had the highest carbohydrate content. Carbohydrate molecules were composed of carbon, hydrogen, and oxygenatoms [18]. These components would be used to cell compartmentssynthesis. The nutrients in the media were used by the mushroom to produce optimal growth. These nutrients also influenced the mushrooms wet weight.

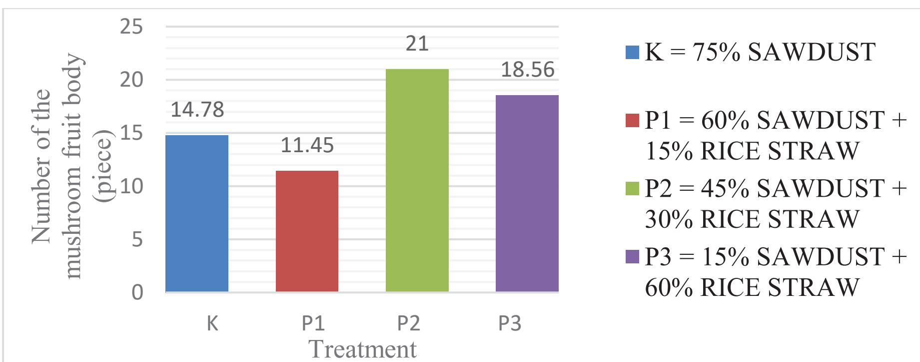

FIGURE 4. The number of oyser mushroom fruit body

The amount of mushroom fruit bodywas affected by the absorption of nutrients in the media. The straw added to the mushrooms planted media increasedthe levels of carbohydrates that were necessary to reproduce the mushroom fruit body [19]. Extracellular enzymes used to parse and form the monosaccharides carbohydrate then it would be absorb by the mushroom for assimilated. Carbon source required for energy needs and structural cells of the mushroom fruit body. The energy used by the mycelium in P2 to cultivate the mushroom fruit body. The energy from the media would focus to increase the absorptive surface area by the increase of the hypha length instead of enlarging the circumference of the hypha [20]. As a result when the hyphahad not got a place to form the mycelium in baglog then the hypha extend and out through the opened incision which would form the mushroom fruit body [21]. The amount of the mushroom fruit body in each treatment were also determined by the ability of white oystermushroomcell growth to extend the hypha tip [22].

The rice straw could be used to substitudethe sawdust on white oyster mushroom planting media.15% : 60% was the concentration of rice straw addition which can substitute the sawdust in planted media of oyster mushroom.The use of this concentration could reduce the use of sawdust and increase the use of rice straw but still produce the same productivity of white oyster mushrooms.

CONCLUSION

The statistical analysis showed that there was no influence of rice straw addition in a planted media on the oyster mushroomgrowth. 15% : 60% was the concentration of rice straw addition which can substitute the sawdust in planted media of oyster mushroom.

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