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Study of Feeding Preference of Subterranean Termites (*Coptotermes curvignathus* Holmgren) on Wood Decaying Fungi

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Abstract

Subterranean termites, *Coptotermes curvignathus* (Holmgren) is the most important termite which caused economic losses is very high in Indonesia and other tropical regions. In this studies, the feeding preferences of the subterranean termite, *C. curvignathus* for decayed wood by some wood rotting fungus were examined to determine whether the presence of wood rotting fungus could alter the relative preference of termites for these decayed wood. The study is expected to find phagostimulant compounds for the development of termite control by baiting techniques. The results showed that, the decayed wood process by the *P. ostreotus* fungi higher rate of decay compared with other fungus (10.86 $\pm$ 2.21%), *S. commune* (10.29 $\pm$ 1.86%), *P. chrysosporium* (6.19 $\pm$1.56%) and *Dacriopinac sp* (5.02 $\pm$ 0.95%). Meanwhile, the lowest rate of decay by the *T. versicolor* fungi (4.25 + 0.93%). Based on the results of this stuies the feeding preference of *C. curvigntahus* on decayed wood by the *P. ostreatus* fungi and *S. commune* fungi is higher than the decayed wood by other wood rotting fungus.

Keywords: phagostimulan, feeding preference, fungi, termites, decay.

1. Introduction

Subterranean termites an economically important insect for causing huge economic losses. Subterranean termites, especially those from the subfamily Rhinotermitinae (*Coptotermes spp*) are found to be attacking buildings in urban area [1] and buildings in rural or suburban areas [1, 2]. *Coptotermes sp* is a common and most important pest species of wooden building in Asia. According several of studies [3-6] that, subterranean termite *Coptotermes sp* was the most dominant pest species found infesting about 70% attacking on building. It cause economic loss million US dollars every year. Such as, in the United States termites cause economic loss of two million US dollars every year [7]. In Japan, hundreds of millions of US dollars per year is spent on prevention and control of termites [8, 9]. Meanwhile in Indonesia, according Kuswanto et al. [10] economic loss due to termite attack is estimated to reach more than 1.6 billion US dollars per year.

At this time, there are two different approaches in termite control, viz. the application of termiticide and termite control using bait toxicant. Although the use of termiticide is still the most widely used, but the use of bait toxicant began to be used widely, especially in buildings is technically difficult to control with termiticide application. Termiticide in the form of baits toxicant are more environmentally friendly, because the target is specific and active ingredients are not exposed widely [11]. The active ingredients are formulated in the form of bait and generally includes a group of insect growth regulators such as diflubenzoron and hexaflumuron [12, 13], noviflumuron [14], bistrifluron [15], sulfuramid [16] and others. While it is believed that one of the requirements of the success of baits toxicant is how develop the bait preferred to termite. Several studies have been done to improve the feeding preference of termites such as the use of essential amino acids [17] or the use of xylose, fructose, and ribose [18].

Compounds derived from decayed wood has the potential to be developed as phagostimulan that useful for development of termite bait toxicant formulation. Many termites showed low interest in the wood that has been decayed by many fungi. The cellulose, hemicellulose and lignin components of decayed wood occured degradation by fungi. Under circumstances suitable for the development of decay, wood can deteriorate faster. Three general types of decay are white rot, brown rot and soft rot [19, 20]. These fungi are able to metabolize photodegraded lignin, holocellulose and derived sugars [21, 22]. Moreover, according by Takahashi [23], wood rotting fungi have a very specific enzyme system capable of degrading wood polymers into digestible units.

The main objective of the present study was to test different decayed wood by many fungi as phagostimulants for management of *C. curvignathus* Holmgren.

2. Experimental

2.1. Preparation of mono culture decay and wood sample test

Sterile petri dishes were prepared, filled to 15 to 20 ml of sterile nutrient chloramphenicol was added to 250 mg/500 ml for nutrition. After that freeze nutrition, mushrooms taken from each of the isolation of fungi, using a loop and kept at the center of nutrient agar in a petri dish planted only one type of fungi, a petri dish was kept at room temperature for approximately 14 days.

Pine wood (*Pinus merkusi* Jung et De Vrise) peeled fresh cut, discarded wooden eyes, then cut to a size of 2 cm x 1 cm x 1 cm. Test the wood is boiled and air dried, then, numbered and weighed wet weight and oven-dried (102^{o}C ± 2^{o} C) for 24 hours, weighed again to obtain dry weight.

2.2. Decay test

Feeding wood into the test fungi in pure culture tests carried out for two months based on ASTM standard D 2017 (Figure 1). Decay rate can be calculated using the equation:

$$\text{Weight losses} = [(W_1 - W_2)/W_2] \times 100\% \quad (1)$$

where, W_1 is dryweight of wood before fed to the fungus test and W_2 is weight of drywood is fed into the mold after test.

Figure 1. Decay Test with ASTM D2017 (ASTM, 1995)

2.3. Feeding Preference Test

Feeding preference test based Modiefield Wood Block Test (MWBT) standard, which is a test meal with no choice . Unit testing with Modiefield Wood Block Test (MWBT) standards is presented in Figure 2.

Test parameters is the feeding preference was percent weight loss of wood that shows the amount of feed consumed by termites for testing. Percentage weight loss of wood after being fed on termites can be calculated using the equation:

$$\text{Weight losses} = [(W_1 - W_2)/W_2] \times 100\% \quad (2)$$

where, W_1 is dryweight of wood before termite exposed and W_2 is weight of wood after termite exposed.

Figure 2. No choice test

3. Results and Discussion

3.1. Wood Decay Test

The results showed that weight loss due to decay by the fungus *S. commune, Dacriopinac sp, P. ostreotus, T. versicolor* and *P. chrysosporium* in a row is 10.29 ± 1.86%, 5.02 ± 0.95%, 10.86 ± 2.21%, 4.25 ± 0.93% and 6.19 ± 1.56%, respectively. Examples of pure cultures and decay of wood in each treatment are presented in Figure 3. Schematically, the test results by each type of wood decay fungi are presented in Figure 4.

Next to see the effect of treatment by several types of wood decay fungi is to lose weight range analyzed (Table 1). Based on the analysis ov various different types of fungi effect weight loss of wood due to decaying. Decaying of wood by fungi decay *P. Ostreotus* higher compared with other fungi (10.86 ± 2.21%) and decay fungi *Dacriopinac sp* (5.02 ± 0.95%). Meanwhile, the lowest rate of decay fungi by fungus decay *T. Versicolor* (4.25 ± 0.93%).

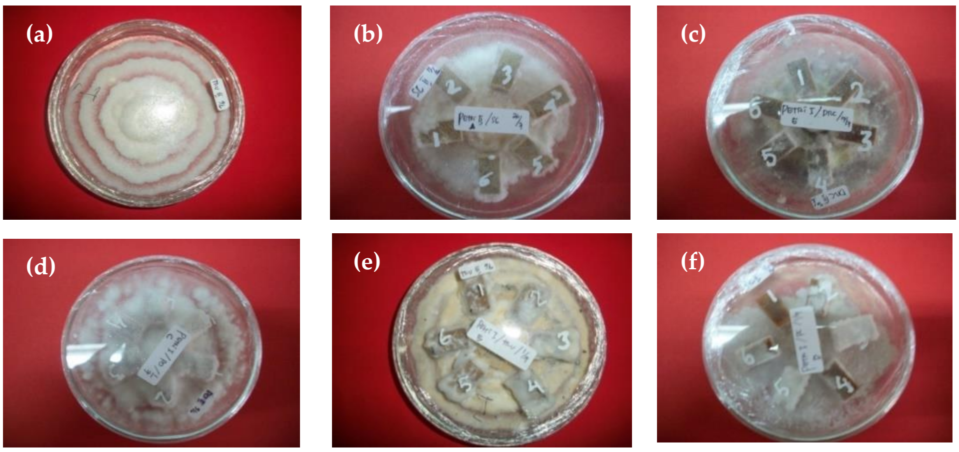

Figure 3. Pure mushroom culture of decay fungal (a) wood by decay conditions (b) *S.commune;* (c) *Dacriopinac sp;* (d) *P. Ostreotus;* (e) *T. Versicolor;* (f) *P.chrysosorium*

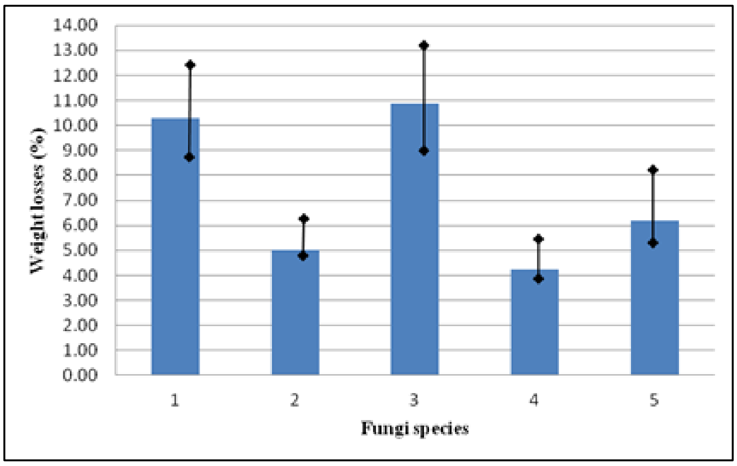

Figure 4. Weight losses by wood decay fungi. (1). *S. commune;* (2) *Dacriopinac sp;* (3) *P. ostreotus;* (4). *T. Versicolor;* (5). *P. chrysosporium*

Table 1. Summary of Analysis of Variance (ANOVA) Effect of Fungus Types Of Weight Losses of Wood Decay (%)*

Source	SS	DF	MS	*F*	*P*
BG	72.358	4.00	18.090	22.178	0.00
WG	20.391	25.00	0.816		
Total	92.749	29.00			

Notes: SS: sums of squares; DF: degree of freedom; MS: means of squares; *F*: the ANOVA test static; *p:* probability of the correlation's treatments; BG: between the groups; WG: within the groups were significant at 95% ($p \leq 0.05$)

Types of fungi give a significant influence on weight loss of decay wood due attack of fungus, then performed further tests to see the difference between Duncan's fate (Table 2).

Table 2. Duncan Mean Value Test

Treatment	Fungi Groups	Weight losses, % (X ± SD)*
Trametes versicolor	White rot fungi	4.25 ± 0.93 a)
Dacriopinac sp	Brown rot fungi	5.02 ± 0.95 a)
Phanaerochaete chrysosporium	White rot fungi	6.19 ± 1.56 a)
S. commune,	White rot fungi	10.29 ± 1.86 b)
Pleorotus ostreotus	White rot fungi	10.86± 2.21 b)

Notes: X: mean value; SD: standard deviation

Duncan test results further indicate that the fungus *P. ostreotus* (10.86 + 2.21%) and fungi *S. commune* (10.29 + 1.86%) were not significantly different, but significantly different from the other three kinds of mushrooms, the fungi *P.chrysosporium* (6.19 +1.56%); *Dacriopinac sp* (5.02 + 0.95%) and fungi *T. versicolor* (4.25 + 0.93%).

Decay wooden mold growth is highly dependent on the substrate and environmental conditions such as temperature, oxygen supply, wood moisture content, moisture, and nutrients are available [24]. Under favorable conditions, mildew is growing very rapidly at the crack of wood with hyphal growth. The easiest path for the development of parenchyma and lumina of the hyphae are vessel cells. The move from one cell to another occurs by penetration with a dot or through cell walls. Differences in weight loss of wood due to wood decay by fungi pelapuk alleged by the differences in the ability of the secreted enzime degrade hyphae in wood cell components, especially lignin and fungal tolenrasi level of substare ekstraftif particularly to substances in the specimen timber. For example, the activity of fungal degradation of wood by white rot *S.commune* and *P.ostreotus*, involving enzime such as laccase, peroxidase, and tyrosinase in which the role will involve enzime to degrade lignin. Enzymes break down the lignin component into simpler compounds that impart diabsorsi or ingested mushrooms.

Weight loss rate is low due to decaying of wood by fungi and fungal of *Dacriopinac sp* and *T. versicolor* presumably due to low tolerance compared to other fungal species of wood ekstratif substances in test samples. Several studies have shown both types of fungi are very good growth in a growing medium for fungal growth but specifically inhibited in fresh woods where high extractives content. Effect of extractive substances of wood on fungal growth can also be differences in the growth of mold different parts of the timber, wood loses weight in part due to decay by fungi where high extractive substances is lower than the edge of the wood weight loss [25].

3.2. Feeding preference of termite

Feeding preference of *C. Curvignathus* against wood rot differs in any wood rot fungi by some type of wood as shown by the difference in weight loss of wood. Successive levels of weight loss are as follows rotten wood by the fungus *S. Commune* (10.75 ± 3.28%); *Dacriopinac sp* (7.17 ± 1.33%); *P.ostreatus* (13.30 ±2.43%); *P.chysosporium* (5.69 ± 1.80%) and controls (8.00 ± 1.92%). Schematically percent weight loss of damage wood by *C. curvignathus* presented in Figure 5.

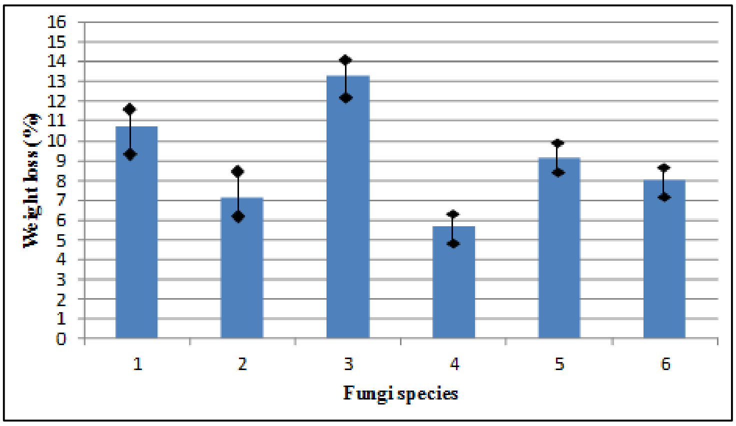

Figure 5. Weight Loss (%) by *C. Curvignathus* in fungi species: 1). *S. commune;* 2) *Dacriopinac sp,* 3) *P. ostreotus;* 4). *T. versicolor,* dan 5). *P. chrysosporium,* 6) Control

4. Conclusions

Wooden stakes of Pinus sp. decayed by *P. ostreotus* was significantly preferred over other species fungi and decay fungi Dacriopinac sp. Meanwhile, the lowest rate of decay fungi by fungus decay T. Versicolor. Weight loss rate is low due to decaying of wood by fungi and fungal of *Dacriopinac sp* and *T. versicolor* due to low tolerance compared to other fungal species of wood ekstratif substances in test samples. Various organic components of decayed wood have been suggested to act as termite phagostimulants. Populations of *Coptotermes curvignathus* differ in their response to potential phagostimulants.

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