DECAY RESISTANCE BETWEEN SAPWOOD AND HEARTWOOD OF *Parashorea malaanonan*

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Abstract: Parashorea malaanonan (locally known as 'Urat Mata Daun Licin') is a high-quality commercial light hardwood in Sabah. The stem of the species however often considered as more prune to infection by wood degrading agents such as decay fungi and also stem borers, as compared to other species in the dipterocarp forest. In relation to this, variation in resistance between the outer and inner portions of the stem is a subject of interest. In this study, we used agar-block test method to measure the weight loss in the sapwood and heartwood of *P. malaanonan* following 12 and 24 weeks exposure to *Gloeophyllum* sp., which was isolated from decayed wound of the host species. Variation was observed in weight loss between the two wood types and in general weight loss was greater in the sapwood than the heartwood wood blocks tested. Mean weight loss was however differ significantly at 24 weeks incubation (38.9±0.1% and 28.3±0.1%, respectively). The result corresponds to the general understanding that thinner wood cell wall in the developing sapwood making it more easily degradable compared to the heartwood.

INTRODUCTION

Parashorea malaanonan is a high-quality light hardwood of Sabah for various structural and panelling utilities. In 1999, it contributes about 17% of timber earning to the state, whilst the other sector is shared by more than 70 other species (Forest Department Sabah, 1999) [4].

Unlike other timber species, the *Parashorea* logs (locally known as 'Urat Mata Daun Licin'), will normally be debarked soon after felling as practiced in Sabah. This is to expedite surface drying so that to minimise vulnerability especially to the woodborers. The stem of the species often judged as more susceptible to infection by wood degrading agents including wood decay fungi compared to other timber species in the dipterocarp forest. In relation to this, variation in resistance between the outer and inner portions of the stem is, therefore, a subject of interest.

The aim of the study was to compare the resistance between the sapwood and heartwood of the *P. malaanonan* degraded by wood decay fungi previously isolated from the decayed wound of the species.

MATERIALS AND METHODS

Preparation of fungal cultures and wood blocks was in accordance with the published procedure (e.g. British Standards Institution, 1961; Building Research Establishment, 1972) [2,3].

Preparation of fungal culture: An isolate on *Gloeophyllum* sp., previously isolated from decayed wound of *P. malaanonan* in eastern Sabah, was used. Fungal culture was prepared by aseptically transferring 5 mm diam. plug of agar plus mycelium cut from actively growing culture of the test isolates into 175 ml autoclaved glass jar slope of potato dextrose agar (PDA; Sigma). Cultures were incubated at 25 °C for 10-14 days in darkness.

Preparation of wood blocks and inoculation: Wood discs taken from healthy stems of *P. malaanonan* (DBH = 39.5 - 65.0 cm) in Ulu Segama Forest Reserve, Sabah were cut into 1 cm x 1 cm x 2 cm blocks of both sapwood and heartwood using a bench-saw. Blocks were labelled by cutting a "V"-shaped notch indicating the replicate number and then oven dried at 60°C for 48 hrs, weighed and sterilized twice by autoclaving at 150 kPa in distilled water at 121°C for 21 min with a 12-hr interval between autoclaving. Blocks were surface dried in a laminar flow hood and placed onto pre-prepared fungal cultures. Blocks placed onto uncolonized media served as controls.

Five replicate culture jars, each containing three blocks was prepared for each of sapwood and heartwood wood blocks. All jars were incubated at 25 °C in darkness before harvested at 12 and 24 weeks periods. During each harvest, blocks were brushed clean of mycelium and oven-dried at 60°C for 48 hrs, and then weighed. Percent weight loss due to decay was expressed as a percentage of original oven-dried weight.

All data (i.e. percent weight loss) were arc-transformed (following Zar, 1996) [9] for analysis but back-transformed to present the results. To confirm that the experiment was free from contamination, data from control blocks were subject to ANOVA which showed no significant weight loss. These data (from the control) were excluded from further analysis. A significance level of 0.05 was used to reject the null hypothesis.

RESULTS

Control wood blocks did not significantly change in percent weight loss (range = 0.57-3.98%) over time in sapwood and heartwood of *P. malaanonan* ($F_{(1,18)}$=0.498, P=0.498).

Comparison of *P. malanonan* heartwood and sapwood data exposed to fungi showed that wood type and temporal factors influenced the weight loss of wood blocks examined (Table 1).

Table 1 ANOVA table for the weight loss of wood blocks in heartwood and sapwoods of *Parashorea malaanonan* after 12 and 24 weeks exposure to *Gleoephylium* sp. Dependent variable of percent weight loss was transformed with arcsine (square root (proportion of weight loss)).

Source of variation	SS	Df	MS	F	P
WOODTYPE	0.032	1	0.032	5.673	0.030
TEMPORAL	0.082	1	0.082	14.536	0.002
WOODTYPE X TEMPORAL	0.005	1	0.005	0.924	0.351
Error	0.089	16	0.006		

Weight loss was relatively greater in sapwood than in the heartwood (Figure 1). The mean differences, however, was only significant at 24 weeks observation ($F_{(1,8)}$=10.935, P=0.011). Sapwood and heartwood weight losses during week 12 were 24.12 (SE=0.003)% and 20.16 (SE=0.014)%, and at week 24 were 38.9 (SE=0.003)% and 28.34 (SE=0.003)% respectively.

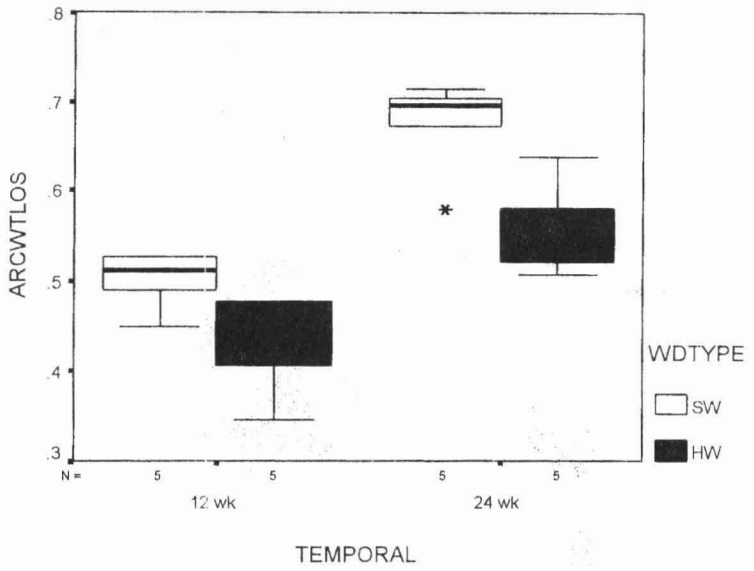

Figure 1 Weight loss variation in *Parashorea* sapwood and heartwood wood blocks by isolate *Gloeophyllum* sp. after 12 week and 24 weeks incubation periods. The dependent variable of percent weight loss was arcsine (square root (proportion of weight loss)) transformed. (n replicates = 5).

DISCUSSION AND CONCLUSION

The sapwood showed more weight loss compared to the heartwood upon exposure to *Gloeophyllum* sp. cultures. Essentially, where fungi utilized the wood carbohydrate and degrade the complex cell wall polymers of lignin, cellulose and hemicellulose through production of extracellular enzymes, structural degradation and weight loss of the wood block are substantial (Rayner & Boddy, 1988) [7].

The present result of higher decay in sapwood compared to the heartwood of *P. malaanonan* was in line with the general understanding that sapwood are more susceptible to degradation by fungi (e.g. Rayner & Boddy, 1988) [7]. Lacking in some metabolic compounds such as phytoalexin and other phenolic extractives for protection against decay fungi, compared to the heartwood (Pearce and Woodward, 1986; Rayner & Boddy, 1988) [6,7] could influence the receptiveness of sapwood.

The resource quality aspects which denotes the physico-chemical properties of wood of a particular species (Rayner & Boddy, 1998) [7] may also intrinsically affected wood degradation by fungi. Such influence might be significant on patterns of degradation by certain fungi on the middle lamella, the primary wall and the S_1, S_2 and S_3 layers of the secondary walls of wood (Shigo & Marx, 1977 [8]; Rayner & Boddy, 1998) [7]. On this respect, decay development would be much related to the aspects of hosts' wood anatomy.

Panshin & DeZeeuw (1980) [5] noticed only slight variations between sapwood and heartwood cells composition in stem however the younger and more actively expanding cambial wood at sapwood may have thinner cell walls than the older heartwood region. Micromorphological observation of the decay of *P. malaanonan* (Sudin, unpublished) showed that during the process degradation of ray parenchyma and thinning or shrunken of tracheids cell wall extensive degradation of the tracheid wall in contact with ray parenchyma cells. Ander & Eriksson (1977) [1], who investigate decay with various white rot fungi suggested some carbohydrate loss must occur concurrently with lignin decomposition. This caused loss in weight of a unit of wood mass, which was used as index of wood degradation in *in vitro* studies.

The study showed that the longer exposure of wood substrates, the wider will be the gap in the weight loss between the sapwood and heartwood of *P. malanonan* due to fungal degradation. In the process of decay, lignin is degraded and over time, it could certainly cause losses to both woods in service as well as in standing trees. In contrast, however, if enzymatic activity of the fungi could be manipulated to delignify all woody tissue equally, an excellent biological pulping process for paper making industry and superb bioremediation agents that degrade pollutants to water and soils, could be utilized.

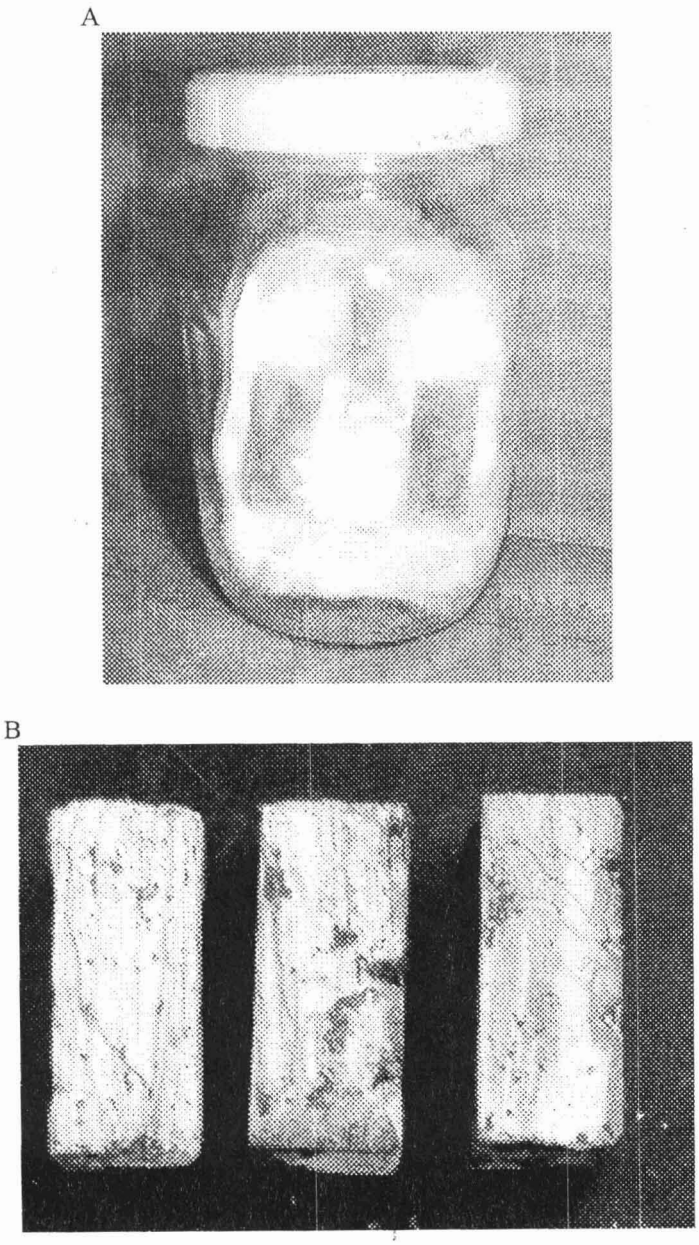

Figure 2 *In vitro* fungal degradation resulting in weight loss of test wood blocks of P. malaanonan after 24-wk incubation. A) Position of wood blocks in culture and B) wood blocks freshly removed and brushed clean of mycelium of isolate of *Gloeophyllum* sp.)

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