Pertanika 6(3), 28–31 (1983)

# Responses to Wood and Wood Extractives of *Neobalanocarpus heimii* and *Shorea ovalis* by the drywood termite, *Cryptotermes cynocephalus* (Isoptera : Kalotermitidae)

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Key words: *Neobalanocarpus heimii, Cryptotermes cynocephalus; Shorea ovalis;* **extractives.**

## RINGKASAN

*Anai-anai kayu kering,* Cryptotermes cynocephalus *Light didedahkan keatas ketul-ketul kayu dan ekstraktif kayu* Neobalanocarpus heimii *King dan* Shorea ovalis *Korth.)* Bl. *Keputusannya menunjukkan kemandirian anai-anai dan kayu yang dimakan adalah lebih banyak berlaku di atas kayu* S. ovalis *dari kayu* N. heimii. *Ujian dengan habuk kayu diekstrak dan tidak diekstrak, dan kertas turas dirawat dengan ekstratif juga memberi kesan yang sama. Ini menunjukkan satu faktor mempengaruhi kerentanan relatif bagi kayu terhadap serangan anai-anai ialah sebatian sekundar terhadap dalam kayu.*

## SUMMARY

*Drywood termites,* Cryptotermes cynocephalus *Light, were exposed to wood blocks and wood extractives of* Neobalanocarpus heimii *King and* Shorea ovalis *Korth.)* Bl. *The results showed that the termites' survival and wood consumption were significantly higher on* S. ovalis *than on* N. heimii. *Termite survival and feeding response obtained on bioassays with sawdust, extracted sawdusts and extract treated filter paper, indicated that one factor affecting the variation in relative susceptibility of the woods to termite attack could be secondary compounds present in the wood.*

## INTRODUCTION

Most timbers are susceptible to drywood termites and very few are resistant to attack. The degree of susceptibility varies from species to species. Many reports attribute this relative susceptibility to wood hardness and to the quality and quantity of chemical components and extractives present in the wood (Wolcott 1957; Rudman and Gay 1967; Carter and Smythe 1974 and Aktar 1981). In this preliminary study, it was decided to examine by forced feeding, the relative susceptibility of two common Malaysian timbers, Chengal *(Neobalanocarpus heimii)* and Meranti Kepong *(Shorea ovalis),* to the drywood termite, *Cryptotermes cynocephalus* Light. The physical and chemical properties of the woods were also assessed so as to relate these properties to their relative susceptibility to termite attack.

Chengal is a heavy hardwood, very durable and commonly used for columns, beams and flooring materials, whereas Meranti Kepong is a light red meranti of light hardwood, moderately durable and widely used for wall sheathing, door and window frames and plywood production.

## MATERIALS AND METHODS

*Termite*

*Cryptotermes cynocephalus* Light (Kalotermitidae) was selected for the experiments because it is one of the most common drywood termites in Peninsular Malaysia (Tho, 1982). In this study, the termites were collected from an infested timber of a rural house in Bukit Badong, Selangor. The pseudergates were removed from the timber and were kept on filter paper for 24 hours. Only active individuals were selected for the tests.

*Wood and Wood Hardness*

For each species, samples were prepared from a piece of heartwood which was purchased from a local sawmill. Blocks about 25mm x 25mm x 20mm were cut from the board and the remainder was used for chemical component analysis, sawdust preparations and recovery of extractives. The hardness of the woods was tested on sample

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of 50mm × 50mm × 150mm according to ASTM D 143–52.

*Extractive Recovery and Wood Component Analysis*

For this purpose, the wood of each species was chipped and ground in a Wiley mill. The sawdust was sieved through a No. 60 (250 μm) sieve and retained on a No. 80 (180 μm) sieve. Because no generalized procedure for extraction of antitermitic materials from tropical wood has been established, the ethanol-benzene extraction technique, which is commonly used for removal of extractive in hardwoods, was adopted in this study (ASTM D 1105–56). A 30gm sample of sawdust of each wood was placed in a thimble and extracted in a soxhlet apparatus. The extracts were collected in Erlenmeyer flasks and kept in a frigerator for subsequent tests. A portion of extracted sawdust was saved for bioassay and the remainder was used for wood chemical components analysis; i.e., holocellulose (ASTM D 1104–56), lignin (ASTM D 1106–56) and ash (ASTM D 1102–56). For each analysis five replicates were used.

*Survival and Feeding on Wood Blocks*

Termite survival and feeding response on wood blocks were tested in an experimental arrangement described by Low (1980). Wood blocks were air-dried for three days and weighed. Ten blocks were tested for each wood; 50 pseudergates were confined to each block and maintained at 28° ± 2°C and 90% relative humidity. Weekly observations were made during the exposure period. After ten weeks the test was terminated and surviving termites were counted. Each block was again air dried and reweighed. Wood mass loss was used for a measure of the wood relative susceptibility.

*Test with Sawdust and Wood Extracts*

Small pieces (3cm diameter) of Whatman filter paper were dipped in extract solution, dried at room temperature for 48 hr and weighed. Ethanol-benzene solvent treated and untreated filter papers were used as controls. Samples (0.5gm) of extracted sawdust and unextracted sawdust, treated and untreated filter papers were placed separately in plastic containers (5cm diameter and 1.8cm high) and 20 pseudergates were released into each container. The test materials were kept in a dark chamber maintained at 28° ± 2°C and 90% relative humidity. Five replicates were used for each test material. Daily observations were made and dead termites were discarded. After four weeks, the numbers of surviving termites were recorded and the filter papers were air-dried and reweighed.

## RESULTS AND DISCUSSION

*Physical and Chemical Properties*

The hardness and the chemical constituents of Chengal and Meranti Kepong are shown in Table 1. Chengal was apparently harder and denser than Meranti Kepong. Comparatively, Chengal contains greater percentages of extractive and holocellulose than Meranti Kepong. In terms of extractive content, the difference between the two species is particularly marked.

TABLE 1
Physical and chemical properties of *S. ovalis* and *N. heimii*

| Properties | Wood Species | |
|---|---|---|
| | *S. ovalis* | *N. heimii* |
| Specific Gravity | 0.54 | 0.94 |
| *Hardness* (Kilo Newton) | | |
| Radial | 2.33 | 5.79 |
| Tangential | 2.53 | 5.81 |
| End | 3.26 | 6.53 |
| *Chemical constituent* (%) | | |
| Holocellulose | 68.10 | 76.80 |
| Lignin | 26.20 | 20.80 |
| Ash | 0.28 | 0.41 |
| Extractive | 1.94 | 20.60 |

*Termite Survival and Feeding on Wood Blocks*

Results of the test showed that *C. cynocephalus* survived higher on the Meranti Kepong than on Chengal wood blocks (Table 2). Respectively, for Chengal and Meranti Kepong, termite survival was 89% and 96% at the end of the first week but dropped to 12% and 32% at the end of the sixth week. At the end of the tenth week, termite survival averaged 3% and 12% on the two woods and the corresponding block weight losses were 67mg and 143mg, respectively. Survival of the unfed termites in the starvation controls was 5%.

Comparison of visual damage of the blocks indicated differences in feeding activity by the termites. Tunnelling as deep as 5mm to 10mm was evident on all Meranti Kepong wood blocks in contrast to Chengal wood blocks where only gnawing marks were observed.

*Termite Survival and Feeding on Sawdust and Extractives*

The bioassays with sawdust, extracted sawdust and treated filter paper indicated that *C. cynocephalus* survived significantly better on Meranti Kepong than on the Chengal test material (Table 3). Highest survival (76%) was obtained from Meranti Kepong extracted sawdust whereas the lowest survival (13%) was from Chengal unextracted sawdust. On extract-treated filter paper, termite survival was 17% higher and paper consumption two times greater on Meranti Kepong than on Chengal treatments.

However, differences in survival on extracted sawdust and extract-treated filter paper were not significant for either Meranti Kepong or Chengal. This could be due to the incomplete extraction of the antitermitic compounds from the sawdust. The alcohol-benzene solvent did remove some antitermitic compounds from the treated woods, as it was observed that the extracted sawdust significantly improved the termite survival when compared with the unextracted sawdust.

Many factors have been considered to be the cause of variation among wood in resistance to

TABLE 2

Mean[1] percent survival and feeding of *C. cynocephalus* on *S. ovalis* and *N. heimii* wood blocks for 1 to 10 weeks.

| Wood | Survival Weeks | | | | | | Wood eaten after 10 weeks | |
|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 4 | 6 | 8 | 10 | mg | % |
| *S. ovalis* | 96 | 81 | 54 | 32 | 23 | 12 | 143 | 2.5 |
| *N. heimii* | 89 | 59 | 38 | 12 | 6 | 3 | 67 | 0.5 |
| [2] Control | 71 | 63 | 43 | 18 | 10 | 5 | – | – |

[1] Means of 10 replicates of wood samples.

[2] Without wood block (starvation control).

TABLE 3

Mean[1] percent survival and feeding of *C. cynocephalus* after 4 weeks on different test materials of *S. ovalis* and *N. heimii.*

| Test materials | Survival (%)[2] | | Feeding (mg) | |
|---|---|---|---|---|
| | *S. ovalis* | *N. heimii* | *S. ovalis* | *N. heimii* |
| Sawdust | 59 bc | 13 a | – | – |
| Extracted sawdust | 76 d | 55 bc | – | – |
| Extract on filter paper | 64 cd | 47 b | 6.32 | 3.12 |
| Solvent on filter paper | 79 d | | 11.02 | |
| Filter paper | 71 dc | | 10.2 | |

[1] Means of 5 replicates.

[2] Percentage values followed by the same letter are not significantly different at the 0.05 level of probability (Duncan's Multiple Range Test).

termites. In a wood composite, these factors are inseparable and complementary in their effects to termites. One factor is hardness which affects the termite chewing ability (Behr *et al.,* 1972). In this test, termites ate less wood from the harder Chengal wood than from Meranti Kepong wood. The other factor is secondary compounds extractives present in the wood which make the wood distasteful, repellent or toxic to termites (Wolcott 1957; Yazaki and Hillis 1977). Thus, it could be suggested from this preliminary study that the differences in the relative susceptibility to termites between Chengal and Meranti Kepong could be due to differences in wood hardness and the presence of antitermitic compounds in the wood.

## ACKNOWLEDGEMENT

The authors wish to record their thanks to Dr. Kamis Awang for reviewing the manuscript and Assoc. Prof. Mohd. Zin Jusoh, Dean, Faculty, of Forestry, Universiti Pertanian Malaysia, for the facilities in the conduct of this study.

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*(Received 9 May 1983)*