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Name of Candidate: Partiban S/O Subramanian (I.C. No: 780427-02-5507)

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Development of biological agents using *Chrysanthemum indicum* (Asteraceae) and
Alpinia galanga (Zingiberaceae) against *Coptotermes gestroi*, *Coptotermes*
curvignathus and *Macrotermes carbonarius*.

Field of Study: Applied Entomology

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Abstract

The antifeedant effects studies of *Alpinia galanga* rhizome and *Chrysanthemum indicum* on *Coptotermes gestroi*, *Coptotermus curvignathus* and *Macrotermus carbonarius* were conducted in the laboratory. Dual choice bioassays were conducted using methanolic extract and essential oil of *A. galanga*. Two paper discs (4.0 cm diameter) were placed in Petri dishes (9 cm diameter). One disc treated with *A. galanga* or *C. indicum* extract and another disc was treated with solvent hexane or methanol as control. Ten termites were placed in the treated petri dish. Percentage of antifeedant was determined by calculating the difference in the paper consumption of treated and control. Data was analysed statistically using ANOVA. Both *A. galanga* and *C. indicum* oil showed antifeedant effects on *C. gestroi*, *C. curvignathus* and *M. carbonarius* adults. 2000 ppm of *A. galanga* and *C. indicum* essential oil was considered as optimum concentration that gave maximum antifeedant effect. The essential oil composition was determined using Gas Chromatography and Gas Chromatography Mass Spectrometry (GCMS). The major compound of the essential oil of *Alpinia galanga* is 1,8-cineol (44.75%) whereas Germacrene D (14.07%) is the major compound of the essential of *C. indicum*. The antifeedant activity of *A. galanga* essential oil is due to 1,8-cineol. Bioassay with synthetic compound, 1,8-cineol shows 200 ppm concentration is the optimum concentration that can cause antifeedant effect on *C. gestroi* after 24 hours of exposure. However, for synthetic farnesene, 500 ppm concentration is the minimum concentration that can cause antifeedant effect on *C. gestroi*. In *C. curvignathus*, 500 ppm 1,8-cineol and 500 ppm farnesene is considered as minimum concentration that can cause antifeedant effect. Similarly, 500 ppm 1,8-cineol is considered as the minimum concentration that can cause antifeedant effect on *M. carbonarius* and 1000 ppm considered as the minimum concentration that can cause antifeedant effect on *M.*

carbonarius in this study. Acute toxicity studies (ED_{50}) shows that *Macrotermes carbonarius* (ED_{50} =2512 and 1905) was more susceptible than *C. gestroi* and *C. curvignathus* to essential oils of *A. galanga* and *C. indicum*, synthetic compound (1, 8-cineol and farnesene, ED_{50} =259 and 2455 respectively) and commercial termiticide, chlorpyrifos (ED_{50} =174). All the three species of termites were significantly more susceptible towards the commercial termiticide, chlorpyrifos compared to the synthetic compound, 1, 8-cineol and farnesene. In the field application study on wood, 5000 ppm of 1,8-cineol and farnesene gave maximum antifeedant effect (89.47% and 67.77% respectively) on *C. gestroi* after 14 weeks. *Alpinia galanga* and *C. indicum* essential oils showed potential to be used as alternative control method against termite in sustainable agriculture practices.

Keywords: *Alpinia galanga*; Essential oil; *Coptotermes gestroi*; *Coptotermes curvignathus*; *Macrotermes carbonarius*; 1, 8-cineol; Farnesene; Chlorpyrifos; Termite antifeedant.

Abstrak

Satu kajian mengenai kesan-kesan anti-pemakanan daripada rizom *Alpinia galanga* dan *Chrysanthemum indicum* terhadap *Coptotermes gestroi*, *Coptotermus curvignathus* dan *Macrotermus carbonarius* telah dijalankan di makmal. Bioasei dua pilihan telah dijalankan dengan menggunakan ekstrak metanol dan minyak pati *A. galanga*. Dua cakera kertas (4.0 cm diameter) di letakkan di dalam piring petri (9 cm diameter). Satu cakera kertas dirawat dengan ekstrak *A. galanga* atau *C. indicum* dan cakera yang lain telah dirawat dengan larutan heksana atau metanol sebagai kawalan. Sepuluh ekor anai-anai telah diletakkan di dalam setiap piring petri. Peratusan anti-pemakanan telah ditentukan dengan mengira perbezaan dalam penggunaan kertas yang dirawat dan kawalan. Data telah dianalisa menggunakan ANOVA. Minyak pati daripada *A. galanga* dan *C. indicum* menunjukkan kesan anti-pemakanan pada *C. gestroi*, *C. curvignathus* dan *M. carbonarius*. Minyak pati *A. galanga* dan *C. indicum* yang kepekatan 2000 ppm dianggap sebagai kepekatan optimum yang memberi kesan anti-pemakanan yang maksimum. Komposisi minyak pati telah ditentukan dengan menggunakan Kromatografi Gas dan Kromatografi Gas-Spektroskopi Jisim. Sebatian utama minyak pati *A. galanga* adalah 1,8-cineol (44.75%), manakala sebatian utama minyak pati *C. indicum* adalah Germacrene D (14.07%). Aktiviti anti-pemakanan dari minyak pati *A. galanga* adalah disebabkan oleh 1,8-cineol. Bioasei dengan sebatian sintetik 1,8-cineol menunjukkan kepekatan 200 ppm ialah kepekatan optimum yang boleh menyebabkan kesan anti-pemakanan pada *C. gestroi* selepas 24 jam pendedahan. Walau bagaimanapun, bagi sebatian sintetik farnesene kepekatan 500 ppm ialah kepekatan minimum yang boleh menyebabkan kesan anti-pemakanan pada *C. gestroi*. Manakala bagi *C. curvignathus*, 500 ppm 1,8-cineol dan 500 ppm farnesene adalah kepekatan minimum yang boleh menyebabkan kesan anti-pemakanan. Begitu juga, 500 ppm 1,8-

cineol dianggap sebagai kepekatan minimum yang boleh menyebabkan kesan anti-pemakanan pada *M. carbonarius* dan 1000 ppm farnesene dianggap sebagai kepekatan minimum yang boleh menyebabkan kesan anti-pemakanan pada *M. carbonarius* dalam kajian ini. Kajian ketoksikan akut (ED_{50}) menunjukkan bahawa *M. carbonarius* (ED_{50} = 2512 dan 1905) adalah lebih sensitif berbanding *C. gestroi* dan *C. curvignathus* terhadap minyak pati (*A. galanga* dan *C. indicum*), sebatian sintetik (1, 8-cineol dan farnesene, ED_{50} =259 dan 2455) dan termitisid komersial, chlorpyrifos (ED_{50} =174). Ketiga-tiga spesies anai-anai adalah lebih sensitif kepada racun anai-anai komersial, chlorpyrifos, berbanding dengan sebatian sintetik, 1,8-cineol dan farnesene. Kajian aplikasi di lapangan pada kayu menunjukkan 5000 ppm 1,8- cineol dan farnesene memberi kesan anti-pemakanan maksimum (89.47% dan 67.77%, masing-masing) pada *C. gestroi* selepas 14 minggu. Minyak pati *A. galanga* and *C. indicum* menunjukkan potensi untuk digunakan sebagai kaedah kawalan alternatif terhadap anai-anai dalam amalan pertanian lestari.

Kata kunci: *Alpinia galanga*; Minyak pati; *Coptotermes gestroi*; *Coptotermes curvignathus*; *Macrotermes carbonarius*; 1, 8-cineol; Farnesene; Chlorpyrifos; Antimakan anai-anai.

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