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Research paper

The Bio-Efficacy of Crude Leaf Extract (Murraya Koenigii) as Botanical Termiticides Against Subterranean Termite, Coptotermes Gestroi

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Abstract

Termites are widely considered as destructive polyphagous insect pests that give problematic issues to the environment and health since chemical and synthetic termiticides are used persistently to control these insect pests. This has caused a great hazard to the environment due to the chemical residual effects. Therefore, the aim of this paper is to explore the toxicity of *Murraya Koenigii* crude leaf extract against subterranean termites. They are the typical species of termites that are responsible for the cause of damage to the manmade structures in Malaysia. In this study, a toxicity determination was conducted through five different concentrations of the *Murraya Koenigii* extract; with various measurement of 0.5, 1, 2.5, 5, and 10 mg/ml; to the termite species under laboratory conditions. From the observation, the crude leaf extract displays a significant anti termiticidal activity after two weeks of exposures to the post treatment. The termites responded differently to the filter papers that were treated with varying concentration of extracts beforehand. Consequently, the frequent exposures to the high concentration of the crude leaf extract will increase the mortality rates of the termites. Instead, the control group disclosed less than 5% of the mortality rates. Thus, the experiment shows that *Murraya Koenigii* crude leaf extraction exhibits significant insecticidal property against the termites since it contains a bioactive compound known as linalool that is responsible for termite control and termiticidal activity.

Keywords: *Murraya Koenigii; termiticidal activity; subterranean termite; linalool; crude leaves extract*

1. Introduction

There are more than 2600 different species of termites found on earth. They are categorized into three groups known as dampwood, drywood and subterranean termites [1]. However, the focus of this study is only on subterranean termite or *Coptotermes Gestroi*; a species that can be found at numerous parts of the world. It is recognized as a destructive insect pest that stretches negative impact to the economy of a country by causing serious damage to various wooden parts in structure of buildings, furniture, books and agricultural crops.

In recent years, many studies have been conducted to search for plant-based compound to act as an alternative synthetic termiticides to control the termites due to its low cost and the compound is environmentally friendly. Generally, billions of dollars are spent annually for the prevention measures of termite worldwide and Malaysia has spent more than 10 million dollars in 2003 only to curb this global issue [2].

Currently, there are several methods that have been used to control the termites. Those are termite baits, soil and wood treatments. Thus, the most common one is chemical insecticides. However, all these methods come with series of disadvantages. The previous studies indicated that the chemical control of termites was expensive, required to be handled by skillful labor [3] and was an ineffective due to the chemical preservatives sold in the market that were aimed only for individual species of termites [4]. Besides, the uncontrolled used of the chemical termiticides trigger the adverse effect to the ecosystem and may result in the death of non-target organisms [5]. Therefore, some of the chemicals control measures such as Persistent Organic Pollutants (POPs) that consist of DDT, aldrin, dieldrin, heptachlor and BHC are prohibited by Environmental Protecting Agency (EPA) [1].

Hence, an alternatives termite control has been considered to replace these chemical insecticides. To date, the use of plant extract as a common source of biopesticides has drawn great attention to researchers as the production of secondary metabolite since the plants are not directly involved in physiological or bio-chemical process [6]. Plant extracts have been reported to have repellent and toxic effect against termites [7] and could be promising alternatives to synthetic pesticides to reduce negative impacts towards human health and the environment in the future [8]. Furthermore, plant-based pesticide usually degrades in a short period of time [9]. Several studies have been carried out to evaluate the effectiveness of plant species on the termite control. There are leaves of *Jatropha Curcas, Carica Papaya, Piper Bettle, Curcuma Longa, Nerium Indicumi, Chenapodium Ambrosoids, Azadirachata Indica* and *Lantana Camara* [10]. However, to the

best of the researchers' knowledge, termiticidal activities of *Murraya Koenigii* leaves on the termites have yet to be reported.
Murraya Koenigii is also known as curry leaf tree which belongs to the family of *Rutaceae.* The characteristic of this plant is aromatic, pubescent, deciduous shrub or small tree and widely used in Peninsular Asia. It has been reported that *Murraya Koenigii* is one of the richest sources of carbazole alkaloids in medicinal plants [11]. This compound possesses various bioactivities such as anti-tumor, anti-oxidative, anti-hyperglycemic, antimicrobial, and anti-inflammatory effects [12]. It also contains significant amount of phenolic and flavonoid compounds that are phytoconstituents responsible for lipid lowering and anti-obesity activities because of strong antioxidant potential [13 – 15].
The phytochemical screening showed that the major compounds of *Muraya Koenigii* consist of linalool, elemol, geranyl acetate, myrcene, allo-ocimene, α-terpinene, β-ocimene and neryl acetate [16]. Linalool has been proven to act as antimicrobial, growth inhibition, contact poison and insect-repellent properties and it might be valuable for control of several insect pests including termites as reported by previous researchers [17-18]. The termiticidal activity of *Murraya Koenigii* could be resorted by the presence of at least two of these major constituents which are linalool and elemol as indicated in Table 1.

Table 1: Chemical composition (%) of the essential oil of *Murraya koenigii* leaves [19]

Compound	Oil (%)
Linalool	32.83
Elemol	7.44
Geranyl acetate	6.18
Myrcene	6.12
Allo-Ocimene	5.02
α-Terpinene	4.90
(E)-β-Ocimene	3.68
Neryl acetate	3.45

The aim of this study was to determine the termiticidal activity of crude extracts derived from *Murraya Koenigii* leaves against subterranean termite; *Coptotermes Gestroi*.

2. Material and methods

2.1. Termites collection

A colony of *Coptotermes Gestroi* was collected from a decaying book found at the library of Universiti Teknologi MARA Kuala Terengganu. It is considered as the natural habitat of termites and the book was brought to the laboratory. The book with the colony was kept and maintained in a plastic container and the moisture was sustained with the aid of a water-filled cotton wool-capped bottle affixed to the side of the container.

2.2. Plant extraction

The fresh leaves of *Murraya Koenigii* were collected around Kuala Terengganu, Malaysia. The raw leaves were washed, were dried under the sunlight and later they were grounded till they changed into powdered form. About 100 mL of deionized water, 70% of alcohol and acetone were added to each of the 20 g powdered form preserved in five covered glass beakers of 250ml for 12 h. Then, the extract was filtered through the Whatmann No. 1 filter paper, and the filtrate was evaporated by rotary evaporator at 40^{o} C to obtain the crude extract. The extract was kept in reagent bottles and refrigerated at 4^{o} C for further analysis.

2.3. Bioassay (toxicity determination)

The toxicity bioassay against *Coptotermes gestroi* was determined according to the method with slight modification [20]. The different concentrations of extracts; 0.5, 1.0, 2.5, 5.0 and 10.0 mg/ml were prepared and placed on separate Whatman filter paper strips cut into the Petri dish plate size (9 cm diameter x 1.5 cm high). A piece of filter paper treated with blank solvent was used as a negative control. Then, the solvent was removed from treated filter paper by air drying at room temperature. For the blank controls, the discs were treated with distilled water only. Green leaves were put into each Petri dish as food for the termites. A total of fifty active termites were introduced in the middle of the Petri dish. The tested petri dishes were covered, placed in an incubator and maintained in darkness at 26.5^{o} C and 80% relative humidity for 14 days. A few drops of water were periodically put onto the bottom edge of the dishes to maintain the moisture. Three replicates were made for each test sample and mortality of the termite was determined daily for about 14 days. The percentage termite mortality was calculated according to [21].
% Mortality = (Number of dead termite/Total number of termite) x 100%

3. Results and discussion

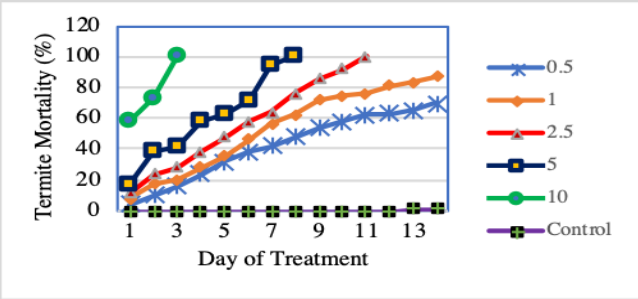

Fig. 1: Anti-termitic activities of crude leaf extract from *Murraya koenigii* against *Coptotermes gestroi* with various concentration.

Fig. 1 shows the percentage of termite mortality after being exposed to different concentrations of *Murraya Koenigii* crude leaf extract within 14 days of post treatment. High mortality of termites was obtained when high concentration of the leaf was used at 10 mg/mL. It showed that 100% of termites were dead after 3 days of exposure to the post treatment. The second was the concentration of 5 mg/mL that caused all termites to be dead at day 9 and the last one was the concentration of 2.5 mg/mL that caused the death of all the termites at day eleventh. Meanwhile, the concentration of 1 mg/ml and 0.5 mg/mL only caused the death of 87% and 70% termite respectively after 14 days in bioassay. As for the control treatment, the termites survived till the last days of the analysis and the mortality rates of the termites was only it only less than 5%. Besides, the feeding activity of the termites was reduced significantly, and the mortality rate was increased at large compared to the treatment given to the control group. Thus, the graph shows that the concentration of the leaf extract and the time of exposure are directly proportional to the mortality rate of termites. Hence, the more of exposure of termites to the in high concentration of the crude leaf extract will increase the rate of their mortality. From the analysis, it is confirmed that the extraction of *Murraya Koenigii* does contain bioactive compounds that are poisonous to the termites. The high concentration of linalool presents in *Murraya Koenigi* has too, been identified as the main component that triggers the toxicity of the substance. This data also suggests that *Murraya Koenigii* crude leaf extract can be another alternative to an eco-friendly and cost effective botanical termiticide.

4. Conclusion

In conclusion, the analysis of anti-termitic activity of crude leaf (*Murraya Koenigii)* extract showed differences depending on the level of concentration used. The higher mortality rate can be seen to be triggered by the higher concentration of treatment. The pre-

sented result also demonstrated that plant extracts are the best alternative to harmful chemical and synthetics termiticides and can be effectively used as anti-termitic agents. In future research, it would be recommended that anti-termite formulations with upgraded efficacy and stability should be further developed and evaluated.

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