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**INSECTICIDAL PROPERTY AND PHYTOCHEMICAL SCREENING OF
MAHOGANY (*Swietenia macrophylla* King) LEAVES, BARKS AND SEEDS
AS AN ALTERNATIVE INSECTICIDE AGAINST FUNGI GROWING
TERMITES [*Macrotermes gilvus* (HAGEN, 1858)]**

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ABSTRACT

The fungi growing termites (*Macrotermes gilvus*) is a damaging insect and are known to be a pest all over the world. Utilization of plant materials as insecticide is considered necessary because it is biodegradable and relatively safe for humans and animals. This study uses mahogany leaves, barks, and seeds as botanical insecticide. The effectiveness of six (6) extracts from mahogany; T₁ (50ml seed hot extract + 50ml distilled water), T₂ (100ml seed hot extract), T₃ (50 ml leaves hot extract + 50 ml distilled water), T₄ (100 ml leaves hot extract), T₅ (50 ml barks hot extract + 50 ml distilled water), and T₆ (100 ml barks hot extract), against termites were compared to a commercial pesticide, Solignum. The treatments were administered by spraying 5ml each to the termites. Phytochemical analysis showed the presence of essential oils, triterpenes, steroids, phenols, coumarines, tannins, alkaloids, flavonoids, anthrones, anthraquinones, fatty acids. Results showed that the use of extracts of mahogany leaves, barks,

and seeds as an insecticide against *M. gilvus* was found effective. The most effective treatment is T₄ (100 ml leaves hot extract) with mortality rate of 100% after 30-seconds of application.

Keywords: Insecticidal Property; Fungi-growing termites; Phytochemical Screening

INTRODUCTION

Mahogany (*S. macrophylla*) provides a number of functions including as shade for coffee and cacao trees, in making furniture such as cabinets, doors and decorative borders and medicines. Mahogany contains flavonoids and saponins and because of these compounds, mahogany's parts can be used as vitamins and drugs to reduce high blood pressure, hypertension, blood sugar disorder and fever. This plant is quite bitter and it has antipyretic and antifungal property. Additionally, most parts of the mahogany tree such as leaves, barks, and seeds can be used for controlling and killing insects and pests like mosquitoes, cockroaches, flies, moths, beetles, termites, and ants which may be harmful to people and can also destroy some of the plants and trees and their surroundings [1]. Termites belong to the group of insects (*Isoptera*), consisting of 2,600 species and 281 genera and it can be found in a vast range of terrestrial environments all over the world [2]. *Macrotermes gilvus* are social insects living in colonies comprised of a king, queen and soldiers. The king and their queen

perform the reproductive functions of the colony, while the workers carry on all aspects of colony maintenance [3]. Termites are one of the most damaging insects and they are known as pest all over the world. They are destructive in both agricultural and industrial field, causing heavy destruction yearly [4].

This study aimed to determine the effectiveness of mahogany seeds, barks and leaves extract as an alternative insecticide against termites. Specifically, the study aimed to: (1) determine the efficacy of mahogany extracts as an insecticide against termites, (2) determine what parts of the tree has the most potential as bio-pesticide and (3) identify the phytochemicals present in the different parts of mahogany.

MATERIALS AND METHODS

Source of Plant Specimen

Leaves, barks and seeds of *S. macrophylla* were collected inside Central Luzon State University, Science City of Munoz, Nueva Ecija, Philippines. All specimen were air dried for 3 days and was pulverized using a mortar pestle and a blender.

Collection of Test Insects

One thousand and fifty (1,050) *M. gilvus* were collected from selected location within Central Luzon State University. Cardboard trap method was used to collect the test insects [5]. The cardboard were cut into strips and were soaked into water. The cardboard strips were placed near the colony of termites so that the termites would go to it. Termites were acclimatized in a container for 24 hours prior to the experiment.

Preparation of Hot Water Extract

One hundred grams of each powdered mahogany seeds, leaves and barks added with 500ml of water were placed in water bath for 2 hours at 80° - 90°C. The extract was cooled and was filtered using a filter paper no.2. The extract were refrigerated until needed.

Insecticidal Property of *S. macrophylla*

The treatment was administered by spraying 5ml of each extracts into the killing boxes. The effectiveness of the applied treatments were determined by counting the number of dead termites in each treatment box. The observation was recorded every 10 seconds. Insects that were not moving when touched were considered dead. The insects' boxes were not touched and opened during experiment to avoid escaping of test termites.

Phytochemical Analysis

Phytochemical screening protocol of Guevarra et al. [6] was carried out to detect the secondary metabolites present in *S. macrophylla*. Extract was spotted on mark and labeled TLC (thin layer chromatography) 7 x 4 cm, and was developed in the acetatemethanol (7:3) mixture in the developing chamber. The spots for a certain metabolite were visualized on the TLC plates and were exposed under UV light and hot plate to check the separation of the different compound. For typical visualization of secondary metabolites, vannilin-sulfuric acid reagents were utilized. This solution can determine the presence of phenols, sterols, triterpenes and essential oils. Methanolic potassium hydroxide was used to test antraquinones, coumarins, and anthrones while phenolics compound and tannins were detected through the use of potassium ferricyanide-ferric chloride reagent. Dragendorff's reagent was used to spot alkaloids and antimony (III) chloride were used to detect the presence of flavonoids.

All samples were sent to the Chemistry Laboratory of the Center for Natural Science at St. Mary's University, Bayombong, NuevaViscaya for phytochemical screening.

Statistical Analysis

Gathered data were laid out using Completely Randomized Design with (CRD). Data were analyzed using One-way ANOVA test. Comparison among means was done using Duncan's Multiple Range Test at 5% level of significance.

RESULTS AND DISCUSSION

Phytochemical Analysis of *Swietenia macrohylla*

Table 1 shows the phytochemicals present in mahogany leaves, seeds and barks. These includes essential oils, triterpenes, steroids, phenols, coumarines, tannins, alkaloids, flavonoids, anthrones, anthraquinones and fatty acids are found in mahogany leaves. Anthrones and anthraquinones were not present in mahogany seeds. No fatty acids were detected from the seed and bark.

Mahogany's essential oil is effective as an insecticide against insects. Study shows that essential oil from mahogany is responsible against killing the termites and pod sucking bugs [7]. Phenols are also effective as an insecticide. Test showed that phenolic acids are effective against *Culex quinquefasciatus* larvae. Within 24 hour of application, mortality was recorded [8].

Coumarines are known for their

pharmacological properties, including being insecticidal [9]. Tannins are effective as an insecticide against soft-bodied insects such as spider mites, mealy bugs, white flies, termites, insect eggs and larvae. Saunders stated that his prepared extract has proven to be highly effective against soft-bodied insects yet no indication of toxicity to plants or animals has been found [10].

Flavonoids are potential insecticide synergists. Wang *et al.*, constructed an insecticide against Colorado potato beetle (CPB), and they found it very effective. They stated that the responsible compound in killing insects that was found in phytochemical analysis of conifer is flavonoids [11]. Plant extract containing alkaloids as bioactive constituents have played an important role in decreasing insects of agricultural and public health importance for centuries [12].

Anthraquinones and anthrones that are only found in barks and leaves of mahogany are found to be effective compound as an insecticide, perch deterrent, and chemical repellent. In the authors study, it was tested against mammals, insects and fishes. It was found to be operative as an insecticide [13].

Percentage Mortality

Percentage mortality of termites was computed by the number of dead insects

over the total population of termites in each boxes.

The percentage mortality of termites at every 10-seconds interval is shown in Table 2. The insecticidal effect of the treatments reconciled right after 10 seconds. On the first 10 – seconds interval of application, T₄ which was 100ml leaves hot water extract of mahogany were found to be the most effective treatment above all the extracts. It showed a mortality rate of 40.67% and it is significantly different with the control which was T₇ (solignum) that showed a mortality rate of 50.67%. While other treatments showed 30 % mortality for T₂, 28 % mortality for T₃, 20.67 % mortality for T₁, 12 % mortality for T₆, and 7.33 % mortality for T₅.

After 20 seconds of applying the treatments, T₄ attained a mortality rate of 74.67% which is comparable to the control, T₇ that attained a mortality of 75.33%. After 30 seconds, all termites were killed in the two treatments. While the other treatments, T₂ reached a mortality rate of 54% that is comparable to T₃ that reached a mortality rate of 52%. While T₁ showed 45.44% mortality and 28%

mortality for T₆. On 100 seconds of applying the treatments, all treatments showed a mortality rate of 100%. The effectiveness of the treatments from mahogany were due to the phytochemicals present in the leaves, barks and seeds. Phytochemicals present in mahogany such as flavonoids serves as a big impact in killing insects [11].

Behavior of Termites

The termites were placed in their respective killing boxes. When the different treatments of mahogany extract were sprayed on the killing boxes containing the termites, the test insects became mobile and walk through the boxes. After a few seconds, death of some termites started. The insects trembled and after several minutes they eventually died. The insects sprayed with solignum became mobile too, but movement was faster compared with the movement of insects sprayed with the different treatments of mahogany. All the insects ran fast and after less than a minute of application, the death of the termites has been recorded in some of the treatments.

Table 1: Phytochemicals present in mahogany leaves seeds and barks

ACTIVE COMPOUND	LEAVES	SEEDS	BARKS
Essential Oils	+	+	+
Triterpenes	+	+	+
Steroids	+	+	+
Phenols	+	+	+
Coumarines	+	+	+
Tannins	+	+	+
Alkaloids	+	+	+
Flavonoids	+	+	+
Anthrones	+	-	+
Anthraquinones	+	-	+
Fatty Acids	+	-	-

Note: + = The compound is present; - = The compound is not present

Table 2: Percentage mortality of termites treated with different treatments at 10 seconds interval

TREATMENT	TIME (SECONDS)									
	10	20	30	40	50	60	70	80	90	100
T ₁	20.67 ^d	45.33 ^c	60 ^{cd}	70.67 ^c	86 ^b	95.33 ^b	100 ^a	100 ^a	100 ^a	100 ^a
T ₂	30 ^c	54 ^b	74 ^b	95.33 ^{ab}	100 ^a	100 ^a	100 ^a	100 ^a	100 ^a	100 ^a
T ₃	28 ^{cd}	52 ^{bc}	75.33 ^b	93.33 ^{ab}	100 ^a	100 ^a	100 ^a	100 ^a	100 ^a	100 ^a
T ₄	40.67 ^b	74.67 ^a	100 ^a	100 ^a	100 ^a	100 ^a	100 ^a	100 ^a	100 ^a	100 ^a
T ₅	7.33 ^e	17.33 ^e	54.67 ^d	68.67 ^c	81.33 ^b	87.33 ^c	92 ^b	95.33 ^b	98 ^b	100 ^a
T ₆	12 ^c	28 ^d	64 ^c	88 ^b	100 ^a	100 ^a	100 ^a	100 ^a	100 ^a	100 ^a
T ₇	50.67 ^a	75.33 ^a	100 ^a	100 ^a	100 ^a	100 ^a	100 ^a	100 ^a	100 ^a	100 ^a

Note: Means with the same letter are not significantly different at 5% level of significant

CONCLUSION

All parts of mahogany were found effective against termites. Concentrated extract from mahogany leaves were found to be the most effective and has the most potential as bio-pesticide. Phytochemicals with known insecticidal property that were detected from the different extracts are essential oils, triterpenes, steroids, phenols, coumarines, tannins, alkaloids, flavonoids, anthrones, anthraquinones and fatty acids.

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