Evaluation of Anti-termitic Effects of Air-Dried “Kantutay” (*Lantana camara* L.), Verbenaceae

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Termite as Pest Problem

- White ants, Order Isoptera
- Economically and ecologically important structural pests
- Become economic pest by feeding on human homes, timber resources and agricultural crops
- Can be threatening and harmful to homes, cellulosic materials and to man
Economic Impact of Termites

- Damage may reach up to US$11 billion annually
- May be controlled using persistent insecticide
- Use of persistent chemical insecticides is of utmost environmental concern, due to the concomitant problems associated with their use (poisoning, persistence, resistance and re-entry, inappropriate disposal and secondary effects of environmental degradation and ground water contamination.)

Plants contain phytochemicals

- Phytochemicals are secondary plant metabolites that serve as the plants’ means of defense against continuous selection pressure from herbivores, predators and other environmental factors.
- Some of these chemicals are alkaloids, essential oils, phenolics, steroids, terpenoids, etc.
- Also called botanicals, these unexploited reservoir of chemical compounds are important in managing pests, conferring less risk than synthetic pesticides which are toxicologically and environmentally undesirable.
"Kantutay" (Lantana camara L.)

- Considered as one of the important medicinal plants of the world;
- One of the most noxious weeds
- Originally an ornamental plant with pink, yellow, white, orange, lilac flowers; leaves wrinkled with strong smell when crushed; fruits fleshy berries in cluster, green when immature turning black when ripe;
- Most commonly known as big sage or wild sage (English), "kantutay" or sapinit" (Tagalog) or "bahu-baho" (Visaya);
"Pesticidal Activity of ‘Kantutay’"

- *L. camara* possess a wide range of essential oils with varying degrees of pest controlling properties (Dua et al, 2010):
  - Lantana leaves display anti-microbial, fungicidal and insecticidal properties;
  - 200 ppm oil produced 100% mortality in *Culex quinquefasciatus* mosquito larvae in 15 min. (Dharmagadd et al, 2005)
Pesticidal Activity of “Kantutay”

- Methanolic extract of *L. camara* tested on cabbage butterfly showed reduction in weight (Sharma & Metha, 2009);

- Essential oil showed insecticidal activity in rice weevil (*Sitophilus oryzae*) adults.
Foraging activity and survival of two subterranean termites, Coptotermes formosanus and Reticulotermes flavipes) showed that incorporation of chipped fresh lantana leaves and stems into the soil has no effect on termite mortality but caused significant reduction in tunneling.
"Termiticidal Activity of "Kantutay"

- 25% mulch barrier against the subterranean termite (*Reticulotermes virginicus* (Banks)) reduced termite tunneling and wood consumption and increased termite mortality (Yuan and Hu, 2011)
Polarity of *L. camara*

- *L. camara* consists of polar and non-polar substances. This triggers a number of physical properties such as surface tension, solubility and melting and boiling points. Thus, polarity determines the effectiveness of a certain substance.

- Extraction of active biochemical from plants depends upon the polarity of the solvents used.

- Polar solvents extract polar molecules and non-polar solvents extract non-polar molecules.
Objectives of the Study

This study evaluated the differential anti-termitic effects of the various concentrations of air-dried leaves of *L. camara*, and compared which among the three solvents used is the most effective against termites. Specifically, this study aimed to:

1. determine the anti-termitic effect of air-dried Lantana leaf extract using different concentrations and solvents in terms of termite mortality rate; and
2. evaluate which among the three solvents: Hexane, Dichloromethane and Methanol, used to extract *L. camara*, is the most effective solvent against termites.
Significance of the Study

- May benefit the household in preventing termites from destroying the wood in their homes and wooden furniture;
- May help reduce the number of termite-damaged facilities in public institutions such as schools, libraries and hospitals;
- May help minimize carpentry expenses and efforts by applying the anti-termitic material.
Significance of the Study

- May help industries such as furniture shop and wood craft merchants by reinforcing the foundation of wooden crafts; and
- May help reduce over-reliance on conventional insecticides, thus preventing environmental contamination.
Evaluation of Antitermitic Effects of Air-dried “Kantutay” (Lantana camara L). Verbenaceae

Methodology
Research Design

- Completely Randomized Design
- Three concentrations
- Three solvents used namely: Hexane, Dichloromethane and Methanol
- Two controls (negative and positive controls)
- Three replications each
Treatments

- Treatment 0 – Negative Control; plain water
- Treatment 00 - Positive Control; Fipronil (Celebrate 2.5 EC)®
- Treatment 1 – 25% concentration
- Treatment 2 – 50% concentration
- Treatment 3 – 75% concentration
Collection of Materials

- **Termite**
- *Microcerotermes losbanonsensis* Oshima
  collected from infested dry trees in environs of Cavite State University, Main campus
  placed in plastic/enamel trays and safely kept in the laboratory. Water and newspaper were used as food sources
  maintained in the aquarium with soil and leaf litter at 24-28°C.
Plant Collection and Preparation

- *L. camara* plants
  - collected at Trece Martires City, and Cavite State University, Indang, Cavite
  - Stems with leaves of the plant were cut and hung dry in the laboratory for one week
  - Air-dried leaves were prepared for grinding
Plant Extracts

- Air-dried leaves were ground to fine powder using electric blender.
- 200g of the powder were then soaked into every one liter of the different solvents namely: Hexane, Dichloromethane and Methanol for seven days.
- Each mixture was then filtered with cheese cloth to glass jars and the filtrate was exposed into open air, letting the solvent evaporate, leaving the extract dry.
Test Procedure

- Stock solutions of the different solvent extracts were prepared by dissolving a weighed amount of the collected extract to its corresponding amount of palm oil to make the 25%, 50% and 75% concentrations.
- Filter papers (Whatman No.1) were treated with the different concentrations, and air-dried at room temperature.
- After one hour, the treated filter papers were placed into Petri dishes (9cm diameter, 1.5cm height).
Test Procedure

- Fifteen termite workers and soldiers were then introduced on each piece of filter paper with a piece of soil or woody material to serve as their hiding place.
- The Petri dishes were placed in a cool temperature (21°C) to avoid unnecessary temperature effects on the termites.
- To test for efficacy of the Lantana extracts, its performance was compared with Fipronil (Celebrate 2.5 EC®) as a positive control.
Mortality count of termites was recorded 30 minutes, 24 and 48 hours after the application of the treatments.
Analysis of Data

- Data was analyzed using Analysis of Variance (ANOVA) to determine the performance of L. camara leaf extract against Microcerotermes losbanosensis foragers and soldiers using different concentrations and solvents in the laboratory.
- The differences among means were compared using Duncan’s Multiple Range Test (DMRT).
- Abbott’s formula was used when necessary.
Abbott’s Formula

Corrected % Mortality = \frac{\text{Mortality in Test} - \text{Mortality in Control}}{100 - \text{Mortality in Control}} \times 100
RESULTS AND DISCUSSION
Termite Mortality in Hexane Leaf Extract of *L. camara*

Cumulative mean percent mortality of termite workers and soldiers at different concentrations of hexane leaf extract and different time intervals (0.5h, 24h and 48 h) is presented in Figure 1.

Figure 1. Percentage of termite mortality as affected by exposure to various concentrations of Hexane leaf extract of *L. camara*
Cross, et al (2015) reported that Fipronil-treated termites were all upside down with horizontal antennae 24 hours after exposure. This indicates that at 30 minutes after treatment, Fipronil is not yet absorbed in the cuticle of the termites, but after 24 hours, its toxic effect is highly visible, leaving all the test termites dead.
Termite Mortality in Dichlororomethane (DCM) Leaf Extract

Figure 2 presents the cumulative mean percent mortality of termite workers and soldiers at different concentrations of dichloromethane extract and time intervals (0.5 h, 24 h and 48 h). Results were significantly different based on Analysis of Variance and Duncan’s Multiple Range Test.

Figure 2. Percentage of termite mortality as affected by exposure to various concentrations of Dichloromethane leaf extract of *L. camara*.
Termite Mortality in Dichloromethane (DCM) Leaf Extract

- At 48 hours after treatment, all the concentrations had comparable results. Evaluation of dichloromethane leaf extract from *L. camara* showed very promising results when tested in vitro against cultures of chloroquine-sensitive and chloroquine-resistant strains of *Plasmodium falcifarum* (Jonville et al, 2008).

- This indicates that dichloromethane can be an effective solvent that can extract some toxic molecules from *L. camara*. 
Termite Mortality in Methanol Leaf Extract

The cumulative mean percent mortality of termite workers and soldiers at different concentrations of methanol extracts of *L. camara* and time intervals (0.5 h, 24 h and 48 h) is presented in Figure 3. Analysis of Variance and Duncan’s Multiple Range Test indicate highly significant differences among means.

Figure 3. Percentage of termite mortality as affected by exposure to various concentrations of Methanol leaf extract of *L. camara*. 

[Graph showing the percentage of termite mortality at different time points (0.5HAT, 24HAT, 48HAT) for different concentrations (25%, 50%, 75%) and a control (Fipronil).]
Termite Mortality in Methanol Leaf Extract

- This result implies that methanol is a good solvent for *L. camara*. This is supported by studies where methanolic extract of *L. camara* had significantly lower effect on reduction in weight of cabbage butterfly (Sharma and Metha, 2009).

- Methanol extract of aerial parts of *L. camara* have been reported to be toxic to *Callosobruchus chinensis* (Dixit, et al, 1992) with 10-43% mortality at 5% concentrations and fecundity loss at higher doses and anti-oviposition values of 40mg /100g of seed.
Ogunsina et al (2009) reported that methanol and hexane extracts are good anti-termitic agents.

The ethanol extract of *L. camara* is more effective and would be more economical to use since they achieved highest mortality with the lowest dosage.

This result could be attributed to the phytochemicals which are found in *L. camara*. *L. camara* was attributed to contain flavonoids.
Most Effective Solvent for L. camara

Insecticidal effects of plant extracts vary with plant species, insect species, geographical varieties and parts used, extraction methodology adopted and polarity of the solvents used during extraction (Ghosh, et al, 2012). Moreover, the effectiveness of a plant extract is largely-dependent upon the type of plant extract used.
Most Effective Solvent for *L. camara*

- To be able to ascertain which solvent would be most effective in extracting the potent compounds from *L. camara*, different solvents were used. Methanol is the most effective solvent overall, already took a significant difference at 24HAT.

- Hexane is the second most effective solvent which at 48HAT, showing big difference from DCM being the least effective solvent.
Table 1. Cumulative mean % termite mortality as affected by different solvents and concentrations used after 0.5, 24 and 48 hours

<table>
<thead>
<tr>
<th>Solvent</th>
<th>0.5h</th>
<th>24h</th>
<th>48h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>25%</td>
<td>50%</td>
<td>75%</td>
</tr>
<tr>
<td>Hexane</td>
<td>4.44\textsuperscript{a}</td>
<td>11.11\textsuperscript{b}</td>
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<td>6.67\textsuperscript{a}</td>
<td>20\textsuperscript{a}</td>
</tr>
<tr>
<td>Methanol</td>
<td>2.22\textsuperscript{a}</td>
<td>6.67\textsuperscript{a}</td>
<td>20\textsuperscript{a}</td>
</tr>
<tr>
<td>Fipronil</td>
<td>33.33\textsuperscript{a}</td>
<td>100\textsuperscript{a}</td>
<td>100\textsuperscript{a}</td>
</tr>
</tbody>
</table>
This study titled “Evaluation for Anti-termitic effects of Air-dried Kantutay (Lantana camara)" aimed to determine the anti-termitic effects of Lantana camara against termites using different solvents with various concentrations.
Summary of Findings

There were five treatments and three concentrations used in the study: $T_0$ (Positive Control), $T_{00}$ (Negative Control), $T_1$ (25, 50, & 75% concentrations of Hexane), $T_2$ (25, 50 & 75% concentrations of DCM) and $T_3$ (25, 50, & 75% concentrations of Methanol). The five treatments were formulated and replicated three times using completely randomized design.
Summary of Findings

- Results revealed that treatment 3 (Methanol) is the best treatment, it showed the highest mortality rate among termites.
- Although the varying concentrations affected the mortality rate at 0.5HAT, the mortality rate kept on increasing as observed at 24HAT and 48HAT. By 48HAT, the mortality rate has boosted up to 100%.
In general, 75% concentration of Methanol exhibited the best results among all treatments. It greatly affected the accustomed life of termites and the solvent methanol made it faster for the termites to die.
Thank you/
Have a nice day