



## Termiticidal Activities and Synergistic Effects of Ethanol Extracts of *Terminalia catappa* and *Terminalia ivorensis* Stem Bark

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### Abstract

**Background:** Termites are destructive organisms that causes damages on forestry, housing, agriculture and construction. They are mostly controlled with the use of chemical substance known as insecticides which are harmful to human beings. *Terminalia catappa* and *Terminalia ivorensis* are plant materials used in folk medicine to exert termiticidal effects. **Objectives:** This study evaluated termiticidal activities of the individual extracts and the synergistic effects of ethanol extracts of *Terminalia cataapa* and *Terminalia ivorensis* stem bark. **Methods:** The extracts were subjected to phytochemical analysis using standard methods. The termicidal activities of the extracts were evaluated using immobilization time and death rate. All data were analyzed using GraphPad Prism version 5 software.  $P < 0.05$  indicates statistical difference between compared data. **Results:** Phytochemical analysis revealed the presence of saponins, tannins, flavonoids, steroids, terpenoids, alkaloids and cardiac glycosides. The individual extracts and the combination significantly (\*\* $P < 0.01$ ) increased the immobilization time and the death rate at 250mg/ml and 500mg/ml compared to the control group. **Conclusion:** Hence, this study confirmed the potency of *Terminalia catappa* and *Terminalia ivorensi* against destructive activities of the termites.

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**Keywords:** Termites, immobilization., *Terminalia catappa*, *Terminalia ivorensi*, Insecticide

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## INTRODUCTION

Termites are tiny creatures that exhibit very destructive characteristics (Adedeji *et al.*, 2018). They are seen to be harmful and infest wood or any woody material within their reach. They destroy furniture, and make them worthless at the end of the day (Nyeko et al *et al.*, 2010). Termites can cause significant damage to buildings, bridges, and other structures, resulting in costly repairs (Ahmed *et al.*, 2016). It is estimated that termites causes over \$20 billion damage annually worldwide (Obi *et al.*, 2008). The damage done by termites cannot be over emphasized because as tiny and little as they may seem, they can wreak havoc on structures beyond imagination. In order to eradicate the deleterious effects of termite on life and properties, various chemical substances which are called insecticides have been produced. Insecticides are chemical substances that are used to eradicate or control insects, especially those that spread diseases to humans and animals (Oaya and Jada, 2013). Numerous insecticides, such as pyrethroids, carbonates, neonicotinoids, and organophosphates, have been produced over time. These chemical substances differs in their efficacy, physiological targets, and ways of action (Malgwi and and Oaya, 2014). For instance, pyrethroids change the sodium and potassium ion balance in nerve cells, whereas carbonates and organophosphates interfere with insects' neurological systems (Soderlund and Bloomquist, 1989). Insecticides can harm non-target animals, the environment, and human health despite their advantages. When insecticides are used carelessly, they can kill beneficial insects, contaminate water and soil, and create populations of pesticide-resistant insects (Reddy *et al.*, 2025). Because of the harmful effects of insecticides on human beings, life and properties, there is a need for production of natural substances from plants origin which are not toxic to life and properties (Atawodi *et al.*, 2003; Waheed and Oaya, 2020). *Terminalia catappa* and *Terminalia ivorensis* are plant materials that exert termiticidal effects. *Terminalia catappa*, commonly known as Tropical Almond, is a deciduous tree species native to tropical Africa and Asia (Lee *et al.*, 2019). This plant has been widely used in traditional medicine for various purposes, including antimicrobial, antifungal, and insecticidal properties (Kumar and Nayoratman 2013). In recent years, *Terminalia catappa* has gained attention for its potential effects in termite control. The leaves

and seeds of *Terminalia catappa* have been used to repel and kill termites, making it a potential natural alternative to chemical pesticides (Kumar and Nayoratman 2013; Lee *et al.*, 2019). *Terminalia ivorensis* also known as Black afara, is a tropical tree species known for its timber and medicinal properties (Ansah *et al.*, 2016). It has potential in controlling termites due to its bioactive compounds. *Terminalia ivorensis* have shown toxicity to termites leading to mortality. It equally inhibits termite growth and development, discourage termites from feeding on materials treated with *Terminalia ivorensis*. It also repels termites, deterring them from infesting treated areas (Ansah *et al.*, 2016). However, this study evaluated the termiticidal effects of ethanol extracts of *Terminalia catappa* and *Terminalia ivorensis* and their synergistic effects against termites.

## METHODOLOGY

### COLLECTION AND PREPARATION OF PLANT MATERIALS

The stem bark of *Terminalia catappa* and *Terminalia Ivorensis* were collected within the main campus of Igbinedion University Teaching Hospital Okada Edo State Nigeria. The plants were identified and authenticated by Dr. Adebayo Ayofe Muritala of the Department of Phamacognosy, College of Pharmacy, Igbinedion University, Okada Edo State Nigeria. The herbarium voucher number allocated was IUO/13/071 for *Terminalia catappa* and IUO/16/133 for *Terminalia ivorensi*. The stem bark of the plants were air dried separately to avoid interaction and contamination which may eventually alter the result of the biological activity. They were turned over periodically to avoid moisture settling on one side of the bark. The process of air drying took about four weeks (28 days) and thereafter grinded into powder form and stored separately in air tight containers.

### EXTRACTION OF *Terminalia catappa* and *Terminalia ivorensis*

Ethanol extract was prepared using maceration method as described by Dahchar *et al.*, (2016). 300g of each of the sample was soaked in 1000ml of ethanol (80% v/v). They were soaked separately with the same volume of solvent. This was allowed to stand for 96 hours in a dark cupboard under room temperature. The content was shaken at a regular

interval to ensure proper mixture. Thereafter, the mixture content was filtered through Whatman's Filter Paper (No. 1). After the filtrate was obtained, the mixture was filtered using a Buchner funnel with cotton wool, and the filtrates were left to stand for two weeks at room temperature to allow the ethanol to evaporate. The stock solution obtained was however, used to constitute 250 and 500 mg/ml concentrations of the treatments that was used for the experiment.

### Phytochemical screening of extracts

The extracts of *Terminalia catappa* and *Terminalia ivorensis* were subjected to phytochemical analysis to identify its chemical constituents, following the methods described by (Sofowora 1982: Kumar and Nayoratman 2013: Ansah et al., 2016)

### EXPERIMENTAL ORGANISM

One hundred and fifty (150) termites were obtained from the hills found in residential guest house of Igbinedion University, Okada Edo State. The termite were identified by a zoologist, Dr Solanke E.O of the Department of Zoology, Faculty of Agriculture, Igbinedion University, Okada Edo State Nigeria. The hill built served as their natural habitat. The termites obtained were used the day they were gotten in order to ensure they were still very active.

### EXPERIMENTAL DESIGN AND ADMINISTRATION OF EXTRACT

To evaluate the termiticidal activity of *Terminalia catappa* and *Terminalia ivorensis* stem bark extracts individually and in combination (synergy), treated filter paper bioassays were conducted using standardized methods as described by Adebayo et al., 2012 One hundred and fifty termites (150) were used for this experiment. They were randomly divided into five groups of 10 termites each. The treatment petri dish and the control were replicated 3 times. Group 1 served as control and they were given 1 ml of distill water in a petri dish covered with filter paper. For group 2 and 3, One ml each of the treatment extract concentrations (250 and 500 mg/ml) was introduced into petri dish. These were covered with filter papers to avoid direct contact of the treatment with the termites, before 10 newly

matured termites were introduced into the petri dish. Group 4 served as the synergistic group, in which 1 ml each of the two extracts concentration (250 mg/ml) were introduced into the petri dish which was covered with the filter paper before 10 matured termites were place there. Group 5 was given 1 ml of Lambda-cyhalothrin (a standard insecticide) which was introduced into the petri dish and covered with filter paper before 10 matured termites were placed there. Mortality count were recorded at predetermined intervals of 1 hour each for the period of 6 hours to evaluate the effectiveness of each treatment.

### Data Analysis

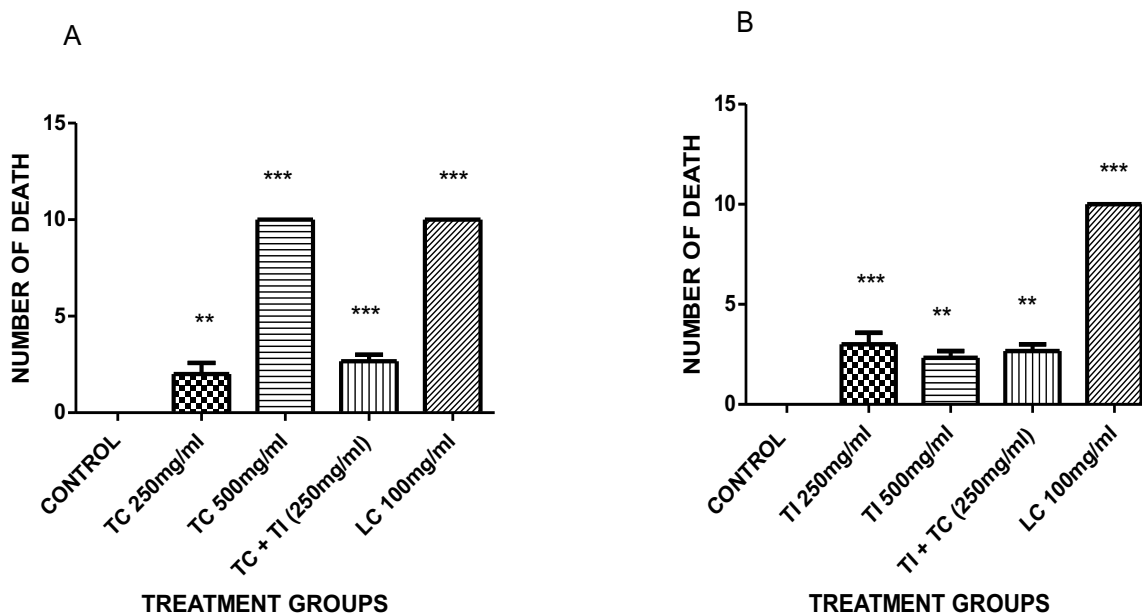
The results are presented as the mean ± standard error of the mean (SEM). Statistical comparisons between groups were performed using one-way analysis of variance (ANOVA), followed by post hoc analysis using the Tukey test. All statistical analyses were performed using GraphPad Prism5 software (GraphPad Software, Inc., La Jolla, USA). A significance threshold of P < 0.05 was considered statistically significant.

## RESULTS

**Table 1: Results of phytochemical analysis of *Terminalia catappa* and *Terminalia ivorensis* extracts**

Phytochemical constituents	<i>Terminalia catappa</i>	<i>Terminalia ivorensis</i>
Saponin	+	++
Tannin	++	++
Flavonoids	++	++
Steroids	++	+
Terpenoids	+	++
Alkaloids	++	++
Cardiac glycoside	++	+

Key; Positive = (+), Highly Positive = (++)



**FIGURE 1:** Toxicological effects of ethanol stem bark extracts of (A) *Terminalia catappa* (B) *Terminalia ivorensis* on number of death in termites \*\*P < 0.01, \*\*\*P < 0.001 when compared with the control group. (n=10). TC-- *Terminalia catappa* : TI-- *Terminalia ivorensis*, LC--- Lambda-cyhalothrin

**Table 2:** Immobilization counts of termite exposed to *Terminalia catappa* and *Terminalia ivorensis* stem bark extracts at 3 hrs treatment interval

Treatment	Conc (mg/ml)	<i>Terminalia catappa</i>	Treatmet	Conc (mg/ml)	<i>Terminalia ivorensis</i>
		Mean ± SEM			Mean ± SEM
CONTROL	0.00	0.0 ± 0.0	CONTROL	0.00	0.0 ± 0.0
TC	250	317 ± 1.73	TI	250	247 ± 1.73
	500	82 ± 1.16***		500	285 ± 1.16
TC + TI	250 + 250	262 ± 1.73	TC + TI	250 + 250	262 ± 1.73
LC	100	12 ± 0.58***	LC	100	12 ± 0.58***

Toxicological effects of ethanol stem bark extracts of *Terminalia catappa* and *Terminalia ivorensis* on immobilization time of termites and their combination \*\*P < 0.01, \*\*\*P < 0.001 when compared with the control group. (n=10). TC-- *Terminalia catappa* : TI-- *Terminalia ivorensis*, LC--- Lambda-cyhalothrin

## DISCUSSION

The pressure exerted from the use of chemical insecticides against insects has caused a lot of harm

to the ecosystem and environmental degradation. As part of the global strategy in tapping plant products in the quest for finding an alternative control measure rather than the use of chemical

insecticides against insect pests, *Terminalia catappa* (TC) and *Terminalia ivorensis* (TI) extracts were evaluated for their termiticidal potential in terms of toxicity and phytochemical constituents in this study.

In this current study, the phytochemical constituents such as tannins, flavonoid, saponin obtained from the extracts of *Terminalia catappa* (TC) and *Terminalia ivorensis* (TI) and the synergistic effect of the two extract are associated with their termiticidal action. According to (Diya et al., 2018) TI contains saponins that harm cellular membranes, tannins that prevent enzyme activity, and alkaloids that interfere with insect nervous systems. Even at low concentrations, these mechanisms work. However, TC depends on tannins and flavonoid chemicals, which inhibit mobilization and induce oxidative stress in termite.

Termites in the control group showed no inhibitory effect, which led to a noticeably longer period of mobilization without any death. This finding demonstrates that termites continue their normal life cycle unhindered in the absence of an active agent (Sotande et al., 2011). This is consistent with prior findings on TI and TC aqueous extracts of (( Diya et al., 2018). This outcome confirms the reliability of the bioassay and the necessity for active agents to achieve termiticidal effects.

*Terminalia catappa* (TC) and *Terminalia ivorensis* (TI) were tested for their efficacy in immobilization activity and death time at 250mg/ml and 500mg/ml. It was discovered that 500mg/ml of *Terminalia catappa* (TC) has more termiticidal effect with a significant immobilization activity when compared with the control and their combination (synergistic). This implies that TC contains strong phytochemicals constituents, including tannins and saponins which work very well at higher quantities to inhibit the survival of the destructive activities of the termites. *Terminalia ivorensis* (TI) on the other hand, also showed a significant (\*\*P < 0.01) action at 500mg/ml concentration. *T. catappa* showed a distinct dose-dependent trend, with the 500mg/ml concentration producing more termiticidal effects than the 250mg/ml concentration. This is consistent

with earlier report by Oramahi et al., (2024) which showed that higher concentrations of *T. catappa* wood vinegar increased termiticidal efficacy against *Coptotermes curvignathus*. The increased efficacy is likely to be due to cumulative phytochemical action, including tannins and saponin with insecticidal properties. The results of this study support the idea, demonstrating that *Terminalia catappa* (TC) and *Terminalia ivorensis* (TI) performs better at higher concentration. This revealed that both *Terminalia catappa* (TC) and *Terminalia ivorensis* (TI) are potentially promising agents against termites, which have continued to destroy human properties both at home and in the farm. This is in agreement with the findings by (Ibe et al., 2018) who showed that neem and other plant sourced treatments recorded 100% mortality of termites after a period of treatment exposure in Imo State, Nigeria. Similarly, Getahun and Jembere (2006) also stated that neem seed powder is a potential agent for the control of termites, as 100% mortality was equally achieved when termites were exposed to crude extracts of neem seed powder.

It was expected that the combination of the extracts of *Terminalia catappa* (TC) and *Terminalia ivorensis* (TI) should have more immobilization activity and termiticidal effect when compare to individual extract. But at 250mg/ml concentration, each of the extract as similar immobilization activity and termiticidal effects with the synergistic group. This implies that the phytochemicals in the two extracts might have an antagonistic or additive interaction, perhaps as a result of dilution or action interference. Certain plant combinations may lessen or nullify individual efficacy rather than increase it, as (Lawal et al., 2010) pointed out.

The convectional insecticide, Lambda-cyhalothrin is a fast-acting synthetic pyrethroid widely used as a reference insecticide in entomological studies (Lawa; et al., 2010). It targets the nervous system of insects by altering sodium ion channel function. Exposure to lambda-cyhalothrin resulted in significant (\*\*P < 0.001) termite immobilization and eventual death when compared with the control group, validating the toxicity and termiticidal

effects of *Terminalia catappa* (TC) and *Terminalia ivorensis* (TI).

## CONCLUSION

In this study, *Terminalia catappa* and *Terminalia ivorensis* offered desirable results in terms of immobilization and termiticidal effects respectively against the termites. Therefore, sustainable use of this biopesticides, which are readily available and affordable, against insect pests like termites will go a long way in protecting our surroundings and the ecosystem at large against the dangerous insecticides or termiticides which are non-biodegradable, costly and harmful to the user.

## AUTHORS CONTRIBUTION

Michael .T. Sobowale – Data analysis, Writing – original Draft of the Manuscript

Muritala .A. Adebayo & Tunde .A. Owolabi - Supervision, Experimental design

Rita .O. Asomadu, Felix Onome, Adedeji D. Ogunbodede, Sunday A. Emaleku. Writing - Review and Editing

Osato. M. Iyekekpolor, Halimah Muhammad, Nkechi Roseline Uba, Sonia Uwaila – Undergraduate Pharmacy Students

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## CONFLICT OF INTEREST

The authors declare no conflicts of interest.

## REFERENCES

Adedeji, G. A., Ogunsanwo, O. Y., Eguakun, F. S., & Elufioye, T. O. (2018). Chemical composition and termiticidal activity of *Khaya ivorensis* stem bark extracts on termites. *Maderas. Ciencia y tecnología*, 20(3), 315-324.

Ahmed, N., Huma, Z., Rehman, S. U., Ullah, M., & Ahmed, S. (2016). Effect of different plant extracts on termite species (*Heterotermis indicola*). *Journal of Bioresource Management*, 3(2), 2.

Ansah, C., Moomin, A., & Boadu, K. M. (2016). *Terminalia ivorensis* A. Chev. Ethanolic stem bark extract protects against gentamicin-induced renal and hepatic damage in rats. *Journal of Applied Pharmaceutical Science*, 6(4), 175-182.

Atawodi, S. E., Bulus, T., Ibrahim, S., Ameh, D. A., Nok, A. J., Mamman, M., & Galadima, M. (2003). In vitro trypanocidal effect of methanolic extract of some Nigerian savannah plants. *African Journal of Biotechnology*, 2(9), 317-321.

Divya N, Rengarajan RI, Ramalingam E, Abdulaziz AA, Abeer H, Manikandan R. and Vijaya A. (2018). Phytotherapeutic Efficacy of the Medicinal Plant *Terminalia catappa* L. *Saudi J Biol Sci* . 26: 985-988

Getahun, D., & Jembere, B. (2006). Evaluation of toxicity of crude extracts of some botanicals on different castes of *Macrotermes* termites. *Pest Management Journal of Ethiopia*, 10, 15-23.

Ibe, C. C., Uzoka, C. N., Isika, P. I., Mbadike, J. O., Ikeh, S., Onwuagba, C. G., ... & Chiagbanwe, A. P. (2018). Evaluation of selected botanical extracts on termite species in umuagwo ohaji, Imo State, Nigeria. *International Journal of Scientific Engineering and Applied Science*, 4(8), 12-25.

Kumar, V. S., & Navaratnam, V. (2013). *Neem* (*Azadirachta indica*): Prehistory to contemporary medicinal uses to humankind. *Asian Pacific journal of tropical biomedicine*, 3(7), 505-514.

Lawal, I. O., Igboanugo, A. B. I., Osikarbor, B., Duyilemi, O. P., Adesoga, A. A., Borokini, T. I., & Adeyanju, B. A. (2010). Evaluation of plant-based non timber forest products (ntfps) as potential bioactive drugs in South-western Nigeria. *Journal of clinical medicine and Research*, 3(4), 061-066.

Lee, C. Y., Yang, S. F., Wang, P. H., Su, C. W., Hsu, H. F., Tsai, H. T., & Hsiao, Y. H. (2019). Antimetastatic effects of *Terminalia catappa* leaf

- extracts on cervical cancer through the inhibition of matrix metalloprotein-9 and MAPK pathway. *Environmental toxicology*, 34(1), 60-66.
- Mahmoud, AM, Abdelrahman, MA, Elnagar, S. A. (2021). Efficacy of lambda-cyhalothrin against agricultural pests. *Journal of Economic Entomology*, 114(2), 567–575.
- Malgwi, A. M., & Oaya, C. S. (2014). Towards Achieving an Integrated Pest Management for the Control of the Groundnut Bruchid (*Caryedon serratus* Olivier) on Stored Groundnut and Tamarind in Yola, Nigeria. *Global Journal of Biology, Agriculture and Health Sciences*, 3(2), 96-104.
- Nyeko, P., Gohole, L. S., Maniania, N. K., Agaba, H., & Sekamatte, B. M. (2010, September). Evaluation of *Metarhizium anisopliae* for integrated management of termites on maize and *Grevillea robusta* in Uganda and Kenya. In *second RUFORUM Biennial Meeting* (pp. 333-337).
- Oaya, C. S., & Jada, M. Y. (2013). Efficacy of wild spikenard (*Hyptis suaveolens* (L.) poit) leaf powder against the cowpea bruchid (*Callosobruchus maculatus* Fab.) [Coleoptera: Bruchidae] on stored cowpea. *African Journal of Agricultural Research and Development*, 6(3), 41-46.
- Obi, J. C., Ogunkunle, A. O., & Meludu, N. T. (2008). Effect of termite infestation on the farming system characteristics of an endemic area in the guinea savanna region of Nigeria. *American-Eurasian Journal of Scientific Research*, 3(1), 1-6.
- Okigbo, R. N., Anuagasi, C. L., & Amadi, J. E. (2009). Advances in selected medicinal and aromatic plants indigenous to Africa. *Journal of medicinal plants Research*, 3(2), 86-95.
- Olufemi AS, Gabriel OY, Bamidele DZ, Abubakar U (2011). Termicidal effect of neem extracts on the wood of *Khaya senegalensis*. *Research Journal of Forestry*. 5:128- 138
- Oramahi, HA., Supartini, T, Supriana, D. (2024). Termicidal activity of ketapang wood vinegar (*Terminalia catappa*) against *Coptotermes curvignathus*. *Philippine Journal of Science*, 153(6B), 2313–2317.
- Reddy, A. A., Minz, K. A., Sharma, K. C., & Rai, P. K. (2025). Atlas of Invasive Insect Species: Status of Geographical Distribution and Economic Losses in India. Available at SSRN 5311742.
- Soderlund, D. M., & Bloomquist, J. R. (1989). Neurotoxic actions of pyrethroid insecticides. *Annual review of entomology*, 34, 77-96.
- Sofowora, A. (1980). The present status of knowledge of the plants used in traditional medicine in western Africa: a medical approach and a chemical evaluation. *Journal of Ethnopharmacology*, 2(2), 109-118.
- Sotannde, O. A., Yager, G. O., Zira, B. D., & Usman, A. (2011). Termicidal effect of neem extracts on the wood of *Khaya senegalensis*.
- Wahedi, J. (2020). Termicidal activity of *Azadirachta indica* and *Khaya ivorensis* extracts on subterranean termites in Mubi, Nigeria. *Journal of entomology and zoology studies*.