

Termiticidal Effect of Methanol Extract of *Deguelia utilis* (A.C.Sm.) A.M.G. Azevedo Vine (Fabaceae) on *Macrotermes bellicosus*

Daniel A. Ambe¹, Faith R. Etim¹, Emmanuel E. Nyong¹, Edem E. A. Offiong²

¹Department of Pharmacognosy and Natural Medicine, Faculty of Pharmacy, University of Uyo, Uyo, Nigeria.

²Department of Animal Science, Faculty of Agriculture, Akwa Ibom State University, Obiokpa Campus.

Corresponding Author: Daniel A. Ambe, Email: danielaambe@uniuyo.edu.ng

DOI: <https://doi.org/10.52403/ijrr.20260120>

ABSTRACT

Termites, particularly *Macrotermes bellicosus*, are major pests of agricultural and structural resources in sub-Saharan Africa, causing significant economic losses. Conventional synthetic termiticides are effective but are associated with environmental hazards and the development of resistance, creating a need for safer botanical alternatives. This study evaluated the termiticidal activity of methanol extracts of *Deguelia utilis* (A.C. Sm.) A.M.G. Azevedo vine (Fabaceae) against worker and soldier castes of *M. bellicosus*. Vine samples of *D. utilis* were collected, shade-dried, pulverized, and macerated in methanol. Serial dilutions (10–80 mg/mL) of the extract were prepared, and 20 μ L of each concentration was topically applied to groups of ten termites per caste. A 2% Solignum solution served as the positive control. Mortality was recorded over hours. Data were analyzed using one-way ANOVA followed by Dunnett's post hoc test, with significance set at $p < 0.05$. The extract exhibited dose- and time-dependent termiticidal effects in both castes. In worker termites, 10 mg/mL caused $33.33 \pm 12.00\%$ mortality at 0.5 h, increasing to $56.67 \pm 26.00\%$ at 2.5 h. At 80 mg/mL, mortality reached 100% within 2.5 h, comparable to the control. Soldier termites showed slightly

lower susceptibility at lower concentrations, with $13.33 \pm 3.33\%$ mortality at 10 mg/mL (0.5 h) and $46.67 \pm 3.33\%$ at 2.5 h, but 80 mg/mL induced 100% mortality by 2.5 h. The methanol extract of *D. utilis* vine demonstrates potent concentration- and time-dependent toxicity against *M. bellicosus*, indicating its potential as a natural alternative to synthetic termiticides in sustainable pest management strategies.

Keywords: *Deguelia utilis*, methanol extract, *Macrotermes bellicosus*, termiticidal effect, botanical pesticide, Fabaceae, subterranean termites

INTRODUCTION

One of the most damaging insect pests of wood and agricultural resources, termites cause substantial economic losses worldwide (Kalleshwaraswamy *et al.*, 2022a). Species like *Macrotermes bellicosus* are especially well-known in Africa for destroying forest products, structures, and crops, endangering rural livelihoods and food security (Kalleshwaraswamy *et al.*, 2022b; Otieno, 2018). Despite the extensive use of synthetic termiticides, such as pyrethroids and organophosphates, to manage termite infestations (Hodoşan *et al.*, 2023), their use is frequently associated with high costs, environmental persistence, toxicity to non-target organisms, and the development of

resistant termite populations (Mishra *et al.*, 2021; Okolonkwo *et al.*, 2022). Due to these drawbacks, there is growing interest in bioactive chemicals produced from plants as environmentally benign and sustainable termite control options (Fenibo *et al.*, 2022). In ethnomedicine, plants in the Fabaceae family are widely recognized for their insecticidal and pesticidal properties, which are attributed to phytochemicals such as flavonoids, alkaloids, saponins, and rotenoids (Ahmed *et al.*, 2021a; Tlak Gajger and Dar, 2021). *Deguelia utilis* (A.C. Sm.) A.M.G. Azevedo, a vine species native to South America that has naturalized in some areas of West Africa, has been ethno-medicinally useful for its pesticidal properties (Ahmed *et al.*, 2021a). Although *D. utilis* is bioactive, there is a lack of scientific evidence supporting its ability to kill economically significant subterranean termites.

This study, therefore, investigates the termiticidal effect of methanol extracts of the *D. utilis* vine on *Macrotermes bellicosus*. By evaluating concentration and time-dependent mortality responses in worker and soldier termite castes, this research aims to provide baseline scientific evidence for the use of *D. utilis* as a natural alternative to synthetic termiticides in sustainable pest management.

MATERIALS AND METHODS

Plant Collection and Identification

Five hundred grams (500 g) of *D. utilis* (DU) vine was harvested in Ibesikpo Asutan Local Government Area of Akwa Ibom State, Nigeria. The collected plant was identified by Professor Henry Akinibosun, a taxonomist, at the Department of Plant Biology and Biotechnology, Faculty of Life Sciences, University of Benin, Benin City, Edo State. A voucher specimen with specimen number UBH-D670 was deposited in the Department's herbarium.

Drying of Plant Materials

Foreign objects were eliminated from the *D. utilis* vine collected. After being chopped, the plant material was left to dry for ten days in

the shade. The dried plant's part was pulverized and kept in a cellophane bag until needed.

Extraction

The powdered plant's part was macerated with absolute methanol for seventy-two hours. The extract obtained was concentrated, weighed, and stored in a labelled bottle. The extract was then stored in the refrigerator at 4 °C until needed.

Collection of the Subterranean Termites.

With the help of local farmers at Odot III, Nsit Atai Local Government Area, a mound of subterranean termites was invaded. Worker and soldier termites were collected for the experiment and kept in aerated plastic containers. The experimental animals were identified by Dr Offiong, Edem Effiong Asukwo of the Animal Science department, Faculty of Agriculture, Akwa Ibom State University, Obiokpa Campus.

Preparation and Administration of the Extract.

Ten, twenty, forty, and eighty milligrams per milliliter concentrations of the plant extract were obtained through serial dilution in distilled water. Ten worker termites were placed in a Petri dish, and each termite received a topical application of 20 µL of each concentration using a graduated micropipette. The results of this procedure were then observed. 20 µL of 2% Solignum was used as a positive control. Following a 24-hour observation period, the mortality rate of the termites was recorded. The same procedure was utilized for the soldiers' termites. The experiment was conducted in triplicate.

STATISTICAL ANALYSIS

The data are presented as mean ± SEM. GraphPad Prism version 6.01 was used to perform an analysis of variance (ANOVA) and a Dunnett's post hoc test at a 95% confidence interval to compare the differences between groups.

RESULTS

Results (Worker Termite): The chart below illustrates the mortality (%) of subterranean worker termite when subjected to various concentrations of *D. utilis* vine methanol extract over different time periods.

It shows clear evidence of dose- or concentration-dependent toxicity of the extract on the termites, with the highest mortality (100%) observed at an 80mg/mL concentration within 2.5 hours, similar to the effect of the control group.

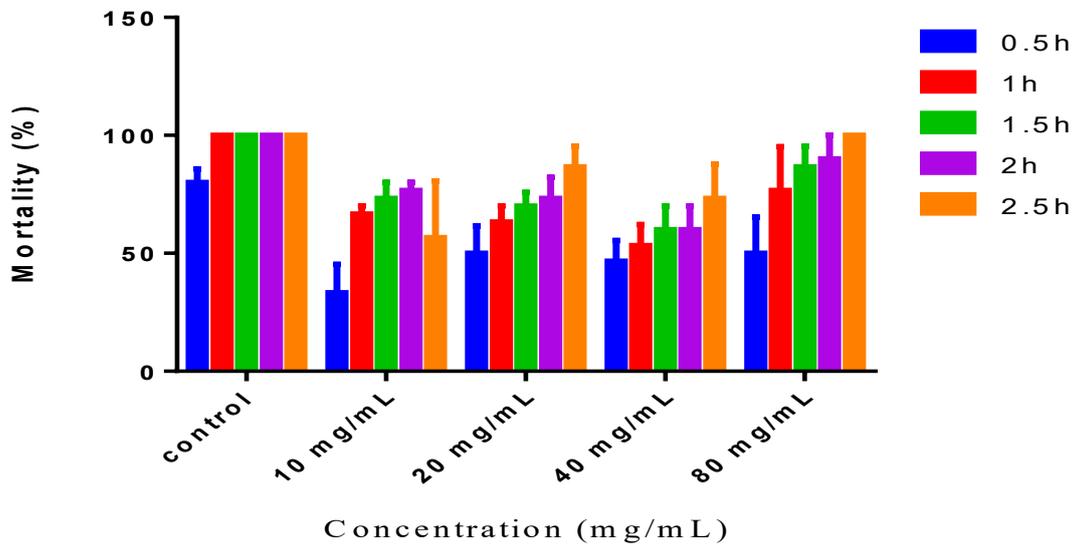


Figure 1: Effect of *Diguelia utilis* vine methanol extract on the subterranean termites (workers) caste.

This suggests that the extract's effectiveness is both time- and concentration-dependent.

Results (Soldier Termite): The chart below shows the mortality rates (%) of subterranean soldier termites exposed to different concentrations of *D. utilis* vine methanol extract over time. The results show clear

evidence of dose- or concentration-dependent toxicity of the extract on the termites, with the highest mortality (100%) observed at an 80mg/mL concentration within 2.5 hours, similar to the effect of the control group.

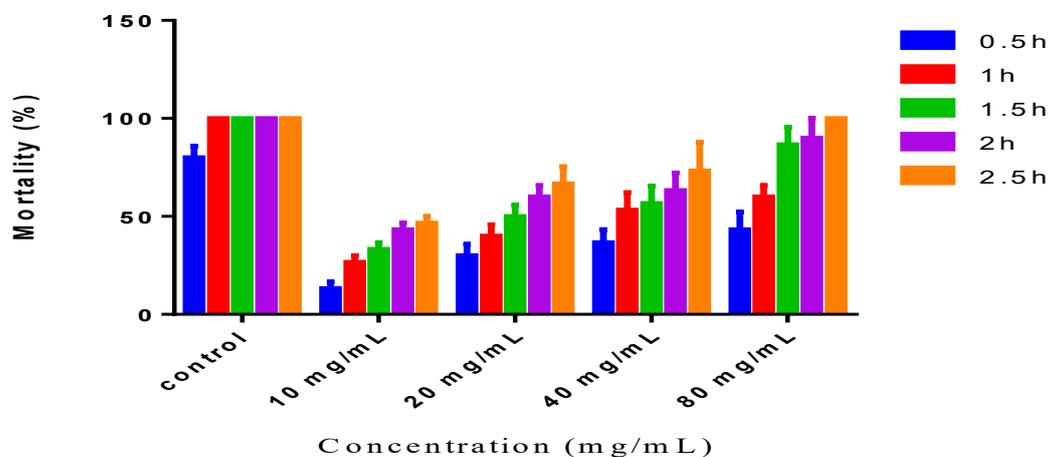


Figure 2: Effect of *Diguelia utilis* vine methanol extract on the subterranean termites (soldiers) caste. Each bar represents the mean \pm SEM. Results are significant at $p < 0.001$. $n=10$.

DISCUSSION

The termiticidal activity of *D. utilis* methanol extract against the worker and soldier castes of *M. bellicosus* was studied. The results showed that mortality rates increased steadily with higher extract concentrations and shorter exposure times, indicating that the extract has both dose and time-dependent toxicity. This aligns with the basic toxicological principle that higher concentrations of bioactive substances generally cause stronger biological responses, especially when contact or ingestion is possible. (Sharma *et al.*, 2018). The extract caused worker termites to die quickly at lower doses (10 mg/mL), with $33.33 \pm 12.00\%$ dying within the first 0.5 hours and more than 56% dying within 2.5 hours (Figure 1). Conversely, soldier termites exposed to the same concentration showed comparatively lower mortality rates ($46.67 \pm 3.33\%$ at 2.5 hours and $13.33 \pm 3.33\%$ at 0.5 hours) (Figure 2). This suggests that soldiers might be more resistant to the phytochemicals in *D. utilis* or have a delayed reaction to them. Soldiers may be more resistant to insecticide substances due to tolerance modulation (Watanabe *et al.*, 2023). Both worker and soldier castes were highly susceptible to higher doses (80 mg/mL), with complete mortality ($100.00 \pm 0.00\%$) observed within 2.5 hours. The effectiveness of the methanol extract is demonstrated by the rapid death rate at this concentration, likely caused by rotenoids, isoflavonoids, or other secondary metabolites with insecticidal properties (Ahmed *et al.*, 2021b; Ukoroije and Otayor, 2020). Caste-specific sensitivity is evident from the tendency of workers to experience higher mortality at lower doses and shorter exposure times compared to soldiers. This difference may also relate to caste physiology; workers may be more vulnerable to and capable of metabolizing hazardous substances more easily than soldiers, due to higher metabolic activity and their role in food processing (Khan *et al.*, 2016). Additionally, lipophilic substances may be absorbed more quickly because of their

relatively thinner exoskeleton (Albin-Brooks, 2024).

The results of other botanical termiticides, including neem (*Azadirachta indica*) (Okweche *et al.*, 2021) and *Tephrosia vogelii* (Chukwulobe and Echezona, 2025), which also show rapid toxicity in subterranean termites, are comparable to the dose and time-dependent activity of *D. utilis* extract. Even at lower concentrations, the rapid onset of mortality suggests that *D. utilis* extract has a strong acute toxic effect, which could serve as a sustainable alternative to synthetic termiticides. Although effective, synthetic termiticides are often linked to bioaccumulation, toxicity to non-target animals, and environmental persistence (Ahamad *et al.*, 2023). Plant-based substitutes are less harmful to the environment and biodegradable.

Given that both castes showed total death at 80 mg/mL in 2.5 hours, it is possible that *D. utilis* methanol extract could be used practically to control termites. Nevertheless, further research is needed to identify and describe the active ingredients, understand their function, and assess their safety profile for both humans and non-target organisms. Efficacy under natural conditions, where environmental factors such as soil composition, moisture, and termite colony size can influence performance, would also require field trials.

CONCLUSION

The methanol extract of the *D. utilis* vine has a dose-dependent and time-dependent toxic effect on subterranean termites (*Macrotermes bellicosus*). These findings highlight the potential of *D. utilis* as a natural termite control agent, paving the way for further research into its practical applications in pest management strategies.

Declaration by Authors

Acknowledgement: None

Source of Funding: None

Conflict of Interest: No conflicts of interest declared.

REFERENCES

1. Ahamad, A., Ahamad, J., & Naim, M. J. (2023). Current perspective on pesticides: Their classification, behaviour, potential use and toxic effects. *Journal of Angiotherapy*, 7(1), 1–12.
2. Ahmed, N., Alam, M., Saeed, M., Ullah, H., Iqbal, T., Al-Mutairi, K. A., Shahjeer, K., Ullah, R., Ahmed, S., & Ahmed, N. A. A. H. (2021a). Botanical insecticides are a non-toxic alternative to conventional pesticides in the control of insects and pests. In *Global decline of insects*. IntechOpen.
3. Ahmed, N., Alam, M., Saeed, M., Ullah, H., Iqbal, T., Al-Mutairi, K. A., Shahjeer, K., Ullah, R., Ahmed, S., & Ahmed, N. A. A. H. (2021b). Botanical insecticides are a non-toxic alternative to conventional pesticides in the control of insects and pests. In *Global decline of insects*. IntechOpen.
4. Albin-Brooks, C. C. (2024). *The Sensation and Perception of Cuticular Hydrocarbons in Ants and Termites*. Doctoral dissertation, Arizona State University.
5. Chukwulobe, M. N., & Echezona, B. C. (2025). Potency of Methanol Extract of Some Botanicals as Contact Insecticide against Two Termite Species. *Tropical Journal of Natural Product Research*, 9(6).p2895
6. Fenibo, E. O., Ijoma, G. N., Nurmahomed, W., & Matambo, T. (2022). The potential and green chemistry attributes of biopesticides for sustainable agriculture. *Sustainability*, 14(21), 14417.
7. Hodoşan, C., Gîrd, C. E., Ghica, M. V., Dinu-Pîrvu, C.-E., Nistor, L., Bărbuică, I. S., Marin, Ştefan-C., Mihalache, A., & Popa, L. (2023). Pyrethrins and pyrethroids: A comprehensive review of natural occurring compounds and their synthetic derivatives. *Plants*, 12(23), 4022.
8. Kalleshwaraswamy, C., Shanbhag, R. R., & Sundararaj, R. (2022a). Wood degradation by termites: Ecology, economics and protection. In *Science of Wood Degradation and its Protection* (pp. 147–170). Springer.
9. Kalleshwaraswamy, C., Shanbhag, R. R., & Sundararaj, R. (2022b). Wood degradation by termites: Ecology, economics and protection. In *Science of Wood Degradation and its Protection* (pp. 147–170). Springer.
10. Khan, M. A., Ahmad, W., Paul, B., Paul, S., Khan, Z., & Aggarwal, C. (2016). Entomopathogenic nematodes for the management of subterranean termites. In *Plant, Soil and Microbes: Volume 1: Implications in Crop Science* (pp. 317–352). Springer.
11. Mishra, P., Verma, M., Jha, S., Tripathi, A., Pandey, A., Dikshit, A., & Sharma, S. (2021). Biological approaches of termite management: A review. *Curr. Bot*, 12, 121–131.
12. Okolonkwo, B. N., Amadi, C. F., & Chimekagbe, O. E. (2022). Organophosphates toxicity: Pathophysiology, diagnosis, and treatment. *Asian Journal of Biochemistry, Genetics and Molecular Biology*, 12(2), 27–37.
13. Okweche, S. I., Hilili, P. M., & Ekoja, E. E. (2021). Termiticidal activity of oil from *Jatropha curcas* L. and *Azadirachta indica* A. Juss against *Coptotermes sjostedti* Holmgren (Isoptera: Rhinotermitidae). *Bulletin of the National Research Centre*, 45(1), 9. doi.org/10.1186/s42269-020-00472-z
14. Otieno, H. (2018). Impacts and management of termites (Isoptera: Termitidae) among smallholder farmers in East Africa. *Journal of Agriculture and Ecology Research International*.16(1),1-12 doi: 10.9734/JAERI/2018/44842
15. Sharma, S., Chunduri, V., Kumar, A., Kumar, R., Khare, P., Kondepudi, K. K., Bishnoi, M., & Garg, M. (2018). Anthocyanin bio-fortified colored wheat: Nutritional and functional characterization. *PLOS ONE*, 13(4), e0194367. https://doi.org/10.1371/journal.pone.0194367
16. Tlak Gajger, I., & Dar, S. A. (2021). Plant allelochemicals as sources of insecticides. *Insects*, 12(3), 189. doi.org/10.3390/insects12030189
17. Ukoroije, R. B., & Otayor, R. A. (2020). Review on the bio-insecticidal properties of some plant secondary metabolites: Types, formulations, modes of action, advantages and limitations. *Asian Journal of Research in Zoology*, 3(4), 27–60.
18. Watanabe, S. Y., Ferreira, L. F., Cruz, M. R., Araújo, A. P., Desouza, O., & Cristaldo, P. F. (2023). It is not only group size: Soldiers also modulate the tolerance to insecticide in termites (Blattodea: Isoptera). *Entomological Science*, 26(2), e12546.

How to cite this article: Daniel A. Ambe, Faith R. Etim, Emmanuel E. Nyong, Edem E. A. Offiong. Termiticidal Effect of Methanol Extract of *Deguelia utilis* (A.C.Sm.) A.M.G. Azevedo Vine (Fabaceae) on *Macrotermes bellicosus*. *International Journal of Research and Review*. 2026; 13(1): 219-223. DOI: <https://doi.org/10.52403/ijrr.20260120>
