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Termiticidal and Repellency Activity of Three Selected Tropical Woods against Subterranean Termite Worker (*Macrotermes bellicosus*)

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Abstract: The study was to assess the termiticidal and repellency activity of hexane and methanol extracts of *Afzelia africana* wood, *Gliricidia sepium* stem bark and wood and *Guarea cedrata* stem bark and wood against termite worker (*Macrotermes bellicosus*). For the termiticidal activity, Whatman No.1 filter paper treated with concentration of 5 % (w/v), 2.5 % (w/v) and 1 % (w/v) while solvent treated filter paper and untreated filter paper used as control were placed in Petri dishes with 20 termites for 5 days. At 5 % (w/v) concentration, methanol extract of *A. africana* wood and stem bark of *G. sepium* recorded 100 % mortality respectively, methanol extract of *G. sepium* wood recorded 92.5% and hexane extract of *A. africana* wood recorded 72.5 %. For repellency activity, Methanol extracts exhibited more repellent activity than hexane extracts. Methanol extract of *G. sepium* stem bark, *G. sepium* wood, *A. africana* wood and hexane extract of *G. sepium* stem bark exhibited strong repellent activity while hexane extract of *A. africana* wood, hexane extract and methanol extract of *G. cedrata* wood shown fair repellent activity. The LC_{50} values of methanol extracts were lower than the hexane extracts

Key woods: Afzelia africana · Gliricidia sepium · Guarea cedrata · Mortality

INTRODUCTION

Wood is one of the most useful natural materials. It has been a pre-dominantly construction materials for both local and industrial uses across the world. About 80% of timber product in Nigeria is utilized for construction purpose such as doors, windows and furniture [1]. Despite the usefulness of wood, it is liable to be degraded by termites, insects and marine borers. In other to increase the durability and efficiency of wood there is a need to treat them against bio deterioration effect cause by termite and other destructive agent. Termite is a social pest that exists as a colony [2] and they pose very serious destructive threat to crops, woods, paper and other cellulosic materials. Termites mostly feed on dead plant material such as wood, yam, cassava, sugar cane, ground nut, sorghum, maize, valuable books and photography [3-6]. About 10% of the estimated 4000 species of the insects are economically significant as pest that can cause serious structural damage to buildings, crops or plantation forest [4] Termites cause damages worth billions of dollar in each year to homes, historical structures and commercial buildings Worldwide [7]. Presently most woods are treated with synthetic chemicals that are expensive, persistent in the environment and toxic to the personnel in the wood industries and non-targeted organisms and crops. Due to the bad effect of the synthetic pesticides which are not friendly to the environment it is therefore important to focus on the use of natural extracts from woods and other plant parts as termite control agents.

Afzelia africana also known as African mahogany or African oak is a large deciduous tree. It is a leguminous tree which belongs to the family of *Fabaceae,* sub-family *Caesalpiniaceae* and found in humid and dry forests. It is widely distributed in many African countries including Benin, Burundi, Cameroon, Central African Republic, Cote d'Ivoire, Gambia, Ghana, Guinea-Bissau, Kenya, Liberia, Mali, Nigeria, Senegal, Sierra-Leone, Sudan, Tanzania and Uganda. In Nigeria, it is called akpalatain Igbo, apain Yoruba, yiasein Tiv, ukpoin Idoma and kawain Hausa [8]. The heartwood of *A. africana* is durable, with an excellent resistance to fungal, termite and borer attacks, but it is liable to marine borers. The sapwood is susceptible to Lyctus attack. Investigations of the fibre and vessel characteristics indicate that the wood is not suitable for the production of good-quality pulp and paper [9]. Phytochemical screening properties of

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the *A. africana* shown that there were present Alkaloids, C. glycoside, Carbohydrate, Flavonoids, Saponins, Steroids and Tannins for the methanol crude extract, Alkaloids and steroid for the petroleum ether partition portion of the methanol crude extract, Alkaloids, C. glycoside, Flavonoids, Steroids and Tannins for the chloroform partition portion of the methanol crude extract, Alkaloids, C. glycoside, Carbohydrate, Flavonoids, Saponins Steroids and Tannins for the N-butanol partition portion of the methanol crude extract, C. glycoside, Flavonoids, Saponins Steroids and Tannins for the aqueous partition portion of the methanol crude extract [10].

Gliricidia sepium is a leguminous tree and belongs to the family *Fabeacae* [11]. It is a medium sized tree introduced into India from the American continent. It is also used as a poison for rodents and in fact the Latin name *Gliricidia* means rodent poison, which is derived from its bark and leaves which when cooked with grain can be used as poisonous bait for rodents due to the presence of tannins, afrormosin, medicarpin and isoflavins in it [12-14]. Sharma *et al*. [15] investigated the larvicidal activity of the crude ethanol extract of *G. sepium* bark and leaves.

Guarea cedrata occurs from Sierra Leone east to Uganda and south to Gabon and DR Congo. It is known as olofun in Yoruba, obobonofua in Benin and it other names are obobo, bosse, cedar [16]. Limonoids, including dregeanin, have been isolated from the bark [17].

There are many woods that have been investigated for termiticidal activity such as *Taxodium distichum* (L.), Scheffrahn [18] *Juniperus procera* (African pencil cedar) [19] *Mansonia altissima* and *Piptadenia strum africanum* [20] and *Diospyros virginiana* [21]. Some other plants that have been investigated for termiticidal preservatives include vetiver grass oil [23] seed of *Khaya ivorensis* [22] wood leaves; leaves of tarbush (*Flourensia cernua*) [24] mature leaves of 7 species of *Eucalyptus* [25] and leaves of *Azadirachta excelsa* [26] fruit and seed of *Xylopia aethiopica* [27]. Sahay *et al*. [28] evaluate anti-termite potential of *Aristrolochia bracteata*, *Calotropis procera*, *Euphorbia tirucalli*, *Ricinus communis* and *Solanum surattense* against *Odontotermes obesus*. The aim of this study was to evaluate termiticidal activity of the hexane and methanol extracts of some selected tropical woods.

MATERIALS AND METHODS

The heart wood and stem bark of the selected wood; *G. cedrata* and *A. africana* were obtained from different sawmills in Akure, while *G. sepium* heart wood and stem bark was collected within the premises of the Federal University of Technology Akure. The collected heartwood, stem bark and shrub were air-dried in an open ventilated room for about three to four weeks and pulverized into powder particles. About 150 g of each powdery wood and stem bark were extracted with hexane for 72 hours using cold extraction method with different volume of solvent; 1000 ml for *A. africana* wood, 800 ml for *G. sepium* stem bark, 1100 ml for *G. sepium* wood, 450 ml for *G. cedrata* stem bark and 1000 ml for *G. cedrata* wood. After extraction, the resulting extracts were concentrated at 45°C using vacuum rotary evaporator. The weight of the crude extracts were taken and recorded accordingly. The residue of hexane extracts were extracted with methanol for 72 hours using different volume of solvent;1000 ml for *A. africana* wood, 800 ml for *G. sepium* stem bark, 1000ml for *G. sepium* wood, 500 ml for *G. cedrata* stem bark and 950 ml for *G. cedrata* wood. Each of the resulting extracts was concentrated 45°C using vacuum rotary evaporator. The weight of the crude extracts were taken and recorded accordingly. Both hexane crude extract and methanol crude extract were stored in the sample bottles for further experiments [29].

Termite Rearing: Subterranean termite active workers (*Macroterme bellicosus*) were collected from decayed log of woods beside Soil, Crop and Pest Department, Federal University of Technology, Akure into perforated container along with pieces of the decayed wood and papers. The perforated container containing termites was kept in the laboratory before it's used. The termite species was identified in Soil, Crop and Pest Department of the Federal University of Technology, Akure.

Termiticidal Activity: The bioassay method described by Roszaini *et al*. [30] with slight modification was employed to evaluate the termiticidal activity of the plant extracts. Concentration of 5 %, 2.5 % and 1 % (w/v) of the crude extract were used treat the filter papers and air-dried for 6 hours. The weights of the filter papers were measured and recorded before and after treatment. Untreated filter paper and solvent treated filter papers was served as control and each of the tests will be carried out in duplicate. Twenty active termite workers will be introduced into each Petri dish that contained 3 g of sterile sand. A few drops of water were periodically added to the base edge of each petri dish. All the petri dishes with covers will be kept in the dark for 5 days. The mortality of the termites were counted and recorded daily. Percentage of termite mortality was calculated according to Niber [31].

$$Mortality\ (\%) = \frac{Number\ of\ dead\ termites}{Total\ number\ of\ termites} \times 100$$

Repellency Activity: Repellant activities of the extract by termite will be conducted in line with the method proposed by McDonald *et al.* [32]. The filter papers were cut into equal halves in a way that the two halve had no contact with each other to prevent exchange of content. One half of the filter papers were treated with 2 % (w/v) concentration of each of the crude extract and allowed to dry while the second half of the filter papers were treated with solvent (Hexane and methanol) and allowed to dried. Both extract treated filter papers and solvent treated filter papers were placed side by side inside the petri dishes, twenty termites (Workers) were introduced and cover. Each treatment was carried out in duplicate. The number of termites present in control (NC) and Treatment (NT) halves will be recorded at interval of one hour for five hours. The mean percentage of Repellency (PR) of each of the plant extracts was calculated after five hours using.

$$PR = \frac{NC - NT}{NC + NT} \times 100$$

Statistical Analysis: One way analysis of variance (ANOVA) was performed on Percentage mortality and repellence data to determine the significance of variation of antitermitic activity between wood species. Mean Values at $P<0.05$ were considered statistically significant using Turkey test.

RESULTS AND DISCUSSION

Extractive Yield: The result of percentage yield of hexane and methanol extracts of the selected tropical woods is presented in the Figure 1. For methanol extracts, 4.55% was obtained for *A. africana* wood, 6.78% for *G. sepium* stem bark, 3.22% for *G. sepium* wood, 2.55% for *G. cedrata* wood and 6.20% for *G. cedrata* stem bark. For hexane extract, 1.88 % was obtained for *G. sepium* stem bark, 1.85 % for *G. sepium* wood, 1.75 % *G. cedrata* wood, 1.94 % for *A. africana* wood and 1.98 % for *G . cedrata* stem bark. The percentage yield of extracts obtained from the selected tropical woods shown that the yield of methanol of extracts were higher than that hexane extracts, the reason for these was that methanol is a polar solvent while hexane is a non-polar solvent and this was in agreement with the previous studied by Roszani *et al.* [33] who reported that maximum extract yield from *Calophyllus inophyllus* L. was obtained with absolute methanol and Rajan and Thangaraj [34] also reported that the amount of extract yield obtained from *Osbeckia parvifolia* using methanol was more than ethyl acetate, ethanol and hexane.

Termiticidal Activity: The result of termiticidal activity of methanol and hexane extracts of the selected tropical woods against termite worker (*Macrotermes bellicosus)* using different extract concentrations at a particular treatment period are presented in Tables 1 and 2. The mortality effect increase with increase in the concentration of the extracts applied. 5 % concentration of methanol extract of *A. africana* wood caused 100 % mortality on the 3rd day of the experiment, 2.5 % concentration caused 92.5 % and 1 % caused 77.5 % on the 5th day of the experiment. They are significant difference at $p<0.05$. 5 % concentration of methanol extract of *G. sepium* stem bark caused 100 % mortality on the 5th day of the experiment, 2.5 % and 1 % concentration of methanol extract of *G. sepium* stem bark caused 100 % and 75.0 % mortality on the 5th day of the experiment. 5 %, 2.5 % and 1 % concentration of methanol extract of *G. sepium* wood caused 82.5 %, 75.0 % and 72.5 % respectively on the 5th day of the experiment. On the 5th day of the experiment, 5 %, 2.5 % and 1 % concentration of methanol extract of *G. cedrata* stem bark recorded 70.0 %, 62.5 % and 30 %. On the 5th day of the experiment, 5 %, 2.5 % and 1 % concentration of the methanol extract of *G. cedrata* wood recorded 75.0 %, 60.0 % and 60.0 % respectively. Methanol treated filter paper, hexane treated filter paper and untreated filter paper recorded 12.5 %, 10.0 % and 2.5 % respectively. The hexane extracts exhibited poor mortality effect against the termite worker (*M. bellicosus*). 5 % concentration of *A. africana* recorded 72.5 % on the 5th day of the experiment. 5 % concentration of hexane extract of *G. cedrata* stem bark and wood recorded 62.5 % and 55.0 % mortality respectively on the 5th day of the experiment. For the control, methanol treated filter paper recorded 12.5 %, hexane treated filter paper recorded 10.0 % and untreated filter paper recorded 2.5 %. However, at 5th day of the experiment, the mortality induced by all the extracts at different concentration was significantly different from the controls. The percentage mortality of termite (*Macrotermes bellicosus*) treated with methanol and hexane extracts increased with increase in concentration of the extracts as the experiment exposure time progressed. The result of the study showed that methanol extracts recorded higher mortality effect than the hexane extracts. These results are in agreement with Adams *et al.* [35] who reported that anti-termitic properties of *Junniperus californica* was not contained in hexane extractable material but as a result of more polar compounds which found in the methanol extract. Roszani *et al.* [33] reported that the strong anti-termitic activity of *Calophyllus inophyllus* L. was extracted using

Table 1: Percentage mortality of methanol plant extracts against Subterranean Termite Worker (*Macrotermes bellicosus*)

Sample	Part of the plant	Conc (w/v)%	Day 1	Day 2	Day 3	Day 4	Day 5
A.africana	Wood	5	$80.0^{c}\pm10.0$	$92.5^{c}\pm2.5$	$100.0^{c}\pm0.0$	$100.0^{b}\pm0.0$	$100.0^{b}\pm0.0$
		2.5	$25.0^{b}\pm0.0$	$52.5^{bc}\pm7.5$	$67.5^{cd}\pm2.5$	$90.0^{c}\pm5.0$	$92.5^{c}\pm2.5$
		1	$17.5^{bc}\pm2.5$	$40.0^{cd}\pm0.0$	$55.0^{c}\pm0.0$	$67.5^{c}\pm2.5$	$77.5^{c}\pm2.5$
G.sepium	Stem bark	5	$35.0^{b}\pm5.0$	$85.0^{c}\pm5.0$	$97.2^{c}\pm2.5$	$100.0^{b}\pm0.0$	$100.0^{b}\pm0.0$
		2.5	$32.5^{b}\pm7.5$	$77.5^{c}\pm2.5$	$90.0^{d}\pm0.0$	$95.0^{c}\pm0.0$	$100.0^{c}\pm0.0$
		1	$25.0^{c}\pm5.0$	$47.5^{d}\pm2.5$	$60.0^{c}\pm5.0$	$67.5^{c}\pm2.5$	$75.0^{c}\pm0.0$
G.sepium	Wood	5	$30.0^{b}\pm5.0$	$42.5^{b}\pm7.5$	$62.5^{b}\pm12.5$	$75.0^{b}\pm10.0$	$82.5^{b}\pm7.5$
		2.5	$25.0^{b}\pm0.0$	$40.0^{b}\pm5.0$	$60.0^{bc}\pm10.0$	$70.0^{bc}\pm10.0$	$72.5^{bc}\pm15.0$
		1	$15.0^{ab}\pm5.0$	$27.5^{b}\pm2.5$	$40.0^{bc}\pm5.0$	$62.5^{bc}\pm7.5$	$72.5^{bc}\pm7.5$
G.cedrata	Stem bak	5	$35.5^{b}\pm2.5$	$42.5^{b}\pm2.5$	$52.5^{b}\pm2.5$	$70.0^{b}\pm5.0$	$70.0^{b}\pm5.0$
		2.5	$30.0^{b}\pm5.0$	$35.0^{b}\pm100$	$42.5^{b}\pm2.5$	$52.5^{b}\pm7.5$	$62.5^{b}\pm7.5$
		1	$7.5^{ab}\pm2.5$	$7.5^{a}\pm2.5$	$17.5^{ab}\pm12.5$	$22.5^{ab}\pm5.0$	$30.0^{ab}\pm5.0$
G.cedrata	Wood	5	$40.0^{b}\pm0.0$	$57.5^{bc}\pm2.5$	$65.0^{b}\pm5.0$	$75.0^{b}\pm10.0$	$75.0^{b}\pm10.0$
		2.5	$32.5^{b}\pm2.5$	$40.0^{b}\pm5.0$	$47.5^{bc}\pm2.5$	$52.5^{b}\pm2.5$	$60.0^{b}\pm0.0$
		1	$15.0^{ab}\pm0.00$	$32.5^{bc}\pm2.5$	$42.5^{bc}\pm2.5$	$50.0^{bc}\pm0.0$	$60.0^{bc}\pm5.0$
MTFP			$0.0^{a}\pm0.0$	$2.5^{a}\pm2.5$	$2.5^{a}\pm2.5$	$5.0^{a}\pm0.0$	$12.5^{ab}\pm2.5$
UTFP			$0.0^{a}\pm0.0$	$0.0^{a}\pm0.0$	$0.0^{a}\pm0.0$	$2.5^{a}\pm2.5$	$2.5^{a}\pm2.5$

Values are means of two duplicate ± standard error. Column means followed by the same superscript letters are not significantly different at P<0.05. MTFP represent methanol treated filter paper and UTFP represent untreated filter paper.

Table 2: Percentage mortality of hexane wood extracts against subterranean termite worker (*Macrotermes bellicosus*)

Sample	Part of the plant	Conc (w/v) %	Day 1	Day 2	Day 3	Day 4	Day 5
A.africana	Wood	5	$35.0^{b}\pm5.0$	$52.5^{b}\pm12.5$	$62.5^{b}\pm10.0$	$72.5^{c}\pm5.0$	$72.5^{c}\pm5.0$
		2.5	$7.5^{a}\pm2.5$	$22.5^{b}\pm2.5$	$37.5^{b}\pm5.0$	$37.5^{b}\pm5.0$	$47.5^{b}\pm5.0$
		1	$5.0^{a}\pm0.0$	$12.5^{a}\pm2.5$	$30.0^{b}\pm0.0$	$37.5^{b}\pm2.5$	$42.5^{b}\pm2.5$
G.sepium	Stembark	5	$10.0^{a}\pm0.0$	$22.5^{ab}\pm2.5$	$30.0^{b}\pm10.0$	$37.5^{b}\pm10.0$	$40.0^{b}\pm10.0$
		2.5	$2.5^{a}\pm2.5$	$5.0^{a}\pm0.0$	$17.5^{ab}\pm2.5$	$20.0^{a}\pm5.0$	$27.5^{ab}\pm7.5$
		1	$0.0^{a}\pm0.0$	$2.5^{a}\pm2.5$	$12.5^{ab}\pm7.5$	$20.0^{ab}\pm0.0$	$25.0^{b}\pm5.0$
G.sepium	wood	5	$10.0^{a}\pm0.0$	$25.0^{ab}\pm5.0$	$32.5^{ab}\pm7.5$	$37.5^{b}\pm7.5$	$45.0^{b}\pm5.0$
		2.5	$7.5^{a}\pm3.5$	$15.0^{ab}\pm5.0$	$20.0^{ab}\pm5.0$	$32.5^{a}\pm2.5$	$42.5^{b}\pm2.5$
		1	$2.5^{a}\pm2.5$	$7.5^{a}\pm2.5$	$7.5^{a}\pm2.5$	$12.5^{a}\pm2.5$	$22.5^{abc}\pm2.5$
G.cedrata	Stembark	5	$12.5^{a}\pm2.5$	$27.5^{ab}\pm7.5$	$40.5^{b}\pm5.0$	$52.5^{c}\pm2.5$	$62.5^{c}\pm7.5$
		2.5	$5.0^{a}\pm0.0$	$15.0^{ab}\pm5.0$	$27.5^{ab}\pm2.5$	$37.5^{b}\pm7.5$	$47.5^{b}\pm7.5$
		1	$2.5^{a}\pm2.5$	$7.5^{a}\pm2.5$	$12.5^{a}\pm2.5$	$22.5^{ab}\pm2.5$	$27.5^{ab}\pm2.5$
G.cedrata	wood	5	$10.0^{a}\pm0.0$	$25.0^{ab}\pm5.0$	$35.0^{ab}\pm10.0$	$47.5^{bc}\pm2.5$	$55.0^{c}\pm0.0$
		2.5	$7.5^{a}\pm2.5$	$12.5^{ab}\pm2.5$	$25.0^{ab}\pm5.0$	$30.0^{a}\pm5.0$	$42.5^{b}\pm2.5$
		1	$5.0^{a}\pm0.0$	$7.5^{a}\pm2.5$	$15.0^{ab}\pm0.0$	$20.0^{ab}\pm5.0$	$27.5^{ab}\pm2.5$
HTFP			$2.5^{a}\pm2.5$	2.5 ± 2.5	$5.0^{a}\pm0.0$	$7.5^{a}\pm2.5$	$10.0^{a}\pm0.0$
UTFP			$0.0^{a}\pm0.0$	0.0 ± 0.0	$0.0^{a}\pm0.0$	$2.5^{a}\pm0.0$	$2.5^{a}\pm2.5$

Values are means of two duplicate ± standard error. Column means followed by the same superscript letters are not significantly different at P<0.05. HTFP represent Hexane treated filter paper and UTFP represent untreated filter paper

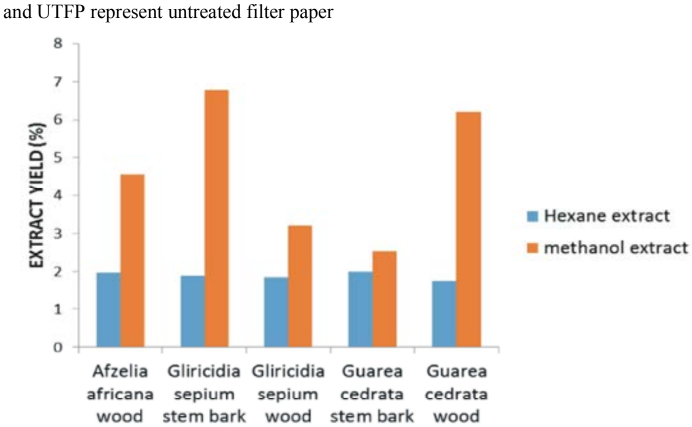

Fig. 1: Percentage of hexane and methanol obtained from the wood samples

Table 3: Lethal concentration at 50 (LC_{50}) values of methanol and hexane extracts of the selected tropical wood against termite *(Macrotermes bellicosus)*

Wood sample	Methanol extract LC_{50} % (w/v)	Regression line	Hexane extract LC_{50} % (w/v)	Regression line
G.sepium wood	0..10	Y=6.8285In(x) + 68.236 R^2=0.8856	7.99	Y=16.319In(x) +16.07 R^2=0.8089
A.africana wood	0.19	Y=15.668In(x) +75.675. R^2= 0.9885	2.42	Y= 19.943In(x)+32.28 R^2= 0.8128
G.sepium stem bark	0.23	Y=17.943In(x)+ 75.633 R^2=0.8157	34.37	Y=9.9747In(x)+14.746 R^2 = 0.813
G.cedrata wood	0.74	Y= 9.816In(x) + 54.842 R= 0.6779	6.40	Y=18.312In(x)+16.063 R^2= 0.8248
G.cedrata stem bark.	2.40	Y=28.229In(x) + 25.304 R=0.9307	3.40	Y=24.327In(x)+20.256 R^2=0.993

Table 4: Mean percentage repellency of termite by the wood extract against subterranean termite worker (*Macrotermes bellicosus*)

Wood	Part of the plant	Hexane extracts	Methanol extracts
A.africana	Wood	51.75^a±0.37	$72.56^{a,b}$±2.59
G.sepium	Stem bark	66.71^b±2.35	83.30^b±4.28
G.sepium	Wood	46.20^a±3.09	87.06^b±4.73
G.cedrata	Stem bark	49.59^a±1.31	58.84^a±4.78
G.cedrata	Wood	50.74^a±1.78	67.23^a±4.0
Control		2.27^a±0.07	3.94^a±0.39

Mean ± Standard error of duplicate for each wood sample. Mean values followed by the same superscript are not significantly different in the same group at p<0.05

methanol, followed by ethanol and lastly petroleum ether. The high mortality effect recorded by *A. Africana* wood was because it is known hardwood which does not required treatment against destructive agents [9]. From various part of *A. africana*, keampferol and its glycosides had been isolated. Ohmura *et al*. [36] reported that keampferol exhibited antifeedant activity against the subterranean termite, *Coptotermes formosanus Shiraki.* From different part of *G. sepium*, compounds like flavones, chalcone, ceryl alcohol, quercetin glycoside, triterpenoid, kaempferol glycoside and hydrocarbon. Toxic compounds like tannins, aformosin and medicarpin are also presence in *G. sepium*. The strong anti-termitic activity of methanol extract of *G. sepium* stem bark and wood is likely from the presence of Couramic, quercetin and medicarpin. Nascimento *et al.* [37] reported that quercetin is used as a termite control agent. Morimoto *et al.* [38] also reported that isomdicarpin, a derivative of medicarpin and quercetin shown anti-termitic activity against *Reticultermes speratus*. Linonoids including dregeanin had been isolated from the bark of *G.cedrata* [17]. The termiticidal activity of *G. cedrata* could be attributed to the presence of Linonoid which had been reported as an antifeedant against *Reticultermes speratus* [39]. All the methanol extracts and hexane extract of *G. sepium* stem bark exhibited strong repellent activity against *Macrotermes bellicosus* while only hexane of *A. africana* wood, *G. sepium* wood and *G . cedrata wood* recorded fair repellent activity against *M . bellicosus*.

Repellency Activity: The result of the repellent activity of the plant extracts is presented in Table 3. For methanol extracts of the selected wood; the highest (87.06%) termite repellence activity was recorded by stem bark of *G. sepium*, followed by (83.30 %) termite repellence activity was recorded by wood of *G. sepium*, *A. africana* wood recorded 72.5 %, *G. cedrata* wood recorded 67.23 % , *G. cedrata* stem bark recorded 58.84 % and control recorded 3.94 %. For hexane extracts, the repellent activity were in this order; *G. sepium* stem bark (66.71 %), *A. africana* wood (51.75 %), *G. cedrata* wood (50.74 %), *G. cedrata* stem bark (49.59 %), *G. sepium* wood (46.20 %) and control recorded 2.27 %. The mean repellency activity caused by the methanol extract of *G. sepium* wood, hexane and methanol extracts of *G. sepium* stem bark were significantly different from the control at p<0.05 while other extracts were not significantly different at t p<0.05. The high repellent activity of methanol extracts can be attributed to high amount of flavonoid, tannins and phenolic compounds which are likely much more presence in methanol extracts than hexane extracts. Rajan and Thangaraj [33] reported that methanol and ethanol are effective solvents to extract polyphenolic compounds like flavonoids, tannins and phenolics, they also reported that concentration of tannins, flavonoids and total phenolic in *Osbeckia parvifolia* were much more higher in methanol extract, followed by ethanol extract and lastly in hexane extract.

Lethal Concentration at 50 (LC_{50}) of the Methanol and Hexane Extracts of the Selected Tropical Woods Against *Macrotermes bellicosus*: The result of LC_{50} of the methanol and hexane extracts of the selected tropical woods against termite worker (*Macrotermes bellicosus)* is presented in Table 4. The LC_{50} value for methanol and hexane extracts of the wood samples against *Macrotermes bellicosus* was calculated to evaluate the concentration that would cause 50% mortality of the tested termites. The value of LC_{50} of methanol extracts was lesser than the hexane extracts which shown that termiticidal activities of the methanol extracts was higher than the hexane. The LC_{50} value of methanol extracts range from 0.10 % (w/v) – 2.40 % (w/v) while the hexane extract range from 2.42 % (w/v) – 34.37 % (w/v).

CONCLUSION

This study had shown that selected tropical woods exhibited termiticidal and repellency activities and that methanol extracts showed higher termiticidal and repellency activity than the hexane extracts. We therefore, further studies should carry out on identification of more bioactive compounds from the various extracts, especially methanol extracts of *A. africana* and *G. sepium and G. cedrata* should be carried out using ^{1}H and ^{13}C NMR, COSY-NMR and Mass spectroscopy. Screen house trials should also be carried on the extracts out to provide basis for large scale field trials.

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