NJE Vol. 41(2): 16-30, 2025
Nigerian Journal of Entomology
Published by the Entomological Soc. of Nig.
www.esnjournal.com.ng
DOI.10.36108/NJE/5202/14.0220

POTENTIALS OF CONSTITUENTS FROM *PARKIA BIGLOBOSA* (JACQ.) R.BR. EX G.DON SEEDS AQUEOUS AND N-HEXANE FRACTIONS AGAINST *MACROTERMES BELLICOSUS* SMEARTHMAN [BLATTODEA: TERMITIDAE]

Oyewole Elizabeth Olajumoke Olabisi[1]*, Fasola Taiye Remi[1], Umeh Vincent C.[2] Adeniran Adedapo Adedayo[3]
[1]Department of Botany, Faculty of Science, University of Ibadan, Nigeria.
[2]National Horticultural Research Institute, Ibadan, Nigeria.
[3]Pharmacognosy and Natural Medicine, University of Calabar, Calabar, Nigeria

Abstract

Globally, termites cause damage to agricultural products, resources and lumber to the tune of around $40 billion annually (Ahmad *et al.,* 2019). Botanically derived insecticides have gained attention as potential substitutes for conventional termite control due to their rich biologically active constituents. These plant-based alternatives for termite control with diverse potential applications are largely untapped. This study therefore was aimed at investigating the scientific basis and efficacy of *Parkia biglobosa* in the management of termites. *Parkia biglobosa* seeds were extracted with 100% methanol, concentrated *in vacuo* and the extract was partitioned into n-hexane, ethyl-acetate, and aqueous fractions. Methanol extract and fractions were screened against *M. bellicosus* for toxicity at 31.25-125 mg/ml and repellency at 125 mg/ml. Chlorpyrifos (Rocket) served as control. The aqueous and n-hexane fractions were subjected to chromatographic analyses (LC-MS and GC-MS) respectively. All samples showed anti-termite activity. *Parkia biglobosa* aqueous methanol fraction was the most toxic with an LC_{50} of 23.86±0.01 mg/ml compared to crude extract (96.08±0.03 mg/ml), n-hexane (106.4±0.02 mg/ml), and ethyl-acetate (153.4±0.01 mg/ml). Aqueous fraction had a mean repellency (%) of 47.8±5.2, n-hexane 38.9±4.8, ethyl-acetate 33.9±7.0, and crude extract 16.1±6.9. Jasmonic acid and quassin were present in the aqueous fraction, while 1, 2-benzenedicarboxylic acid, diisooctyl ester, 2-nonenal, (Z)-, furan, 2-pentyl-, hexadecanoic acid, methyl ester, stigmasterol, nonanal, n-caproic acid vinyl ester were present in n-hexane fraction. The bioactive constituents responsible for insecticidal activity of *P. biglobosa* seeds have been tested and confirmed. Thus, *P. biglobosa* can be recommended as alternative to synthetic termiticides in termite management.

Keywords: Anti-termite, Bioactive constituents, Chromatography-mass spectrometry, *Macrotermes bellicosus, Parkia biglobosa*

*Correspondence email:
lizzyoye2020@gmail.com
ORCID: 0009-0000-2931-7237

INTRODUCTION

Termite control methods typically involve utilization of either chemical (synthetic insecticides) or no-chemical strategies (Abdullah *et al.,* 2014). Various synthetic insecticides offer effective protection against termites. However, their indiscriminate use for termite control has resulted in several environmental and biological threats; including contamination of water, food, soil and air. The listed human-made issues encompass mammalian toxicity, phytotoxicity, pesticide residues, insect resistance, and resurgence (Elango *et al.,* 2012). Formerly, synthetic insecticides like Dichlorodiphenyltrichloroethane (DDT), Benzene hexachloride (BHC), dieldrin as well as aldrin were widely employed to give long-lasting defense against infestation of termite. Nevertheless, due to the adverse environmental effects resulting from their persistence in the soil and residue issues, many countries have banned their use (Noor *et al.,* 2018).

The challenges stemming from the widespread use of synthetic insecticides have led to a renewed interest in exploring alternative termite control methods, with plant-derived compounds emerging as potential solutions.

Plants offer a wide array of active ingredients that can be used as insecticides to combat insect resistance and mitigate environmental challenges (Sahay *et al.,* 2014). Botanicals contain phytochemicals such as saponins, flavonoids, terpenoids, or a combination thereof, which can induce repellency, mortality, or disrupt intestinal microbiota of termites (Verma *et al.,* 2009). Anti-termite compounds of natural origin offer promising alternatives, exhibiting varying degrees of bioactivity against different termite species and posing fewer toxicological and environmental risks compared to their synthetic counterparts (Haouas *et al.,* 2011) due to their ability to readily biodegrade

Traditional knowledge has identified numerous indigenous plants with possible insecticidal/termiticidal potentials (Okori *et al.*, 2022; Ali *et al.,* 2022). The scientific basis of the anti-termite effect of *Parkia biglobosa* seed, for example has been scientifically elucidated (Femi-Ola *et al*., 2008; Olugbemi, 2012; Ojewunmi *et al*., 2017), but the bioactive constituents responsible for this activity have not yet been determined. Therefore, this study aimed to investigate the scientific basis and efficacy of *P. biglobosa* seed in the management of termites, and the termiticidal constituents responsible for its termite controlling property.

MATERIALS AND METHODS

Plant Collection

Parkia biglobosa seeds were acquired at Oja-oba market in Ibadan South-east local government, Oyo state, Nigeria, which is located within 7°20'3.73" N 3°54'12.92" E,.

At the University of Ibadan Herbarium (UIH), Department of Botany, the plant samples were identified and authenticated, while the herbarium specimen was deposited with the herbarium number 23097.

Termites Collection and Preparation

Populations of adult *Macrotermes bellicosus* workers and soldiers were collected and identified at the National Institute of Horticulture Research and Training (NIHORT), Ibadan, Oyo state, Nigeria. Mounds were excavated using shovels, and some portions containing the colony were carefully packed into basins covered with net so as to prevent their escape while ensuring adequate air flow. Soil particles were separated from the termites with a brush. The termites were then sorted into containers following a method outlined by Addisu *et al.* (2014). For an anti-termite screening, these containers were moved to Ethnobotany Laboratory, Department of Botany, University of Ibadan. Both *M. bellicosus* workers and soldiers were sustained in the laboratory at ambient temperature and relative humidity spanning from 27-30 °C and 75-80%, respectively. They were provided with moistened sugarcane pieces for food and kept in a calm and dim environment until required for experimentation. The termites were acclimated for a week prior to screening.

Crude Extract Preparation

Four kilograms of powdered *P. biglobosa* seeds were thoroughly soaked in 12 litres of absolute methanol 33.3mg/ml (w/v) and stirred vigorously every 12 hours for a period of 72 hours. This mixture was filtered with Whatmann No.1 filter sheets. The filtration procedure was carried out twice, while extract was concentrated *in vacuo* using rotary-evaporator. For further usage, the resultant dry extract was kept in the refrigerator (Sharma and Gupta, 2011). The percentage yield was calculated as follows:

$$\text{Percentage Yield} = \frac{\text{Mass of crude extract}}{\text{Mass of plant material}} \times 100$$

Fractionation of Crude Extract

Parkia biglobosa methanolic extract was reconstituted in a 3:1 methanol to water ratio and vigorously shaken. Thereafter, it was fractionated into n-hexane and ethyl-acetate using a separatory funnel successively. The remaining portion was labelled as the aqueous fraction. The dried fractions obtained were stored at 4 °C for further work.

Toxicity Test Using No-Choice Method

One hundred and twenty-five milligrams of methanol extract along with its fractions (aqueous, ethyl- acetate, n- hexane) were separately dissolved in 1ml of their respective solvents, and they were topically applied on 9 cm filter paper. Three concentrations (31.25, 62.5 and 125 mg/ml) were prepared with methanol, water, ethyl-acetate, and n- hexane, respectively. The control experiments consist of filter papers treated with either 0.1% Chlorpyrifos (Rocket) or solvents alone. Termite mortality was observed every 4 hours for a total of 24 hours (Sattar *et al.,* 2014). The experiment followed a completely randomized design with three replications. All data were converted to percentage mortality and mortality in the control was corrected with Abbort's formula.

Repellency/Attractant Screening Using Choice Method

Cellulose pad halves were treated with 1ml aliquots of methanol, n-hexane, ethyl acetate and water solutions of corresponding extract/fractions (125 mg/ml) while the other halves were treated with plain solvents after which they were allowed to evaporate. The extract/fractions treated halves were placed beside the plain solvent treated halves in 11 mm petri-dishes (Addisu *et al.,* 2014). Twenty termites (soldiers and workers) were positioned at the midpoint of each container. Data were taken at 15 mins interval for 1 hour and subsequently, 30 mins interval for another 1 hour. The experiment design was a completely randomized design in triplicates.

Where $C = \frac{\text{Number of termites on solvent treated halves}}{\text{Total number of Termites}} \times 100$

While $PR = 2(C - 50)$

The Percent Repellency (PR) test was computed using the methodology outlined by Acda, (2014), with C representing the percentage of insects found on the solvent treated pad (Control). Repellency was indicated by a positive PR value, while attractancy was indicated by a negative PR value.

Liquid Chromatography Mass Spectrometric (LC-MS) Analyses

Parkia biglobosa aqueous fraction was analyzed with LC-MS according to the methodology outlined by Piovesana *et al.* (2019) with certain adjustments. In brief, aqueous fraction was dissolved in methanol and sieved by a polytetrafluoroethylene (PTFE) membrane filter with a 0.45 µm pore size. Subsequently, the filtrate (10.0 µL) was added to the LC system and left to separate on a column having dimensions of 4.6 × 150 mm and a particle size of 5.0 µm. The mobile phase was composed of 0.1% formic acid in water (solvent A) and 0.1% formic acid in acetonitrile (solvent B) at a gradient ratio of A/B: 95:5 for the initial minute, maintained for an additional minute, then transitioned to A/B: 5:95 over 13 minutes, maintained until the 15th minute, followed by a return to A/B: 95:5 over the next 2 minutes, and maintained until the 19th minute, and finally transitioned back to the initial ratio at the 20th minute. During the chromatographic separation, the rate of flow was set at 1.0 ml/min, whereas sample and column temperature were fixed at 25°C. Detection was carried out with a photodiode array (PDA) detector set to a wavelength range of 210–400 nm, with a resolution of 1.2 nm and a sampling rate of 10 points per second and mass spectra were obtained between 100 and 1250 m/z. The acquired information was processed by Empower 3 software. Based on data including elution order, base m/z, fragmentation pattern, and retention time (R_t), compounds were identified.

Gas Chromatography Mass Spectrometric (GC-MS) Analyses

Phytochemical investigation of *P. biglobosa* n-hexane fraction was conducted following the procedure outlined by Kanthal *et al.* (2014), utilizing a gas chromatography-mass spectrometry system from Thermo Scientific Co., specifically the Thermo GC-TRACE ultra-version:5.0, coupled with the Thermo MSDSQII.

Experimental conditions for the GC-MS system involved the use of a TR 5-MS capillary standard non-polar column 30 m, 0.25 mm wide and 0.25 µm thick. Carrier gas used was helium (He), with a flow rate set at 1 ml/min. The temperature programme started at 40 °C and was increased to 250 °C at a rate of 5 °C/min. One microlitre of sample dispersed in n-hexane was injected into the system and it was fully run between 50 and 650 m/z. The Wiley Spectral library search tool was used to compare the results that were obtained.

Statistical Analysis

Statistical analysis was employed to compute the mean values along with the standard error of the mean (SE). SPSS version 23 statistical software was applied for the Analysis of Variance (ANOVA) and Scheffe post-hoc test was used to compare among group means. All statistical tests were judged significant at p=0.05.

RESULTS

A total yield of 770 g was obtained from the powdered seed of *P. biglobosa* (4 Kg) representing 19.3% of the methanol crude extract. The toxicity of crude extract (MeOH) and fractions of *P. biglobosa* against *M. bellicosus* at different concentrations is presented in Table 1. The highest toxicity was observed for the aqueous fraction with mean percentage mortality of 99.4% within 24 hours, followed by the crude extract (82.9%) at the highest concentration (125 mg/ml). The hexane fraction exhibited mortality levels of 55.1%, 69.1%, and 78.8% at concentrations of 31.3 mg/mL, 62.5 mg/mL, and 125 mg/mL, respectively. The mortality levels for the ethyl acetate fraction were 29.4%, 40.5%, and 65.4% at concentrations of 31.25 mg/mL 62.5 mg/mL, and 125 mg/mL, respectively.

Table 1: Mean Percentage Mortality of Methanol Extract and Fractions of *Parkia biglobosa* against *Macrotermes bellicosus* at Different Concentrations within 24 Hours

Concentration (mg/ml)	Methanol Extract	F (P- Value)	Aqueous Fraction	F (P-Value)	Ethyl-acetate Fraction	F (P-Value)	N-hexane Fraction	F (P-Value)
31.25	60.2±8.1^{a}	43.7(.000)	88.1±4.4^{b}	64.6(.000)	29.4±6.3^{b}	44.0(.000)	55.1±8.1^{a}	57.9(.000)
62.5	70.8±7.1^{a}	25.7(.000)	96.1±2.0^{a}	10.6(.000)	40.6±6.9^{a}	19.0(.000)	69.0±6.8^{a}	50.6(.000)
125	82.9±5.4^{a}	10.7(.000)	99.4±0.6^{a}	1.0(.458)	65.4^{b}±7.38	1.0(.458)	78.8±6.6^{a}	15.4(.000)

Note: Means followed by different superscript letters within the same row are significantly ($p<0.05$) different using Scheffec post-hoc test.

The median lethal concentrations (LC_{50}) at 8 hours of exposure to *P. biglobosa* extract and fractions are presented in Table 3. The LC_{50} values at 95% confidence level were 96.08±0.03 mg/ml for crude extract, 106.4±0.02 mg/ml for n-hexane fraction, 153.4±0.01 mg/ml for ethyl acetate fraction, and 23.86±0.01 mg/ml for aqueous methanol fraction. The aqueous fraction showed the highest toxicity and ethyl acetate fraction had the least toxicity.

Repellency/Attractant (Choice Test)

The results from the repellency test depicted in Table 2, indicate that the crude extract and fractions exhibited repellent properties against termites at the dose of 125 mg/ml. Aqueous methanol fraction of *P. biglobosa* showed the highest mean percentage repellency of 47.8%, followed by n-hexane (38.9%), ethyl acetate (33.9%) and methanol extract (16.1%).

The F-statistics was 4.8 ($p<0.04$), indicating that there were statistically significant differences among the repellent actions of the aqueous, n-hexane, and ethyl acetate fractions of *P. biglobosa*. However, results of post-hoc tests conducted to further explore pairwise comparisons between treatments revealed significant values of 0.080 and 0.458 between methanol extract and ethyl acetate fraction, as well as between methanol extract and n-hexane fraction, respectively.

Table 2: Mean Percentage Repellency of Methanol Extract and fractions of *Parkia biglobosa* at 125 mg/mL

Sample	N	Mean ± Standard Error	F- Statistics
Methanol extract	18	16.1^{a} ± 3.3	
Aqueous fraction	18	47.8^{c} ± 5.2	4.468***
Ethyl-acetate fraction	18	33.9^{ab}± 7.0	(0.004)
N-hexane fraction	18	35.6^{ab} ± 5.4	

Note: Mean followed by different superscript letters within the same column are significantly ($p < 0.004$) different using Scheffec post-hoc test.

LC-MS from Aqueous Methanol Fraction of *Parkia biglobosa* Seed

Nine chemical compounds were detected in the aqueous methanol fraction of *Parkia biglobosa* seed as presented in Figure 1. On the basis of the precursor ion (base peak ion), product ions, and molecular weight, six out of the nine compounds detected in the aqueous methanol fraction of *Parkia biglobosa* seed were identified (Table 3).

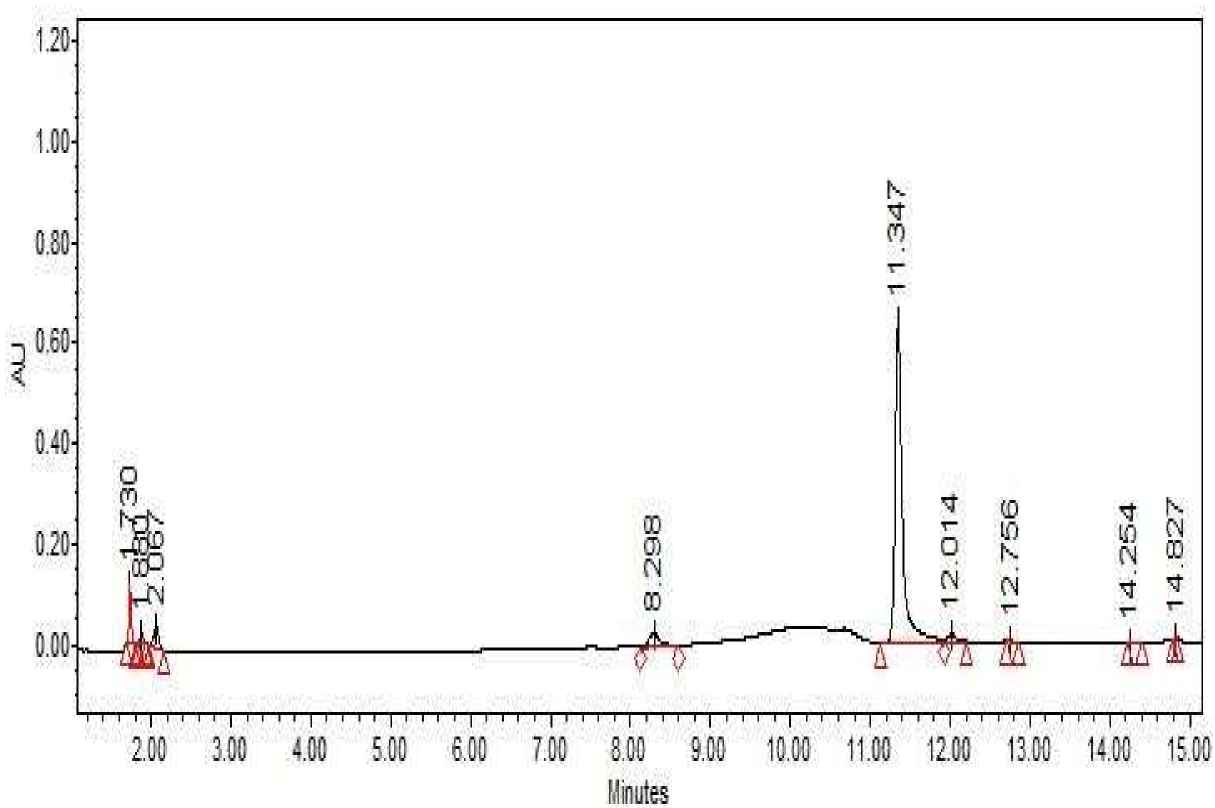
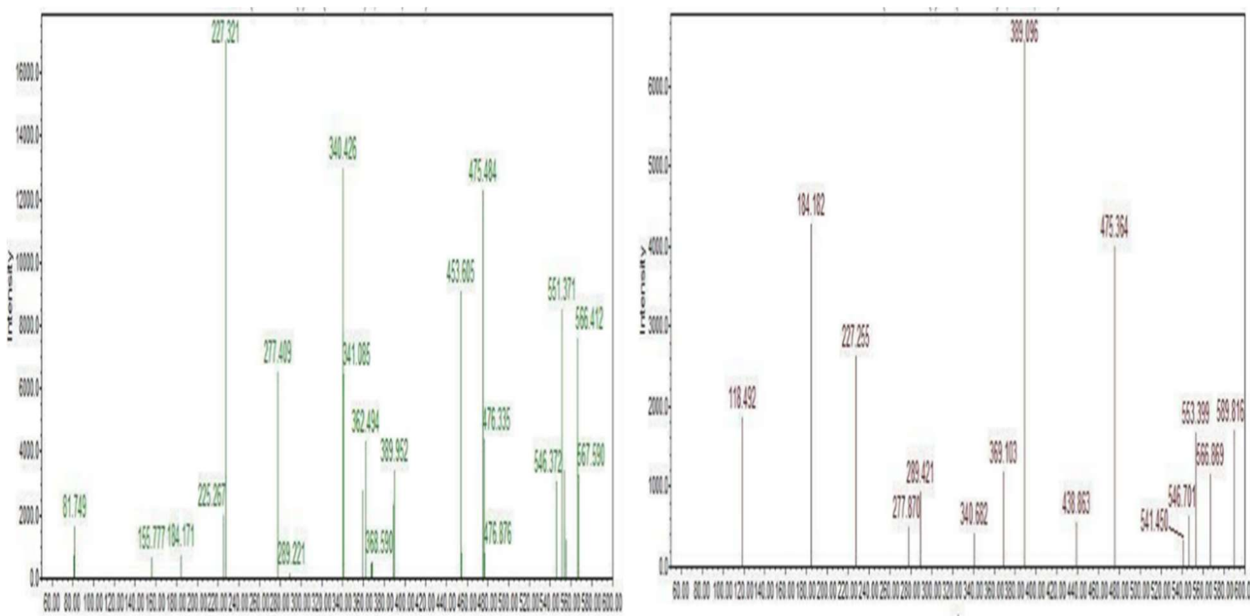


Figure 1: LC-MS chromatogram of aqueous methanol fraction of *Parkia biglobosa* seed

Table 3: The identified compounds from aqueous fraction of *Parkia biglobosa* seed

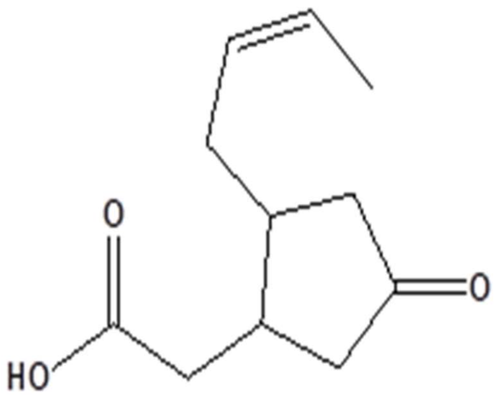
Peak No	Retention Time (min)	Compounds	Molecular Formular	Base Peak Ion (m/z)	Product Ions (m/z)	Molecular Weight (g/mol)
1	1.73	Ondansetron (Carbazoles)	$C_{18}H_{19}N_{3}O$	292.926	174.192, 174.772, 210.571, 232.793.	293
2	1.88	Gardenin B (8-O-Methylated flavonoids)	$C_{19}H_{18}O_7$	359.511	118.092, 134.115, 214.567, 225.267, 227.188.	358
3	2.067	Tuberonic acid (Jasmonic acid)	$C_{12}H_{18}O_3$	227.321	81.114, 81.749, 155.777, 184.171.	226
4	8.298	Allylphenol	$C_9H_{10}O$	134.097	134.097	133
5	12.014	Maklamicin (Sesterterpenoids)	$C_{32}H_{44}O_6$	523.3	156.477, 168.324, 232.917, 292.740, 312. 826	524
6	12.756	Quassin (Quassinoids)	$C_{22}H_{28}O_6$	389.285	104.379, 155.327, 214.489, 225.217, 277.472, 289.321,	388

Identification of two insect controlling compounds was accomplished through mass spectrometry analysis: jasmonic acid characterized by a precursor ion of 227.321 m/z and a retention time of 2.067 mins, and quassin featuring a precursor ion of 389.285 m/z and a retention time of 12.756 mins. The mass spectral data of identified termicidal compounds (Figure 2) and the chemical structures of jasmonic acid and quassin are shown in Figure 3.

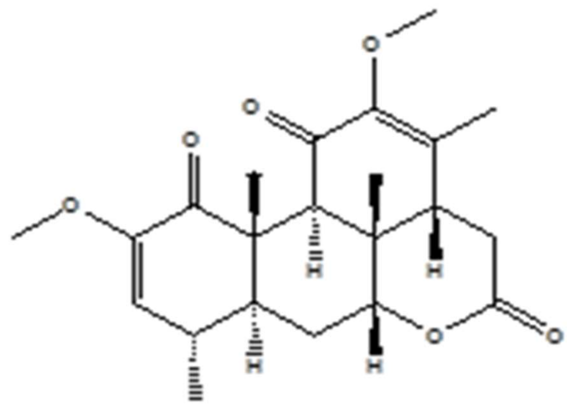


Jasmonic acid **Quassin**

Figure 2: Mass spectra of termiticidal compounds from aqueous methanol fraction of *Parkia biglobosa* seed



Jasmonic acid



Quassin

Figure 3: Termiticidal compounds from aqueous methanol fraction of *Parkia biglobosa* seed

GC-MS from of *Parkia biglobosa* Seed N-hexane Fraction

The chromatogram from GC-MS analysis of the n-hexane fraction derived from *Parkia biglobosa* seeds is illustrated in Figure 4. The most abundant compound detected was terephthalic acid, having a peak area of 18.17% and retention time (R_t) of 57.65. This was followed by octadecanoic acid, with a peak area of 8.78% and R_t of 30.98, while the least abundant compound identified was 2-nonenal, (Z) -, with a peak area of 0.15% and R_t of 11.56. The spectrum displayed various aliphatic acids, aromatic compounds, and ketones, predominantly consisting of long-chain hydrocarbons.

Among the identified compounds were nonanoic acid, stigmasterol, hexadecanoic acid, hexadecanoic acid methyl ester, 2-heptanone, and 1, 2-benzenedicarboxylic acid. The identified termiticidal constituents are hexadecanoic acid, methyl ester, furan, 2-pentyl- , 2-nonenal, (Z)-, nonanal, n-caproic acid vinylester, 1, 2-benzenedicarboxylic acid, diisooctyl ester and stigmasterol.

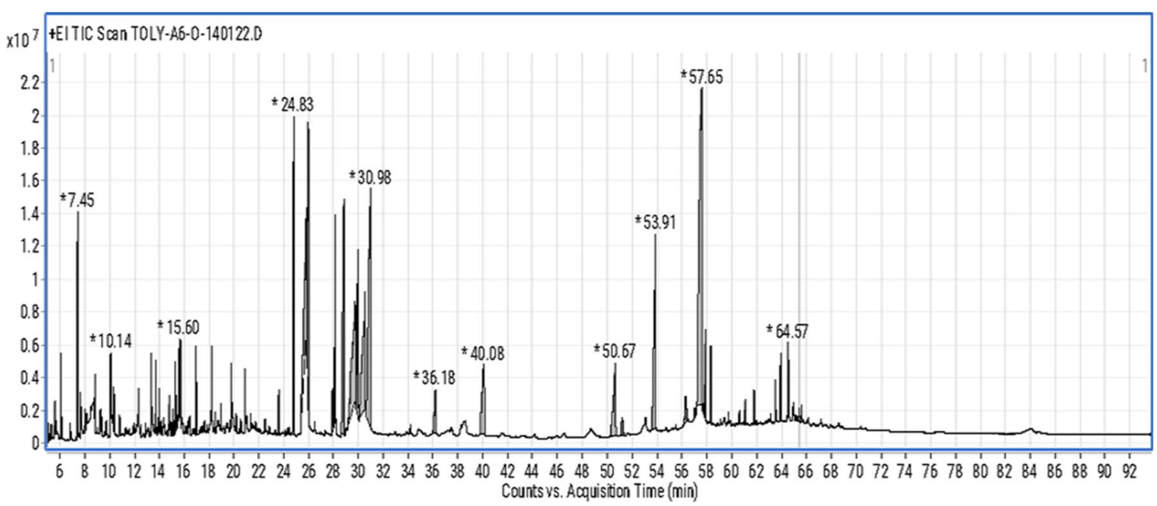
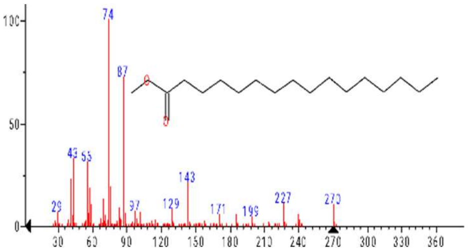
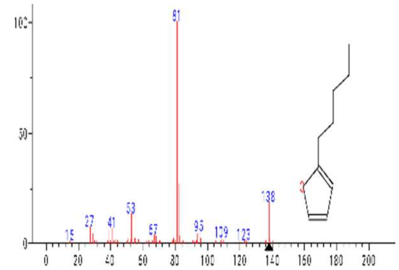


Figure 4: GC-MS Chromatogram from N-hexane Fraction of *Parkia biglobosa* Seed

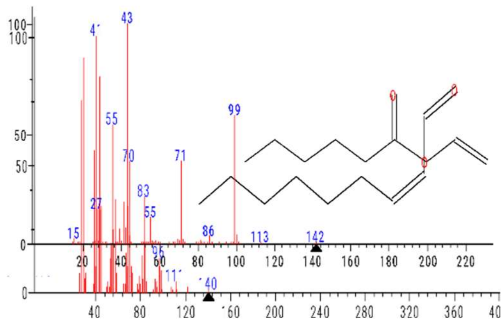
Table 4: Some Compounds Identified from N-hexane Fraction of *Parkia biglobosa* Seeds

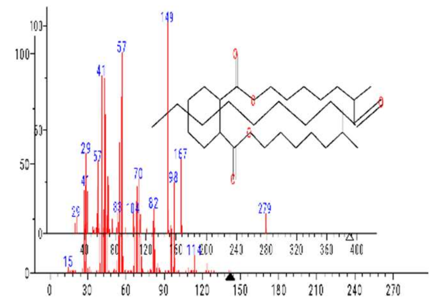
Peak No	Retention Time	Compound Name	Molecular Formular	Molecular Weight (g)	Area %
2	5.34	2-heptanone	$C_7H_{14}O$	114	0.1
5	6.14	hexanoic acid, methyl ester	$C_7H_{14}O_2$	130	0.5
8	7.72	furan,2-pentyl-	$C_9H_{14}O$	138	0.26
13	9.37	n-caproic acid vinyl ester	$C_8H_{14}O_2$	142	0.13
15	10.35	Nonanal	$C_9H_{18}O$	142	0.28
18	11.56	cis-2-nonenal	$C_9H_{16}O$	140	0.03
33	24.83	hexadecanoic acid, methyl ester	$C_{17}H_{34}O_2$	270	4.73
41	30.58	octadecanoic acid	$C_{18}H_{36}O_2$	284	6.66
46	51.24	1,2-benzenedicarboxylic acid, diisooctyl ester	$C_{24}H_{38}O_4$	390	0.48
50	57.65	terephthalic acid, di (2-ethylhexyl) ester	$C_{24}H_{38}O_4$	390	18.17
55	63.93	Stigmasterol	$C_{29}H_{48}O$	412	0.71





hexadecenoic acid, methyl ester **furan, 2-pentyl-**
2-nonenal, (Z) **nonanal**





n-caproic acid vinyl ester **1,2-benzenedicarboxylic acid, diisooctyl ester**
Stigmasterol

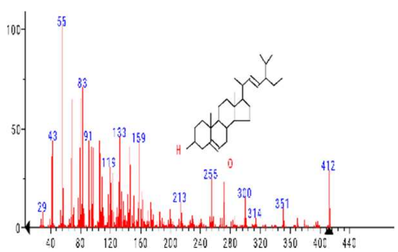


Figure 5: Mass Spectra of Some Termiticidal Compounds from *Parkia biglobosa* Seed N-hexane Fraction

DISCUSSION

The toxicity assessment revealed that both the *P. biglobosa* extract and fractions were toxic to the termites. Moreover, as the dose rose from 31.25 to 125mg/ml, the toxicity significantly increased.

Notably, the aqueous fraction *of P. biglobosa* exhibited the lowest concentration (23.86±0.01 mg/ml) required to cause 50% mortality of termites with 95% confidence intervals.

In the investigation of the chemical constituents and termiticidal effect of *P. biglobosa* by Femi-Ola (2008), the raw seed extract showed activity while the boiled seed extract did not. It was observed that heavy metals like lead (Pb), copper (Cu), nickel (Ni), cadmium (Cd), and cobalt (Co), which were discovered in raw seeds, were not detected in cooked seeds. Cheng (1990) reported that these heavy metals, naturally occurring in the earth crust, are toxic at low doses. Omafubve *et al.* (2004) suggested that these heavy metals likely escaped during the boiling process. This may explain the rationale behind using water extract obtained during the preparation of locust beans from fermented *P. biglobosa* seeds as a remedy for termite control locally (Ivbijaro *et al.,* 1993; Malaka, 1996). According to Olugbemi (2012), the interaction between polar organic compounds and heavy metals found in the raw seed extracts may be the cause of *P. biglobosa* seed's termiticidal effect. Indeed, plants serve as natural laboratories where a vast array of chemical compounds is biosynthesized, making them invaluable sources of chemical substances (Muhammad *et al*., 2015).

In previous studies, the termite controlling property of *P. biglobosa* seed extracts was investigated against various termite species. Femi-Ola (2008) found that *P. biglobosa* seed aqueous and acetone extract exhibited dose-dependent anti-termite activity against *Amitermes evuncifer* Silvestri, with termites mortality within 40 and 110 mins at concentrations of 0.4 g/ml of aqueous and acetone extracts, respectively. Similarly, Olugbemi (2012) studied the anti-termite activity of *P. biglobosa* against *Coptotermes intermedius* Silvestri and found termites mortality in 30 mins, 40 mins, and 110 mins on exposure to treatments at concentrations of 4g/ml for the aqueous, alcoholic, and acetone extracts, respectively.

In order to ensure food, animal, and environmental safety, repellents are advantageous in pest management since plants with repellent properties typically have minimal adverse effects on the environment, as they prompt pests to flee through the stimulation of their sensory organs before causing plant damage (Addisu *et al.,* 2014). The methanol extract and fractions derived from *P. biglobosa* demonstrated repellent effects on both worker and soldier termites of *M. bellicosus*. According to the classification of repellency proposed by Juliana and Su (1983), the aqueous methanol fraction showed the highest repellent action at 47.8%, categorizing it under Class III. In contrast, the methanol extract showed the lowest repellent activity at 16.1%, falling into Class I. Meanwhile, the ethyl acetate and n-hexane fractions displayed repellent activities of 33.9% and 38.9%, respectively, placing them in Class II. The statistical analysis, with an F-Statistics value of 4.468, indicated significant difference ($p<0.004$) among the test samples.

The liquid chromatography mass spectrometry analyses of aqueous methanol fraction of *P. biglobosa* seed indicated the presence of two termiticidal constituents: jasmonic acid and quassin. Through the octodecanoid route, linolenic acid is converted into jasmonic acid, sometimes referred to as tuberonic acid (a naturally occurring plant hormone). When insect herbivores attack a plant, they usually emit jasmonic acid, which increases the production of defensive chemicals and strengthens the plant's resistance to herbivory (Pickett *et al.,* 2006). Studies conducted in Germany have demonstrated the effectiveness of jasmonic acid exogenously applied to wheat plants against *S. mosellana* protecting the kernels from spoilage and increasing produce (El-Wakeil *et al*., 2010). Jasmonic acid has been reported to trigger resistance against various insect pests (Senthil- Nathan *et al.,* 2009).

Quassin is a member of the quassinoids, a class of highly oxygenated, structurally complex degraded triterpenes that are classified into five categories based on their core skeleton: C-18, C-19, C-20, C-22, and C-25. During the late 17th century, extracts from *Quassia amara* were applied to treat insects for the first time. It exhibits antifeedant activity against various pests, including aphids, the southern armyworm and Mexican bean beetle. Several quassinoids, such as glaucarubinone, simalikalactone, isobrucein, and bruceantin, also demonstrate antifeedant and insecticidal effects on insects (Guo *et al*., 2005).

Interestingly, the *P. biglobosa* seed n-hexane fraction also contained several termiticidal chemical compounds. Methyl palmitate, also known as hexadecanoic methyl ester, has been documented to possess toxicity and acaricidal activity against *Tetranychus cinnabarinus*, a pest commonly found on strawberries and various horticultural crops (Wang *et al.*, 2009). Additionally, hexadecanoic methyl ester and hexadecanoic acid, as reported by Abdullah (2019), have pesticidal properties. Palmitic acid (n-hexadecanoic acid) has been shown to exhibit insectistatic effects against *Spodoptera frugiperda*, a pest that affects staple crops like rice, sorghum, maize, and soybean (Montezano *et al.*, 2018). Another compound identified, ethyl hexadecanoate, demonstrated toxicity against *Bemisia tabaci* (sweet potato whitefly) in a research conducted by Cruz-Estrada *et al.* (2013). Stearic acid (octadecanoic acid) exhibits larvicidal properties against *Culex quinquefasciatus*, a species of mosquito (Kannathasan *et al.*, 2008). Furthermore, stigmasterol has been shown to be cytotoxic to *Spodoptera litura*, a pest that causes damage to various economically important cultivated field crops (Huang *et al*., 2009).

CONCLUSION

The efficacy of botanical insecticides in termite control can be attributed to their composition, which includes a diverse array of natural bioactive compounds. The abundance of insecticidal organic compounds found in *Parkia biglobosa* seeds clarifies its dual action of toxicity and repellency against termite, thereby justifying their traditional role in termite control**.**

REFERENCES

Abdullah, R. R. H. 2019. Insecticidal activity of secondary metabolites of locally isolated fungal strains against some cotton insect pests. *Journal of Plant Protection and Pathology* 10 (12): 647-653.

Abdullah, Z. A., Ahmed, A. Z. and Refeat, A. A. 2014. Insecticidal activities of some plant extract against subterranean termites, *Psammotermes hybostoma* (Deneux) (Isoptera: Rhinotermitidae) *International Journal of Agricultural Science.* 4 (9): 257-260.

Acda, M. N. 2014. Repellent effects of *Annona* sp. crude extract on the Asian subterranean termite *Coptotermes gestroi* Wasman (Isoptera: Rhinotermitidae). *Sociobiology* 61 (3), 322–337.

Addisu, S., Mohamed D. and Waktole, S. 2014. Efficacy of botanical extracts against termites, *Macrotermes* spp., (Isoptera: Termitidae) under laboratory conditions. *International Journal of Agricultural Research* 9 (2), 60-73.

Ahmad, F., Fouad, H., Liang, S., Hu, Y. and Mo, J. 2019. Termites and Chinese agricultural system: applications and advances in integrated termite management and chemical control. *Insect Science* 28 (1):2–20.

Ali, A.D., Ior, L. D., Dogo, G. A., Joshua, J. I. and Gushit, J. S. 2022. Ethnobotanical survey of plants used as biopesticides by indigenous people of Plateau state, Nigeria. *Journal of Diversity* 14 (10), 851:1–18.

Cheng, H. H. 1990. Pesticides in the soil environment: Processes, impacts, and modeling, W/S Soil Science Society of America, 2 Wis, USA. Retrieved August 8, 2020 from https://www.cabdirect.org/cabdirect/abstract/19912304076.

Cruz-Estrada, A., Gamboa-Angulo, M., Borges-Arga´ez, R. and Ruiz-

Sa´nchez, E. 2013. Insecticidal effects of plant extracts on immature whitefly, *Bemisia tabaci* Genn. (Hemiptera: Aleyroideae). *Electron Journal Biotechnology* 16 (1): 1-9

Elango, G, Rahuman, A. A. Kamaraj, C. Bagavan, A. Zahir, A. A. Santhosh, K. T., Marimuthu, S. Velayutham, K., Jayaseelan, C., Vishnu, K. A. and Rajakumar, G. 2012. Efficacy of medicinal plant extracts against Formosan subterranean termite, *Coptotermes formosanus*. *Journal Industrial Crops and Products* 36: 524–530.

Femi-Ola, T. O., Ajibade, V. A. and Afolabi, A. 2008. Chemical composition and termicidal properties of *Parkia biglobosa* (Jacq) Benth. *Journal of Biological Sciences* 8: 494-497.

Guo, Z., Vangapandu, S., Sindelar, R. W., Walker, L. A., Sindelar, R. D. 2005. Biologically active quassinoids and their chemistry: potential lead for drug design. *Current Medicinal Chemistry* 12 (2), 173–190.

Haouas, D., F. Guido, B. H. K. Monia and Habib, B. H.M. 2011. Identification of an insecticidal polyacetylene derivative from *Chrysanthemum macrotum* leaves. *Industrial Crops Production* 34: 1128-1134.

Huang, J. G., Zhou, L. J., Xu, H. H. and Li, W. O. 2009. Insecticidal and cytotoxic activities of extracts of *Cacalia tangutica* and its two active ingredients against *Musca domestica* and *Aedes albopictus*. *Journal of Economic Entomology* 102: 1444–1447.

Ivbijaro, M. F., Mutsaers, H. J. W. and Umeh, V. C. 1993. Laboratory toxicity of the crude extracts of *Piper guineense* Schum& Thonn, *Azadirachta indica* A Juss and *Parkia biglobosa* (Jacq) on termites *Macrotermes nigeriensis*. *Insect Science and its Application* 14 (2) 229-233.

Julianna, G. H. C. F. and Su, H. C. F. 1983. Laboratory studies on several plant materials as insect repellents for protection of cereal grains. *Journal of Economic Entomology* 76:154- 157.

Kannathasan, K., Senthilkumar, A., Venkatesalu, V. and Chandrasekaran, M. 2008. Larvicidal activity of fatty acid methyl esters of *Vitex* species against *Culex quinquefasciatus*. *Parasitology Reserve* 103: 999-1001.

Kanthal, L. K., Dey, A., Satyavathi, K. and Bhojaraju, P. 2014. GC-MS analysis of bio-active compounds in methanolic extract of *Lactuca runcinata* DC. *Pharmacognosy Research* 6 (1): 58–61.

Malaka, S. L. O. 1996. *Termites in West Africa.* University of Lagos Press, Lagos, Nigeria.

Montezano, D. G., Specht, A., Sosa-Gómez, D. R., Roque-Specht, V. F., Sousa-Silva, J. C. Paula-Moraes, S. V., Peterson, J. A. and Hunt, T. E. 2018. Host plants of *Spodoptera frugiperda* (Lepidoptera: Noctuidae) in the Americas. *African Entomology* 26 (2), 286-300.

Muhammad, S. 2015. The killer chemicals for control of agriculture insect pests: the botanical insecticides. *International Journal of Chemical and Biomolecular Science* 1 (3), 123–128.

Noor, H. B., Hamady, D., Shaida, F. S. and Abdul, H. A. M. 2018. Evaluation of the toxicity and repellency of tropical plant extract against subterranean termites, *Globitermes sulphureus* and *Coptotermes gestroi*. *Information Processing in Agriculture* 5: 298–307.

Ojewunmi M. E., Ogunbiyi, I. and Adeoye, J. 2017. Termiticidal Effects of African Locust Bean (*Parkia biglobosa*) Seed Oil Extracts. *International Journal of Current Research,* 9 (7): 53929-53939.

Okori, B. C., Oryema, C., Opiro, R., Amos, A, Obici, G. I., Rutaro, K., Geofrey, M. Malinga, G. M. and Sande, E. 2022. Ethnobotanical survey of plants locally used in the control of termite pests among rural communities in Northern Uganda. *Centre for Agriculture and Bioscience International* 3(1), 37, **1–10**

Olugbemi, B. 2012. Termiticidal activity of *Parkia biglobosa* (Jacq) Benth seed extracts on the termite *Coptotermes intermedius* Silvestri (Isoptera: Rhinotermitidae). Psyche: *Journal of Entomology* 869415:1-5

Omafuvbe, B. O. Falade, O. S. Oshuntogun, B. A. and Adewusi, S. R. A. 2004. Chemical and Biochemical Changes in African Locust Bean (*Parkia biglobosa*) and Melon (*Citrullus vulgaris*) Seeds during Fermentation to Condiments. *Pakistan Journal of Nutrition* 3 (3):140–145.

Pickett, J. A., Bruce, T. J., Chamberlain, K., Hassanali, A., Khan, Z. R., Matthes, M. C. 2006. Plant volatiles yielding new ways to exploit plant defense. *Chemical ecology: from gene to ecosystem* (Eds. M. Dicke and W. Takken), Springer Publishing, Dordrecht, Netherlands. Frontis Series 16: 161–173.

Piovesana, A., Rodrigues, E. and Norena, C. P. Z. 2019. Composition analysis of carotenoids and phenolic compounds and antioxidant activity from hibiscus Calyces (*Hibiscus sabdariffa* L.) by HPLC-DAD-MS/MS. *Phytochemical Analysis* 30 (2): 208-217.

Senthil- Nathan, S. K. K., Choi, M. Y.and Paik, C. H. 2009. Effects of jasmonic acid-induced resistance in rice on the plant brown hopper, *Nilaparvata lugens* Stal (Homoptera: Delphacidae). *Pesticide Biochemistry and Physiology* 95:77- 84.

Sattar A., Naeem M. and Ehsan-ul-Haq 2014. Efficacy of Plant Extracts Against Subterranean Termites i.e., *Microtermes obesi* and *Odontotermes lokanandi* (Blattodea:Termitidae). *Journal of Biodiveritys Biopropecting Development* 1(2):122

Verma, M. Sharma, S. and Prasad, R. 2009. Biological alternatives for termite control: a review. *International Biodeterioration Biodegradation* 63 (8):959–972.

Wang, Y. N., Wang, H. X., Shen, Z. J., Zhao, L. L., Clarke, S. R., Sun, J. H., Du, Y. Y. and Shi, G. L. 2009. Methyl palmitate, an acaricidal compound occurring in green walnut husks. *Journal of Economical Entomology* 102: 196–202

NJE Vol. 41(2): 16-30, 2025
Nigerian Journal of Entomology
Published by the Entomological Soc. of Nig.
www.esnjournal.com.ng
DOI.10.36108/NJE/5202/14.0220