plants

MDPI

Article

Insecticidal Activities and GC-MS Analysis of the Selected Family Members of Meliaceae Used Traditionally as Insecticides

Kolwane Calphonia Shilaluke * **and Annah Ntsamaeeng Moteetee**

Department of Botany and Plant Biotechnology, University of Johannesburg, P.O. Box 524, Auckland Park 2006, South Africa
* Correspondence: 201311632@student.uj.ac.za; Tel.: +27-78-850-7971

Abstract: The environmental and health risks associated with synthetic pesticides have increased the demand for botanical insecticides as safer and biodegradable alternatives to control insect pests in agriculture. Hence in this study, five Meliaceae species were evaluated for their insecticidal activities against the *Spodoptera frugiperda* and the *Plutella xylostella* larvae, as well as their chemical constituents. Repellence, feeding deterrence, and topical application bioassays were employed to evaluate their insecticidal activities. GC-MS analysis was performed to identify chemical compounds present in each plant. The repellence bioassay indicated that *Melia azedarach* extracts exhibited the highest repellence percentage against *S. frugiperda* (95%) and *P. xylostella* (90%). The feeding deterrence bioassay showed that *M. azedarach* and *Trichilia dregeana* extracts displayed excellent antifeeding activity against the *S. frugiperda* (deterrent coefficient, 83.95) and *P. xylostella* (deterrent coefficient, 112.25), respectively. The topical application bioassay demonstrated that *Ekebergia capensis* extracts had the highest larval mortality against *S. frugiperda* (LD_{50} 0.14 mg/kg). Conversely, *M. azedarach* extracts showed the highest larval mortality against *P. xylostella* (LD_{50} 0.14 mg/kg). GC-MS analysis revealed that all plant extracts had compounds belonging to the two noteworthy groups (phenols and terpenes), which possess insecticidal properties. Overall, this study lends scientific credence to the folkloric use of Meliaceae species as potential biocontrol agents against insect pests.

Keywords: antifeedants; botanical insecticides; insect pests; Meliaceae; synthetic pesticides

Citation: Shilaluke, K.C.; Moteetee, A.N. Insecticidal Activities and GC-MS Analysis of the Selected Family Members of Meliaceae Used Traditionally as Insecticides. *Plants* **2022**, *11*, 3046. https://doi.org/10.3390/plants11223046

Academic Editors: Carmen Formisano, Vincenzo De Feo and Laura De Martino

Received: 10 October 2022
Accepted: 4 November 2022
Published: 10 November 2022

1. Introduction

The agricultural sector has always been faced with challenges due to insect pests and will continue to do so in the future [1]. These pests damage crops during the growing period, and they may also subsequently cause damage to the harvested products stored in storehouses [2]. Controlling insect pests remains a problem as the insects keep building resistance to common pesticides while, on the other hand, toxic pesticides are being removed from the markets [1]. Synthetic pesticides have been commonly used and are considered a highly effective means of controlling plant damage caused by insects [3], which leads to remarkable improvements in plant yield productivity [4]. However, the indiscriminate and haphazard usage of synthetic pesticides has adversely affected human health and the ecosystem as a whole [5].

The presence of pesticide residues in foods, fruits, vegetables, and even in breastfeeding mothers' milk creates a threat to human health. In developing countries, nearly 3 million farmworkers experience severe pesticide poisoning, resulting in about 18,000 deaths, while 25 million workers suffer from mild pesticide poisoning each year [6]. The use of synthetic pesticides also raises several environmental concerns because over 5% of the sprayed synthetic pesticides do not reach their target insect pests; instead, they can be found in air, soil, and water streams [7]. As a result of these devastating occupational synthetic pesticide poisoning cases, research to find alternative methods that are environmentally friendly and cost-effective in controlling insect pests has increased [1].

Based on recent studies to find ways to mitigate problems caused by synthetic pesticides, natural bio-insecticides from medicinal plants can be an excellent alternative strategy to overcome pest resistance and environmental contamination [8]. This possibility is not surprising as plants are rich sources of bioactive chemicals, and botanical insecticides have been reported to have fewer adverse effects on the environment or human health [1].

Meliaceae is one of two flowering plant families that have gained considerable attention, whereby systematic investigations of its members for their insecticidal potential have been undertaken [9,10]. Chemicals extracted from members of the Meliaceae have received attention recently from applied entomologists due to their excellent properties as control agents for insects [11]. This knowledge has prompted the interest to assess other family members for their insecticidal and antifeedant properties in this study.

Plutella xylostella (L.) (Lepidoptera: Plutellidae), commonly known as the diamondback moth (DBM) or the cabbage moth, is an economically important pest of cruciferous plants globally [12]. The Diamondback moth is an oligophagous insect that mainly feeds on cole crops, including broccoli, brussels sprouts, canola, cauliflower, and cabbage, which are of essential economic value [13]. The insect is important in agriculture as causes yield losses of as much as 100% [14]. In the 1970s, there was a major outbreak of DBM, mainly due to the development of resistance to synthetic insecticides [13]. It has been estimated that the yield losses and control associated with diamondback moth globally ranged between 4–5 US billion dollars yearly [14]. In sub-Saharan Africa, crop losses due to diamondback moths have been reported to be between 8–22% in the field [15].

Spodoptera frugiperda (J.E. Smith) (Lepidoptera: Noctuidae), commonly known as the fall armyworm (FAW), is a polyphagous insect that is important in agriculture as it is difficult to control and, as a result, causes a lot of damage [16]. This migratory insect also causes enormous economic losses, mainly attacking crops that form part of the primary staple food [17], including rice, maize, forage grasses, sorghum, alfalfa, vegetable crops, and many others [16]. The first case to be reported in Africa of the fall armyworm was in late 2016, when it attacked most West African farms and subsequently spread throughout the continent rapidly and is now found in 44 African countries [18]. Environmentally friendly and effective methods to control fall armyworms are crucial as these insects are heavy foliage feeders [17] and can result in the total loss of crops. In sub-Saharan Africa, maize, rice, sorghum, and sugarcane crop damage is estimated to cause up to USD 13 billion yearly [19].

Ever since plant-derived products have gained increased attention from researchers to assess their insecticidal properties, more than 2000 plant species have been recorded to be used traditionally as insecticides [20]. However, many studies that attempted to validate these properties scientifically are incomplete; the bioassays procedures used were usually inappropriate or inadequate [21]. As a result, biological compounds that are potentially useful remain uninvestigated, undiscovered, underutilized, or undeveloped from this reservoir of unstudied plant materials [22]. Hence, in this study, four Meliaceae species that had previously not been evaluated extensively for their insecticidal and antifeedant properties against the test insects *S. frugiperda* and *P. xylostella* were selected. *Melia azedarach* was chosen as a positive control as it is a well-known bioinsecticide plant. Water extracts were selected for extraction in this study because it is one of the simplest and safest (non-toxicity) solvents. In addition, aqueous plant extracts are traditionally used to control insect pests. Using aqueous extracts is fitting because the main purpose of this study is to identify safer, cost-effective, and renewable alternative methods to synthetic pesticides. Slightly polar acetone and ethanol extracts were selected because the main targeted compounds, limonoids (terpenes), were reported to have a higher solubility in polar solvents and alcohol [23].

2. Results

2.1. Antifeedant and Insecticidal Analysis

2.1.1. Repellence Test

Repellence Bioassay against *S. frugiperda* Larvae

Table 1 indicates the results of the repellence bioassay test of the five selected Meliaceae species against the *S. frugiperda*. Positive average percentage repulsion values exhibit repellence, and negative average percentage repulsion values exhibit attractancy. Plant extracts that are ranked in higher classes (i.e., III, IV, and V) are considered to have a high repellence against the larvae, and those that are ranked to lower classes (I and II) have partial repellence against the larvae. Aqueous and ethanolic extracts of *Melia azedarach* L. and *Trichilia dregeana* Harv. & Sond. acetone extracts were found to have strongly repelled the *S. frugiperda* larvae with repellence of 95%, 65%, and 71%, and they belonged to class V, IV, and IV, respectively. It is followed by aqueous extracts of *Turraea floribunda* Hochst. (49%) belonging to class III. Aqueous and ethanol extracts of *T. dregeana* and ethanolic extracts of *Turraea obtusifolia* Hochst. moderately repelled the *S. frugiperda* with repellence of 40%, 30%, and 30%, respectively. Aqueous and acetone extracts of *T. obtusifolia* were recorded to have the lowest repellency (3% and 5%) and were all assigned to the lowest class (I). Ethanolic extracts of *T. floribunda* (−55%) indicated *S. frugiperda* larvae stimulation.

Table 1. Average repellence of five Meliaceae species leaf extracts against *Spodoptera frugiperda* larvae using the treated filter paper test.

	Plant Species	Extract	Dose/ Concentration (%)	Percentage Repulsion (PR) = 2 × (C − 50) in Hours C = Is the Percentage of Insects on the Untreated Half of the Disk				Average (PR)	Class
				1 H	2 H	3 H	4 H		
1.	*Ekebergia capensis* Sparrm	Aqueous	0.5	60	60	0	100	33	II
			1.0	−20	20	20	20		
		Acetone	0.5	−20	20	20	20	15	I
			1.0	20	20	60	−20		
		Ethanol	0.5	60	20	20	20	10	I
			1.0	−60	−20	20	20		
2.	*Melia azedarach* L.	Aqueous	0.5	100	100	100	100	95	V
			1.0	100	60	100	100		
		Acetone	0.5	20	60	0	0	28	II
			1.0	60	−20	100	0		
		Ethanol	0.5	20	100	20	20	65	IV
			1.0	100	100	60	100		
3.	*Trichilia dregeana* Harv. & Sond.	Aqueous	0.5	20	20	20	20	40	II
			1.0	20	60	60	100		
		Acetone	0.5	60	60	50	0	71	IV
			1.0	100	100	100	100		
		Ethanol	0.5	100	60	−60	−60	30	II
			1.0	20	60	60	60		
4.	*Turraea floribunda* Hochst.	Aqueous	0.5	−60	100	100	100	49	III
			1.0	0	100	0	50		
		Acetone	0.5	60	60	20	100	20	I
			1.0	100	−100	−60	−20		
		Ethanol	0.5	−60	−100	−60	−100	−55	-
			1.0	−60	−60	20	−20		

Table 1. *Cont.*

	Plant Species	Extract	Dose/ Concentration (%)	Percentage Repulsion (PR) = 2 × (C − 50) in Hours C = Is the Percentage of Insects on the Untreated Half of the Disk				Average (PR)	Class
				1 H	2 H	3 H	4 H		
5.	*Turraea obtusifolia* Hochst.	Aqueous	0.5	0	0	5	0	3	I
			1.0	−20	−20	20	20		
		Acetone	0.5	60	−20	60	−20	5	I
			1.0	−20	−20	−20	20		
		Ethanol	0.5	−20	20	20	20	30	II
			1.0	20	60	60	60		

Repellence Bioassay against *P. xylostella* Larvae

Table 2 indicates the average percentage repulsion for the five Meliaceae species screened for their repellence activity against *P. xylostella* larvae. The overall highest percentage repulsion against the *P. xylostella* larvae was recorded for the aqueous (90%) and ethanol (80%) extracts of *Melia azedarach*, meaning that they exhibited excellent repellent activity, hence they were assigned to classes V and IV, respectively. Good repellent activity against *P. xylostella* was also recorded for acetone (65%) and ethanol (65%) extracts of *T. dregeana*, and they were assigned to class IV. Extracts of *E. capensis* moderately repelled *P. xylostella* larvae with repellence of 60% (aqueous), 50% (acetone), and 50% (ethanol), assigned to class III. All extracts of *T. obtusifolia*, i.e., aqueous (15%), acetone (30%), and ethanol (31%), recorded the lowest repellent activities against *P. xylostella.* Ethanolic extracts of *T. floribunda* (−10%) indicated the *P. xylostella* larvae stimulation.

Table 2. Average repellence of five Meliaceae species leaf extracts against *Plutella xylostella* larvae using the treated filter paper test.

	Plant Species	Extract	Dose/ Concentration (%)	Percentage Repulsion (PR) = 2 × (C − 50) in Hours C = Is the Percentage of Insects on the Untreated Half of the Disk				Average (PR)	Class
				1 h	2 h	3 h	4 h		
1.	*Ekebergia capensis*	Aqueous	0.5	60	60	100	100	60	III
			1.0	−20	20	60	100		
		Acetone	0.5	−20	20	60	100	50	III
			1.0	20	20	100	100		
		Ethanol	0.5	60	20	100	100	50	III
			1.0	−60	−20	100	100		
2.	*Melia azedarach*	Aqueous	0.5	100	100	100	100	90	V
			1.0	100	60	100	60		
		Acetone	0.5	20	60	20	20	35	II
			1.0	60	−20	60	60		
		Ethanol	0.5	20	100	100	60	80	IV
			1.0	100	100	100	60		
3.	*Trichilia dregeana*	Aqueous	0.5	20	20	60	60	45	III
			1.0	20	60	60	60		
		Acetone	0.5	60	60	60	20	65	IV
			1.0	100	100	60	60		
		Ethanol	0.5	100	60	100	60	65	IV
			1.0	20	60	60	60		

Table 2. *Cont.*

	Plant Species	Extract	Dose/ Concentration (%)	Percentage Repulsion (PR) = 2 × (C − 50) in Hours C = Is the Percentage of Insects on the Untreated Half of the Disk				Average (PR)	Class
				1 h	2 h	3 h	4 h		
4.	*Turraea floribunda*	Aqueous	0.5	−60	100	20	60	43	III
			1.0	0	100	100	20		
		Acetone	0.5	60	60	20	60	30	II
			1.0	100	−100	20	20		
		Ethanol	0.5	−60	−100	60	60	−10	-
			1.0	−60	−60	20	60		
5.	*Turraea obtusifolia*	Aqueous	0.5	0	0	60	60	15	I
			1.0	−20	−20	20	20		
		Acetone	0.5	60	−20	20	60	30	II
			1.0	−20	−20	60	100		
		Ethanol	0.5	20	−60	60	100	31	II
			1.0	60	−50	20	100		

2.1.2. Feeding Deterrence Test

Feeding Deterrence Activity of *S. frugiperda* Larvae

Table 3 indicates the feeding deterrent activity coefficients of Meliaceae species against the fall armyworm larvae. All extracts exhibited feeding activity against the larvae to a certain extent, except for the ethanolic extracts of *T. floribunda*, which were found to have inert antifeedant compounds against the *S. frugiperda* larvae with a feeding deterrent coefficient of −12.89. Of all the tested extracts, aqueous extracts of *M. azedarach* (83.92) and aqueous (68.44) and ethanol (67.29) extracts *T. obtusifolia* recorded the highest coefficient of deterrence, indicating a good feeding deterrence activity. Aqueous extracts of *T. floribunda* and aqueous extracts of *T. dregeana* moderately caused larvae fertility, with feeding deterrence coefficients of 66.96 and 62.02, respectively, ranked ++. Furthermore, ethanolic extracts of *E. capensis* and acetone extracts of *T. floribunda* were the least effective feeding deterrents against the *S. frugiperda* larvae.

Feeding Deterrence Activity of *P. xylostella* Larvae

Table 4 indicates the feeding deterrent activities of the studied Meliaceae species against the diamondback moth larvae. All plant extracts exhibited noteworthy deterrence against the *P. xylostella* larvae. All extracts of *T. dregeana* showed exceptionally high feeding deterrent activities, with acetone recording a 112.25 deterrence coefficient ranked +++, ethanol (99.39, ++), and aqueous (98.77, ++). Aqueous extracts of *T. obtusifolia* and ethanolic extracts of *E. capensis* moderately caused feeding deterrence of the larvae, with feeding coefficients of 86.74 and 85.79, respectively, both ranked ++. Meanwhile, aqueous (13.95, +) and acetone (25.93, +) extracts of *T. floribunda* were the least effective feeding deterrents against *P. xylostella* larvae.

Table 3. Feeding deterrent activity coefficient of five Meliaceae species leaf extracts against *Spodoptera frugiperda*.

Plant Species		Extract	Coefficient of Deterrence			Efficacy of Extracts
			Absolute (A)	Relative (R)	Total (T)	
1.	*Ekebergia capensis*	Aqueous	21.66	26.61	48.27	+
		Acetone	25.14	19.97	45.11	+
		Ethanol	−10.77	28.55	17.78	+
2.	*Melia azedarach*	Aqueous	48.04	35.88	83.92	++
		Acetone	58.14	3.43	61.57	++
		Ethanol	28.96	8.39	37.35	+
3.	*Trichilia dregeana*	Aqueous	29.95	32.07	62.02	++
		Acetone	29.01	23.84	52.85	++
		Ethanol	14.30	31.99	46.29	+
4.	*Turraea floribunda*	Aqueous	24.40	42.56	66.96	++
		Acetone	17.86	3.04	20.90	+
		Ethanol	3.04	−15.93	−12.89	0
5.	*Turraea obtusifolia*	Aqueous	40.91	26.38	67.29	++
		Acetone	17.51	17.17	34.65	+
		Ethanol	27.06	41.38	68.44	++

Table 4. Feeding deterrent activity coefficient of five Meliaceae species leaves extracts against *Plutella xylostella* larvae.

Plant Species		Extract	Coefficient of Deterrence			Efficacy of Extract
			Absolute (A)	Relative (R)	Total (T)	
1.	*Ekebergia capensis*	Aqueous	27.65	3.61	31.26	+
		Acetone	50.60	2.57	53.17	++
		Ethanol	40.39	45.40	85.79	++
2.	*Melia azedarach*	Aqueous	34.79	3.34	38.13	+
		Acetone	32.89	13.55	46.44	+
		Ethanol	56.13	4.13	60.26	++
3.	*Trichilia dregeana*	Aqueous	45.85	52.92	98.77	++
		Acetone	62.37	49.88	112.25	+++
		Ethanol	63.52	35.87	99.39	++
4.	*Turraea floribunda*	Aqueous	34.70	−20.75	13.95	+
		Acetone	49.41	−23.48	25.93	+
		Ethanol	49.65	−5.43	44.22	+
5.	*Turraea obtusifolia*	Aqueous	42.24	44.50	86.74	++
		Acetone	38.94	0.94	39.88	+
		Ethanol	55.43	−1.06	54.37	++

2.1.3. Topical Application Test

Contact Toxicity against *S. frugiperda* Larvae

Table 5 shows the direct contact toxicity of the Meliaceae plant extracts to the *S. frugiperda* larvae using different concentrations. Aqueous extracts of *T. dregeana* and *M. azedarach* exhibited a positive correlation, where the least concentrated extracts [0.5] showed less toxicity than the more concentrated extracts [1.0]. At [0.5], extracts recorded a 20% mortality rate, while [1.0] recorded an 80% mortality rate. The negative correlation between the concentration of extracts and the rate of mortality observed was recorded for *E. capensis* (acetone), *M. azedarach* (acetone and ethanol), and *T. floribunda* (acetone), where at [0.5] 20%, the mortality rate and at [1.0] mortality rate was 80%. Extracts that did not show any correlation and had constant mortality rates were aqueous extracts of *E. capensis* where, at [0.5] and [1.0], 80% of the larvae died, aqueous extracts of *T. floribunda* at [0.5] and [1.0] caused 60% mortality, and ethanolic extracts of *T. floribunda* at [0.5] and [1.0] caused 20% larval mortality. Probability unit (Probit) analysis showed that aqueous extracts of *E. capensis* (LD_{50} value of 0.14 mg/kg) and *T. floribunda* (LD_{50} value of 0.56 mg/kg) were more toxic to the *S. frugiperda* larvae. Probit analysis also indicated that ethanolic extracts of *E. capensis* were the least toxic to the fall armyworm, with LD_{50} values of 851.14 mg/kg.

Contact Toxicity against *P. xylostella* Larvae

Results of the direct contact toxicity of the Meliaceae plant extracts to the *P. xylostella* larvae using different concentrations are outlined in Table 6. All extracts of *M. azedarach* at 500 ppm and 1000 ppm concentrations showed excellent results, as they killed 80% of the *P. xylostella* larvae. The Probit analysis further supported this and indicated that all three different extracts of *M. azedarach* were the most toxic to *P. xylostella*, with LD_{50} of 0.14 mg/kg. Results for acetone extracts of *E. capensis* and ethanolic extracts of *T. floribunda* showed a positive correlation between the concentration of extracts and mortality rates recorded. At [0.5], *E. capensis* and *T. floribunda* recorded a mortality of 20%, and at [1.0], they recorded an 80% mortality rate. The negative correlation between the concentration of extracts and the rate of mortality observed was recorded for acetone extracts of *T. dregeana* and aqueous extracts of *T. floribunda*. At [0.5], both extracts killed 80% of the larvae; at [1.0], *T. dregeana* killed 20%, while *T. floribunda* killed 40% of the larvae. Extracts that did not show any correlation and had a constant mortality rate were aqueous extracts of *T. obtusifolia* because, at [0.5] and [1.0], the extracts killed 40% of the *P. xylostella* larvae. Probit analysis indicated that only the aqueous extract of *T. obtusifolia* was the second most toxic to the *P. xylostella* larvae, with an LD_{50} value of 1.78 mg/kg. Meanwhile, all other plant extracts displayed insignificant toxicity to the *P. xylostella*, with acetone and ethanol extracts of *T. obtusifolia* recording the highest LD_{50} value of 1318.26 mg/kg.

2.2. GC-HRT-MS Analyses

The presence of chemical compounds in plants is important as they may be responsible for their biological activities, antifeedant and insecticidal properties. Tables 7–14 indicate active compounds present in each Meliaceae species using GC-MS analyses, with their retention time (RT), observed mass to charge ion ratio (*m/z*), molecular formula (MF), metabolite class (MC), and fold change (FC, the average of the peak area values obtained at the different injections of the same compound). In *E. capensis* acetone extracts, thirty-three compounds were identified (Table 7), most of which are triterpenoids (five), alkanes (three), esters (three), sesquiterpenoids (three), diterpenoids (two), methyl esters (two), and two compounds were unclassified. Ethanolic extracts of *E. capensis* in Table 8 identified fifty compounds, of which most are sesquiterpenoids (eight), fatty acids (five), diterpenoids (three), methyl esters (three), triterpenoids (three), benzofurans (two), esters (two), fatty amides (two), and one compound was unclassified.

Table 5. Toxicity of five Meliaceae species leaf extracts applied topically to *Spodoptera frugiperda* larvae.

Plant Species	Extracts	Concentration (ppm)	log10 (Concentration)	% Dead	Probit	LD_{50} (mg/kg)
1. *Ekebergia capensis*	Aqueous	500	2.70	80	5.84	0.14
		1000	3.00	80	5.84	
	Acetone	500	2.70	80	5.84	707.95
		1000	3.00	20	4.16	
	Ethanol	500	2.70	20	4.16	851.14
		1000	3.00	60	5.25	
2. *Melia azedarach*	Aqueous	500	2.70	20	4.16	707.95
		1000	3.00	80	5.84	
	Acetone	500	2.70	80	5.84	707.95
		1000	3.00	20	4.16	
	Ethanol	500	2.70	80	5.84	707.95
		1000	3.00	20	4.16	
3. *Trichilia dregeana*	Aqueous	500	2.70	20	4.16	707.95
		1000	3.00	80	5.84	
	Acetone	500	2.70	60	5.25	707.95
		1000	3.00	40	4.75	
	Ethanol	500	2.70	40	4.75	588.84
		1000	3.00	80	5.84	
4. *Turraea floribunda*	Aqueous	500	2.70	60	5.25	0.56
		1000	3.00	60	5.25	
	Acetone	500	2.70	80	5.84	707.95
		1000	3.00	20	4.16	
	Ethanol	500	2.70	20	4.16	6.92
		1000	3.00	20	4.16	
5. *Turraea obtusifolia*	Aqueous	500	2.70	60	5.25	371.54
		1000	3.00	80	5.84	
	Acetone	500	2.70	40	4.75	707.95
		1000	3.00	60	5.25	
	Ethanol	500	2.70	60	5.25	371.54
		1000	3.00	80	5.84	

Table 6. Toxicity of five Meliaceae species leaf extracts applied topically to *Plutella xylostella* larvae.

Plant Species	Extracts	Concentration (ppm)	log10 (Concentration)	% Dead	Probit	LD_{50} (mg/kg)
1. *Ekebergia capensis*	Aqueous	500	2.70	40	4.75	691.83
		1000	3.00	60	5.25	
	Acetone	500	2.70	20	4.16	707.95
		1000	3.00	80	5.84	
	Ethanol	500	2.70	40	4.75	691.83
		1000	3.00	60	5.25	
2. *Melia azedarach*	Aqueous	500	2.70	80	5.84	0.14
		1000	3.00	80	5.84	
	Acetone	500	2.70	80	5.84	0.14
		1000	3.00	80	5.84	
	Ethanol	500	2.70	80	5.84	0.14
		1000	3.00	80	5.84	
3. *Trichilia dregeana*	Aqueous	500	2.70	40	4.75	691.83
		1000	3.00	60	5.25	
	Acetone	500	2.70	80	5.84	707.95
		1000	3.00	20	4.16	
	Ethanol	500	2.70	60	5.25	691.83
		1000	3.00	40	4.75	
4. *Turraea floribunda*	Aqueous	500	2.70	80	5.84	851.14
		1000	3.00	40	4.75	
	Acetone	500	2.70	20	4.16	851.14
		1000	3.00	60	5.25	
	Ethanol	500	2.70	20	4.16	707.95
		1000	3.00	80	5.84	
5. *Turraea obtusifolia*	Aqueous	500	2.70	40	4.75	1.78
		1000	3.00	40	4.75	
	Acetone	500	2.70	20	4.16	1318.26
		1000	3.00	40	4.75	
	Ethanol	500	2.70	80	5.84	1318.26
		1000	3.00	60	5.25	

Table 7. Compounds identified in leaf acetone extracts of *Ekebergia capensis*.

	RT (min)	Observed Ion *m*/*z*	MF	Name	MC	FC
1.	13.95	218.9578	$C_{15}H_{24}O$	(1R,3E,7E,11R)-1,5,5,8-Tetramethyl-12-oxabicyclo[9.1.0]dodeca-3,7-diene	Epoxide	26,6925.50
2.	29.96	263.8374	$C_{13}H_{20}N_2SSi$	1,2-Benzisothiazol-3-amine, TBDMS derivative	Sugar	18,674.71
3.	13.45	202.1718	$C_{15}H_{22}$	1,8-Cyclopentadecadiyne	Sesquiterpenoid	115,106.00
4.	12.71	180.1142	$C_{11}H_{16}O_2$	2(4H)-Benzofuranone, 5,6,7,7a-tetrahydro-4,4,7a-trimethyl-	Benzofuran	132,297.50
5.	16.78	165.1639	$C_{13}H_{26}O$	2-Undecanone, 6,10-dimethyl-	Fatty aldehyde	204,579.33
6.	30.25	326.7937	$C_{24}H_{36}O_2Si_2$	4-Methyl-2,4-bis(p-hydroxyphenyl)pent-1-ene, 2TMS derivative	Bisphenol A	25,467.00
7.	18.36	218.9095	$C_{20}H_{40}$	5-Eicosene, (E)-	Aliphatic hydrocarbon	70,769.00
8.	21.85	218.9260	$C_{18}H_{35}NO$	9-Octadecenamide, (Z)-	Fatty amide	448,270.50
9.	20.26	130.9614	$C_{11}H_{16}FNO_3$	Benzeneethanamine, 2-fluoro-β,3,4-trihydroxy-N-isopropyl-	Organofluorine compound	173,648.67
10.	24.10	130.9736	$C_{39}H_{28}O_4$	Bis[2-(cinnamoyloxy)-1-naphthyl]methane		10,127.50
11.	13.56	218.9391	$C_{15}H2_4O$	Caryophyllene oxide	Sesquiterpenoid	411,365.67
12.	27.33	394.3601	$C_{27}H_{44}O$	Cholesta-4,6-dien-3-ol, (3β)-	Cholesterol	108,829.33
13.	28.04	218.9138	$C_6H_{18}O_3Si_3$	Cyclotrisiloxane, hexamethyl-	Organosilicon	24,262.25
14.	22.87	155.1795	$C_{27}H_{56}$	Heptacosane	Alkane	215,283.20
15.	13.54	218.8042	$C_{16}H_{34}$	Hexadecane	Alkane	729,031.09
16.	2.59	32.0408	H_4N_2	Hydrazine	Non-metal compound	12,709.83
17.	29.62	426.3880	$C_{30}H_{50}O$	Lupeol	Triterpenoid	84,095.50
18.	2.96	32.0260	CH_4O	Methyl Alcohol	Alcohol	2773,625.86
19.	18.18	256.2399	$C_{16}H_{32}O_2$	n-Hexadecanoic acid	Fatty acid	829,242.33
20.	16.70	218.9267	$C_{20}H_{38}$	Neophytadiene	Diterpenoid	202,795.80

Table 7. *Cont.*

	RT (min)	Observed Ion *m*/*z*	MF	Name	MC	FC
21.	21.89	154.1226	$C_9H_{19}NO$	Nonanamide	Amide	349,356.50
22.	24.39	218.7771	$C_{28}H_58$	Octacosane	Alkane	171,462.67
23.	29.30	408.3768	$C_{32}H_{52}O_2$	Olean-12-en-3-ol, acetate, (3β)-	Triterpenoid	210,758.00
24.	17.09	224.0999	$C_{22}H_{23}NO_4$	Phthalic acid, 4-cyanophenyl heptyl ester	Ester	454,868.00
25.	23.33	218.8161	$C_{20}H_{30}O_4$	Phthalic acid, heptyl 3-methylbutyl ester	Ester	4577,088.00
26.	16.70	218.8513	$C_{20}H_{40}O$	Phytol	Diterpenoid	202,160.25
27.	14.32	218.8335	$C_{15}H_{24}O$	Tetracyclo[6.3.2.0(2,5).0(1,8)]tridecan-9-ol, 4,4-dimethyl-	No records	91,373.50
28.	17.65	227.2006	$C_{14}H_{28}O_2$	Tridecanoic acid, methyl ester	Methyl ester	380,039.50
29.	30.36	283.8030	$C_{18}H_{45}AsO_3Si_3$	Tris(tert-butyldimethylsilyloxy)arsane	Ester	29,655.00
30.	19.68	199.1691	$C_{12}H_{24}O_2$	Undecanoic acid, methyl ester	Methyl ester	74,944.00
31.	14.46	200.1558	$C_{15}H_{20}$	α-Calacorene	Sesquiterpenoid	49,402.00
32.	27.58	431.3842	$C_{31}H_{52}O_3$	α-Tocopheryl acetate	Triterpenoid	183,414.80
33.	28.36	401.3731	$C_{31}H_{52}O_2$	β-Sitosterol acetate	Triterpenoid	696,117.67

Table 8. Compounds identified in leaf ethanol extracts of *Ekebergia capensis*.

	RT (min)	Observed Ion *m*/*z*	MF.	Name	MC	FC
1.	13.49	218.9559	$C_{15}H_{24}O$	(-)-Spathulenol	Sesquiterpenoid	225,729.33
2.	23.93	150.1032	$C_{12}H_{15}ClN_2$	(1R,2R,4S)-2-(6-Chloropyridin-3-yl)-7-methyl-7-azabicyclo[2.2.1]heptane	Epibatidine analogues	148,243.33
3.	13.98	220.1821	$C_{15}H_{24}O$	(1R,3E,7E,11R)-1,5,5,8-Tetramethyl-12-oxabicyclo[9.1.0]dodeca-3,7-diene	Epoxide	499,685.75
4.	29.29	263.9630	$C_{13}H_{20}N_2SSi$	1,2-Benzisothiazol-3-amine, TBDMS derivative	Sugar	23,401.00
5.	14.34	218.7645	$C_{15}H_{24}O$	10,10-Dimethyl-2,6-dimethylenebicyclo[7.2.0]undecan-5β-ol		193,820.25
6.	19.99	265.2496	$C_{21}H_{36}O_2$	11,14,17-Eicosatrienoic acid, methyl ester	Methyl ester	815,008.50
7.	12.74	180.1142	$C_{11}H_{16}O_2$	2(4H)-Benzofuranone, 5,6,7,7a-tetrahydro-4,4,7a-trimethyl-	Benzofuran	260,204.00

Table 8. *Cont.*

	RT (min)	Observed Ion *m*/*z*	MF.	Name	MC	FC
8.	4.15	110.0360	$C_6H_6O_2$	2-Furancarboxaldehyde, 5-methyl-	Aryl-aldehyde	76,995.50
9.	4.59	112.0154	$C_5H_4O_3$	2H-Pyran-2,6(3H)-dione	Valerolactone	166,899.00
10.	8.89	150.0679	$C_9H_{10}O_2$	2-Methoxy-4-vinylphenol	Ketone	215,229.67
11.	5.13	102.0550	$C_6H_{13}NO$	2-Pyrrolidinemethanol, 1-methyl-	Proline	1586,572.00
12.	16.80	193.1957	$C_{13}H_{26}O$	2-Undecanone, 6,10-dimethyl-	Fatty aldehyde	441,117.67
13.	17.00	278.2967	$C_{20}H_{40}O$	3,7,11,15-Tetramethyl-2-hexadecen-1-ol	Diterpenoid	321,637.00
14.	14.96	218.7685	$C_{20}H_{27}FO_2$	3-Fluorobenzoic acid, tridec-2-ynyl ester	Organofluorine compound	255,232.00
15.	6.58	144.0415	$C_6H_8O_4$	4H-Pyran-4-one, 2,3-dihydro-3,5-dihydroxy-6-methyl-	Fatty acid	1257,832.00
16.	13.21	200.1558	$C_{15}H_{20}$	4-Isopropyl-6-methyl-1-methylene-1,2,3,4-tetrahydronaphthalene	Sesquiterpenoid	67,046.83
17.	28.47	340.8050	$C_{24}H_{36}O_2Si_2$	4-Methyl-2,4-bis(p-hydroxyphenyl)pent-1-ene, 2TMS derivative	Bisphenol A	17,941.50
18.	15.56	218.8078	$C_{13}H_{20}O_2$	6,6-Dimethyl-2-(3-oxobutyl)bicyclo[3.1.1]heptan-3-one	Oxepane	360,494.00
19.	16.14	196.1090	$C_{11}H_{16}O_3$	6-Hydroxy-4,4,7a-trimethyl-5,6,7,7a-tetrahydrobenzofuran-2(4H)-one	Benzofuran	480,778.00
20.	15.70	180.0778	$C_{15}H_{26}O_2$	7-Acetyl-2-hydroxy-2-methyl-5-isopropylbicyclo[4.3.0]nonane	Sesquiterpenoid	296,149.33
21.	21.89	282.2742	$C_{18}H_{35}NO$	9-Octadecenamide, (Z)-	Fatty amide	875,563.20
22.	10.36	122.0361	$C_7H_6O_2$	Benzaldehyde, 4-hydroxy-	Hydroxybenzaldehyde	78,283.50
23.	28.39	400.3717	$C_{28}H_{48}O$	Campesterol	Ergosterol	683,575.33
24.	14.80	218.9483	$C_{15}H_{24}O$	Caryophylla-4(12),8(13)-dien-5α-ol	Sesquiterpenoid	309,195.00
25.	13.60	220.1821	$C_{15}H_{24}O$	Caryophyllene oxide	Sesquiterpenoid	768,061.33
26.	8.55	110.0361	$C_6H_6O_2$	Catechol	Catechol	198,727.00
27.	27.36	379.3372	$C_{27}H_{44}O$	Cholesta-4,6-dien-3-ol, (3β)-	Cholesterol	293,677.67
28.	13.34	218.7878	$C_{12}H_7Cl_5O_4$	Fumaric acid, ethyl pentachlorophenyl ester	Ester	166,528.00

Table 8. *Cont.*

	RT (min)	Observed Ion *m*/*z*	MF.	Name	MC	FC
29.	3.38	97.0278	$C_4H_8O_4$	Glycolaldehyde dimer	Pentose	8,931.50
30.	20.31	226.2170	$C_{16}H_{33}NO$	Hexadecanamide	Fatty amide	594,910.67
31.	23.05	258.2501	$C_{19}H_{38}O_4$	Hexadecanoic acid, 2-hydroxy-1-(hydroxymethyl)ethyl ester	1-monoacylglycerol	184,585.67
32.	2.60	32.0564	H_4N_2	Hydrazine	Non-metal compound	24,186.67
33.	2.97	32.0261	CH_4O	Methyl Alcohol	Alcohol	1931,798.17
34.	14.84	198.1405	$C_{15}H_{18}$	Naphthalene, 1,6-dimethyl-4-(1-methylethyl)-	Sesquiterpenoid	72,764.67
35.	16.72	278.2967	$C_{20}H_{38}$	Neophytadiene	Diterpenoid	454,427.18
36.	18.26	256.0055	$C_{16}H_{32}O_2$	n-Hexadecanoic acid	Fatty acid	2543,102.33
37.	6.28	85.0840	$C_6H_{13}NO$	N-Methyl-L-prolinol	Amino acid	957,665.00
38.	20.13	284.2714	$C_{18}H_{36}O_2$	Octadecanoic acid	Fatty acid	650,507.00
39.	12.24	206.1660	$C_{14}H_{22}O$	Phenol, 3,5-bis(1,1-dimethylethyl)-	Sesquiterpenoid	100,587.50
40.	18.16	279.1556	$C_{20}H_{30}O_4$	Phthalic acid, heptyl pentyl ester	Ester	7104,005.33
41.	19.61	278.2963	$C_{20}H_{40}O$	Phytol	Diterpenoid	714,988.60
42.	28.60	412.3707	$C_{29}H_{48}O$	Stigmasterol	Steroid	825,673.33
43.	15.83	228.2081	$C_{14}H_{28}O_2$	Tetradecanoic acid	Fatty acid	274,646.67
44.	18.28	213.1522	$C_{13}H_{26}O_2$	Tridecanoic acid	Fatty acid	5679,271.50
45.	17.67	228.2043	$C_{14}H_{28}O_2$	Tridecanoic acid, methyl ester	Methyl ester	307,666.00
46.	17.69	143.0654	$C_{12}H_{24}O_2$	Undecanoic acid, methyl ester	Methyl ester	255,331.00
47.	12.89	200.1555	$C_{15}H_{20}$	α-Calacorene	Sesquiterpenoid	60,816.33
48.	27.60	431.3854	$C_{31}H_{52}O_3$	α-Tocopheryl acetate	Triterpenoid	681,154.00
49.	29.34	426.3876	$C_{30}H_{50}O$	β-Amyrin	Triterpenoid	390,576.00
50.	29.01	414.3870	$C_{29}H_{50}O$	β-Sitosterol	Triterpenoid	1529,284.00

Table 9. Compounds identified in leaf acetone extracts of *Melia azedarach*.

	RT (min)	Observed Ion *m*/*z*	MF	Name	MC	FC
1.	30.53	248.8762	$C_{11}H_{10}O_6$	1,2,4-Benzenetricarboxylic acid, 1,2-dimethyl ester	Benzoic acid	21,666.00
2.	30.13	265.2098	$C_{13}H_{20}N_2SSi$	1,2-Benzisothiazol-3-amine, TBDMS derivative	Sugar	23,300.33
3.	28.24	208.9309	$C_{12}H_{22}Si_2$	1,2-Bis(trimethylsilyl)benzene	Organosilicon	11,527.50
4.	16.78	218.8432	$C_{14}H_{28}O$	2-Tetradecanone	Ketone	182,214.50
5.	21.78	218.8388	$C_{21}H_{40}O_2$	4,8,12,16-Tetramethylheptadecan-4-olide	Beta-diketone	73,950.50
6.	30.24	258.8419	$C_{24}H_{36}O_2Si_2$	4-Methyl-2,4-bis(p-hydroxyphenyl)pent-1-ene, 2TMS derivative	Bisphenol A	56,309.00
7.	14.92	218.9359	$C_{14}H_{20}O_3$	8-(2-Acetyloxiran-2-yl)-6,6-dimethylocta-3,4-dien-2-one	Fatty alcohol ester	151,894.00
8.	23.33	168.0373	$C_{24}H_{38}O_4$	Bis(2-ethylhexyl) phthalate	Ester	54,139.00
9.	28.57	394.3614	$C_{29}H_{46}$	Cholesta-6,22,24-triene, 4,4-dimethyl-	Cholesterol	449,205.00
10.	28.25	207.9947	$C_6H_{18}O_3Si_3$	Cyclotrisiloxane, hexamethyl-	Organosilicon	22,319.83
11.	20.34	218.9400	$C_{27}H_{56}$	Heptacosane	Alkane	136,232.20
12.	18.43	218.9511	$C_{16}H_{34}$	Hexadecane	Alkane	461,468.60
13.	2.59	32.0036	H_4N_2	Hydrazine	Non-metal compound	31,792.00
14.	2.93	33.0194	H_3NO	Hydroxylamine	Amine	687,694.00
15.	24.40	206.8313	$C_{20}H_{42}O$	Isobutyl hexadecyl ether	Ether	99,861.00
16.	15.46	218.8891	$C_{19}H_{18}F_2O_4$	Isophthalic acid, 3,5-difluorophenyl pentyl ester	Ester	9,181.00
17.	2.97	32.0260	CH_4O	Methyl Alcohol	Alcohol	2893,853.89
18.	16.70	218.8535	$C_{20}H_{38}$	Neophytadiene	Diterpenoid	212,138.00
19.	20.24	130.9100	$C_9H_{19}NO$	Nonanamide	Amide	100,542.80
20.	19.59	278.2969	$C_{20}H_{40}O$	Phytol	Diterpenoid	354,182.00
21.	17.66	227.2007	$C_{14}H_{28}O_2$	Tridecanoic acid, methyl ester	Methyl ester	263,243.33
22.	30.06	340.7472	$C_{18}H_{45}AsO_3Si_3$	Tris(tert-butyldimethylsilyloxy)arsane	Ester	21,078.67
23.	19.68	218.8605	$C_{12}H_{24}O_2$	Undecanoic acid, methyl ester	Methyl ester	67,474.00
24.	29.63	432.3895	$C_{31}H_{52}O_3$	α-Tocopheryl acetate	Triterpenoid	222,825.33
25.	28.37	401.3752	$C_{31}H_{52}O_2$	β-Sitosterol acetate	Triterpenoid	548,590.25

Table 10. Compounds identified in leaf ethanol extracts of *Melia azedarach*.

	RT (min)	Observed Ion *m*/*z*	MF	Name	MC	FC
1.	14.94	218.9352	$C_{13}H_{16}O_4$	1,6,6-Trimethyl-7-(3-oxobut-1-enyl)-3,8-dioxatricyclo[5.1.0.0(2,4)]octan-5-one	Ketone	208,378.00
2.	17.00	138.1403	$C_{16}H_{30}$	1-Hexadecyne	Hydrocarbon	146,746.50
3.	17.00	278.2964	$C_{18}H_{34}$	1-Octadecyne	Hydrocarbon	182,460.00

Table 10. *Cont.*

	RT (min)	Observed Ion *m*/*z*	MF	Name	MC	FC
4.	2.77	43.0049	C_2H5ClO	2-Chloroethanol	Chloroethanol	10,825.00
5.	12.38	155.0941	$C_8H_{13}NO_2$	2-Hydroxy-1-(1′-pyrrolidiyl)-1-buten-3-one	No record	163,420.00
6.	16.79	218.8744	$C_{14}H_{28}O$	2-Tetradecanone	Ketone	191,685.50
7.	16.79	218.8549	$C_{13}H_{26}O$	2-Undecanone, 6,10-dimethyl-	Fatty aldehyde	177,821.00
8.	16.94	40.9534	$C_2H_4N_2$	3-Methyl-1,2-diazirine	No record	10,163.33
9.	16.30	144.0416	$C_6H_8O_4$	4H-Pyran-4-one, 2,3-dihydro-3,5-dihydroxy-6-methyl-	Fatty acid	419,184.67
10.	21.87	218.9503	$C_{18}H_{35}NO$	9-Octadecenamide, (Z)-	Fatty amide	368,824.25
11.	12.30	220.1819	$C_{15}H_{24}O$	Butylated Hydroxytoluene	Phenylpropane	26,415.67
12.	28.39	405.0388	$C_{31}H_{52}O_3$	Cholesterol 3-O-[[2-acetoxy]ethyl]-	No record	498,714.50
13.	29.66	430.3826	$C_{29}H_{50}O_2$	dl-α-F	Resorcinol	505,469.00
14.	20.27	130.9692	$C_{12}H_{25}NO$	Dodecanamide	Fatty amide	74,969.00
15.	13.24	128.0426	$C_{12}H_7Cl_5O_4$	Fumaric acid, ethyl pentachlorophenyl ester	Ester	90,985.50
16.	20.27	130.9721	$C_{16}H_{33}NO$	Hexadecanamide	Fatty amide	107,671.50
17.	2.90	32.0228	CH_4O	Methyl Alcohol	Alcohol	1607,627.00
18.	13.03	157.1220	$C_{10}H_{20}O_2$	n-Decanoic acid	Fatty acid	86,722.40
19.	18.19	124.0390	$C_{20}H_{38}$	Neophytadiene	Diterpenoid	454,350.71
20.	17.21	256.2401	$C_{16}H_{32}O_2$	n-Hexadecanoic acid	Fatty acid	1632,949.33
21.	17.21	154.1226	$C_9H_{19}NO$	Nonanamide	Amide	223,305.67
22.	22.39	340.2390	$C_{23}H_{32}O_2$	Phenol, 2,2′-methylenebis[6-(1,1-dimethylethyl)-4-methyl-	Diterpenoid	40,545.33
23.	12.23	206.1636	$C_{14}H_{22}O$	Phenol, 2,5-bis(1,1-dimethylethyl)-	Sesquiterpenoid	29,976.67
24.	18.16	278.1512	$C_{20}H_{30}O_4$	Phthalic acid, heptyl pentyl ester	Ester	4299,525.00
25.	17.11	223.0966	$C_{21}H_{25}NO_3$	Phthalic acid, monoamide, N-ethyl-N-(3-methylphenyl)-, isobutyl ester	Ester	197,285.67
26.	19.62	278.2964	$C_{20}H_{40}O$	Phytol	Diterpenoid	658,427.67
27.	29.10	331.0378	$C_{29}H_{48}O$	Stigmasta-5,24(28)-dien-3-ol, (3β,24Z)-	Steroid	57,701.00
28.	28.61	412.3719	$C_{29}H_{48}O$	Stigmasterol	Steroid	701,624.67
29.	21.80	130.8943	$C_{10}H_{16}O_2$	Tetrahydrofuran-2-one, 3-[2-pentenyl]-4-methyl-	Fatty acid ester	65,973.00
30.	19.56	85.0282	$C_{17}H_{30}O_3$	Tetrahydropyran Z-10-dodecenoate	Ester	18,107.50
31.	17.68	218.9267	$C_{14}H_{28}O_2$	Tridecanoic acid, methyl ester	Methyl ester	119,263.00
32.	27.60	431.3843	$C_{31}H_{52}O_3$	α-Tocopheryl acetate	Triterpenoid	70,903.00
33.	29.01	414.3875	$C_{29}H_{50}O$	β-Sitosterol	Triterpenoid	1380,935.00

Table 11. Compounds identified in leaf acetone extracts of *Trichilia dregeana*.

	RT (min)	Observed Ion *m/z*	MF	Name	MC	FC
1.	20.94	272.2504	$C_{20}H_{32}$	(R,1E,5E,9E)-1,5,9-Trimethyl-12-(prop-1-en-2-yl)cyclotetradeca-1,5,9-triene	Diterpenoid	661,369.50
2.	29.36	263.7976	$C_{13}H_{20}N_2SSi$	1,2-Benzisothiazol-3-amine, TBDMS derivative	Sugar	24,657.75
3.	5.25	109.1014	C_8H_{14}	1,6-Heptadiene, 2-methyl-	Alkadiene	241,431.50
4.	18.65	277.2445	$C_{20}H_{34}O$	1H-Naphtho[2,1-b]pyran, 3-ethenyldodecahydro-3,4a,7,7,10a-pentamethyl-, [3R-(3α,4aβ,6aα,10aβ,10bα)]-	Triterpenoid	254,957.50
5.	21.38	218.9118	$C_{15}H_{26}O$	1-Naphthalenemethanol, 1,4,4a,5,6,7,8,8a-octahydro-2,5,5,8a-tetramethyl-	Sesquiterpenoid	910,101.00
6.	22.82	292.1670	$C_{17}H_{24}O_4$	2-Hydroxy-4-methoxy-7-methyl-7,8,9,10,11,12,13,14-octahydro-6-oxabenzocyclododecen-5-one	Gingerdione	53,596.00
7.	16.78	180.1858	$C_{13}H_{26}O$	2-Undecanone, 6,10-dimethyl-	Fatty aldehyde	498,290.33
8.	21.78	263.8585	$C_{21}H_{40}O_2$	4,8,12,16-Tetramethylheptadecan-4-olide	Beta-diketone	288,631.33
9.	29.60	281.9882	$C_{17}H_{30}OSi$	4-tert-Octylphenol, TMS derivative	Alkylbenzene	32,218.33
10.	21.69	270.2347	$C_{20}H_{30}$	Bicyclo[3.1.1]hept-2-ene, 2,2′-(1,2-ethanediyl)bis[6,6-dimethyl-	Diterpenoid	205,660.50
11.	23.33	218.8484	$C_{24}H_{38}O_4$	Bis(2-ethylhexyl) phthalate	Ester	105,403.33
12.	21.69	289.2480	$C_{26}H_{40}O_2$	Butyl 4,7,10,13,16,19-docosahexaenoate	Fatty acid	286,373.50
13.	20.88	263.9540	$C_{20}H_{40}O_2$	Butyric acid, hexadecyl ester	Fatty acid	180,132.50
14.	28.14	226.1588	$C_6H_{18}O_3Si_3$	Cyclotrisiloxane, hexamethyl-	Organosilicon	21,468.33
15.	18.15	278.1513	$C_{16}H_{22}O_4$	Dibutyl phthalate	Ester	5113,869.00
16.	15.29	87.0440	$C_{13}H_{26}O_2$	Dodecanoic acid, 2-methyl-	Ester	161,611.50
17.	18.47	263.8584	$C_{20}H_{42}$	Eicosane	Alkane	491,217.33
18.	28.36	417.0340	$C_{30}H_{50}O_2$	Ergost-5-en-3-ol, acetate, (3β,24R)-	Triterpenoid	303,607.00
19.	20.35	218.8367	$C_{27}H_{56}$	Heptacosane	Alkane	179,363.50
20.	13.54	130.8832	$C_{16}H_{34}$	Hexadecane	Alkane	578,509.80
21.	20.96	263.8346	$C_{21}H_{44}O$	Hexadecyl pentyl ether	Ether	415,977.00
22.	2.58	32.0175	H_4N_2	Hydrazine	Non-metal compound	195,016.33
23.	21.06	272.2508	$C_{20}H_{32}$	Kaur-15-ene	Diterpenoid	464,961.67
24.	2.89	32.0474	CH_4O	Methyl Alcohol	Alcohol	3486,357.33
25.	16.70	218.8848	$C_{20}H_{38}$	Neophytadiene	Diterpenoid	115,963.50
26.	20.27	130.9004	$C_9H_{19}NO$	Nonanamide	Amide	132,986.33

Table 11. *Cont.*

	RT (min)	Observed Ion *m/z*	MF	Name	MC	FC
27.	18.37	272.2506	$C_{20}H_{32}$	Phenanthrene, 7-ethenyl-1,2,3,4,4a,4b,5,6,7,9,10,10a-dodecahydro-1,1,4a,7-tetramethyl-, [4aS-(4aα,4bβ,7β,10aβ)]-	Diterpenoid	728,659.00
28.	17.09	223.0964	$C_{22}H_{23}NO_4$	Phthalic acid, 4-cyanophenyl heptyl ester	Ester	230,352.00
29.	19.58	278.2973	$C_{20}H_{40}O$	Phytol	Diterpenoid	287,838.33
30.	28.57	412.3716	$C_{29}H_{48}O$	Stigmasterol	Steroid	308,190.00
31.	3.08	70.0412	C_2H_4OS	Thioacetic acid	Alkylthiol	687,016.50
32.	17.67	227.2003	$C_{14}H_{28}O_2$	Tridecanoic acid, methyl ester	Fatty acid ester	219,513.33
33.	18.43	130.9689	C_4BrF_9	Tris(trifluoromethyl) bromomethane		19,641.50
34.	27.58	430.3812	$C_{29}H_{50}O_2$	Vitamin E	Resorcinol	173,224.00
35.	21.06	218.8441	$C_{15}H_{24}O$	α-Santalol	7-hydroxycoumarin	82,416.00
36.	27.58	432.3888	$C_{31}H_{52}O_3$	α-Tocopheryl acetate	Triterpenoid	186,539.25
37.	28.99	414.3867	$C_{29}H_{50}O$	β-Sitosterol	Triterpenoid	1328,446.00
38.	29.98	412.3719	$C_{29}H_{48}O$	γ-Sitostenone	Steroid	519,588.00

Table 12. Compounds identified in leaf ethanol extracts of *Trichilia dregeana*.

	RT (min)	Observed Ion *m/z*	MF	Name	MC	FC
1.	13.97	218.9516	$C_{15}H_{24}O$	(1R,3E,7E,11R)-1,5,5,8-Tetramethyl-12-oxabicyclo[9.1.0]dodeca-3,7-diene	Epoxide	100,323.50
2.	20.96	275.2370	$C_{20}H_{34}O$	(E)-3-Methyl-5-((1R,4aR,8aR)-5,5,8a-trimethyl-2-methylenedecahydronaphthalen-1-yl)pent-2-en-1-ol	Diterpenoid	545,931.00
3.	22.71	118.9170	$C_{12}H_{10}Cl_2O_4$	1,2-Benzenediol, o-dichloroacetyl-o′-cyclopropanecarbonyl-		9,766.00
4.	30.62	266.9226	$C_{13}H_{20}N_2SSi$	1,2-Benzisothiazol-3-amine, TBDMS derivative	Sugar	30,994.67
5.	26.17	280.9730	$C_{20}H_{34}O$	1,6,10,14-Hexadecatetraen-3-ol, 3,7,11,15-tetramethyl-, (E,E)-	Diterpenoid	320,433.80
6.	5.25	96.0564	C_8H_{14}	1,6-Heptadiene, 2-methyl-	Alkadiene	241,432.00
7.	18.67	276.2407	$C_{20}H_{34}O$	1H-Naphtho[2,1-b]pyran, 3-ethenyldodecahydro-3,4a,7,7,10a-pentamethyl-, [3R-(3α,4aβ,6aα,10aβ,10bα)]-	Triterpenoid	370,766.67
8.	23.14	218.8896	$C_{15}H_{26}O$	2,6,10-Dodecatrien-1-ol, 3,7,11-trimethyl-	Sesquiterpenoid	136,124.67
9.	12.49	218.9198	$C_{15}H_{24}O$	2,6,10-Dodecatrienal, 3,7,11-trimethyl-, (E,E)-	Sesquiterpenoid	141,636.50
10.	22.84	292.1672	$C_{17}H_{24}O_4$	2-Hydroxy-4-methoxy-7-methyl-7,8,9,10,11,12,13,14-octahydro-6-oxabenzocyclododecen-5-one	Gingerdione	45,244.00

Table 12. *Cont.*

	RT (min)	Observed Ion *m*/*z*	MF	Name	MC	FC
11.	16.80	179.1786	$C_{13}H_{26}O$	2-Undecanone, 6,10-dimethyl-	Fatty aldehyde	393,929.33
12.	20.91	263.8061	$C_{14}H_{28}O_3$	3-Hydroxymyristic acid	Fatty acid	161,204.00
13.	21.21	274.2300	$C_{19}H_{30}O$	4,14-Dimethyl-11-isopropyltricyclo[7.5.0.0(10,14)]tetradec-4-en-8-one	Androgen	101,356.00
14.	21.80	263.9405	$C_{21}H_{40}O_2$	4,8,12,16-Tetramethylheptadecan-4-olide	Beta-diketone	269,254.50
15.	11.17	130.8733	$C_7H_{12}O$	4-Hepten-2-one, (E)-	Organooxygen compound	136,106.00
16.	21.88	263.8605	$C_{18}H_{35}NO$	9-Octadecenamide, (Z)-	Fatty amide	708,408.50
17.	21.71	289.2489	$C_{26}H_{40}O_2$	Butyl 4,7,10,13,16,19-docosahexaenoate	Fatty acid	318,610.00
18.	12.29	220.1824	$C_{15}H_{24}O$	Butylated Hydroxytoluene	Phenylpropane	27,910.67
19.	2.88	41.0132	CH_6N_4O	Carbohydrazide	Carbohydrazide	151,106.00
20.	23.54	257.2272	$C_{12}H_{25}NO$	Dodecanamide	Fatty amide	55,399.50
21.	17.69	227.2003	$C_{13}H_{26}O_2$	Dodecanoic acid, methyl ester	Methyl ester	127,277.00
22.	2.62	31.0644	$C_2H_4Cl_2O$	Ethanol, 2,2-dichloro-	Alcohol	12,654.00
23.	21.41	218.8306	$C_{15}H_{26}O$	Humulane-1,6-dien-3-ol	Sesquiterpenoid	1117,231.00
24.	11.43	130.9770	$C_{15}H_{24}$	Humulene	Sesquiterpenoid	33,834.00
25.	2.86	32.0543	H_4N_2	Hydrazine	Non-metal compound	29,779.50
26.	21.08	272.2510	$C_{20}H_{32}$	Kaur-15-ene	Diterpenoid	494,925.33
27.	2.65	31.9949	CH_4O	Methyl Alcohol	Alcohol	1822,640.42
28.	15.82	171.1382	$C_{10}H_{20}O_2$	n-Decanoic acid	Fatty acid	115,234.67
29.	16.72	137.1327	$C_{20}H_{38}$	Neophytadiene	Diterpenoid	139,113.50
30.	18.22	256.2398	$C_{16}H_{32}O_2$	n-Hexadecanoic acid	Fatty acid	1293,680.33
31.	18.39	272.2504	$C_{20}H_{32}$	Phenanthrene, 7-ethenyl-1,2,3,4,4a,4b,5,6,7,9,10,10a-dodecahydro-1,1,4a,7-tetramethyl-, [4aS-(4aα,4bβ,7β,10aβ)]-	Diterpenoid	807,281.67
32.	22.39	340.2411	$C_{23}H_{32}O_2$	Phenol, 2,2′-methylenebis[6-(1,1-dimethylethyl)-4-methyl-	Diterpenoid	67,053.50
33.	12.22	206.1663	$C_{14}H_{22}O$	Phenol, 2,5-bis(1,1-dimethylethyl)-	Sesquiterpenoid	41,210.00
34.	15.89	218.9111	C_3F_9P	Phosphine, tris(trifluoromethyl)-	Organofluorine	14,308.25
35.	18.17	278.1507	$C_{20}H_{30}O_4$	Phthalic acid, heptyl pentyl ester	Ester	3770,875.00

Table 12. *Cont.*

	RT (min)	Observed Ion *m*/*z*	MF	Name	MC	FC
36.	17.11	223.0962	$C_{21}H_{25}NO_3$	Phthalic acid, monoamide, N-ethyl-N-(3-methylphenyl)-, isobutyl ester	Ester	244,482.50
37.	19.61	137.1326	$C_{20}H_{40}O$	Phytol	Diterpenoid	223,292.75
38.	28.34	380.3446	$C_{29}H_{48}O$	Stigmasta-5,24(28)-dien-3-ol, (3β,24Z)-	Steroid	234,342.50
39.	25.42	218.9552	$C_{30}H_{50}$	Supraene	Triterpenoid	565,315.33
40.	27.60	431.3852	$C_{31}H_{52}O_3$	α-Tocopheryl acetate	Triterpenoid	264,498.80
41.	29.01	414.3875	$C_{29}H_{50}O$	β-Sitosterol	Triterpenoid	1371,309.00
42.	30.00	412.3724	$C_{29}H_{48}O$	γ-Sitostenone	Steroid	540,348.67
43.	27.05	416.3666	$C_{28}H_{48}O_2$	γ-Tocopherol	Steroid	121,387.50

Table 13. Compounds identified in leaf acetone extracts of *Turraea floribunda*.

	RT (min)	Observed Ion *m*/*z*	MF	Name	MC	FC
1.	15.00	220.1822	$C_{15}H_{24}O$	((4aS,8S,8aR)-8-Isopropyl-5-methyl-3,4,4a,7,8,8a-hexahydronaphthalen-2-yl)methanol	Sesquiterpenoid	171,920.00
2.	19.57	201.1638	$C_{15}H_{24}$	(1R,4S,5S)-1,8-Dimethyl-4-(prop-1-en-2-yl)spiro[4.5]dec-7-ene	Hydrocarbon	192,589.50
3.	26.14	263.8413	$C_{20}H_{32}$	(E,E,E)-3,7,11,15-Tetramethylhexadeca-1,3,6,10,14-pentaene	Diterpenoid	480,221.00
4.	21.84	273.2215	$C_{20}H_{32}$	1,3,6,10-Cyclotetradecatetraene, 3,7,11-trimethyl-14-(1-methylethyl)-, [S-(E,Z,E,E)]-	Diterpenoid	484,433.00
5.	20.78	201.1639	$C_{15}H_{22}$	1,3,7,11-Cyclotetradecatetraene, 2-methyl-		902,135.00
6.	18.80	263.7967	$C_{20}H_{34}O$	1,6,10,14-Hexadecatetraen-3-ol, 3,7,11,15-tetramethyl-, (E,E)-	Diterpenoid	650,540.67
7.	13.56	202.1714	$C_{15}H_{26}$	1H-3a,7-Methanoazulene, octahydro-1,4,9,9-tetramethyl-	Sesquiterpenoid	128,891.33
8.	8.68	142.0775	$C_{11}H_{10}$	1H-Indene, 1-ethylidene-	Hydrocarbon	28,659.00
9.	12.71	161.1324	$C_{11}H_{16}O_2$	2(4H)-Benzofuranone, 5,6,7,7a-tetrahydro-4,4,7a-trimethyl-, (R)-	Benzofuran	135,928.67
10.	26.14	280.9475	$C_{22}H_{36}O_2$	2,6,10,14-Hexadecatetraen-1-ol, 3,7,11,15-tetramethyl-, acetate, (E,E,E)-	Fatty alcohol	176,010.50
11.	15.19	210.1614	$C_{13}H_{22}O_2$	2-Cyclohexen-1-one, 4-(3-hydroxybutyl)-3,5,5-trimethyl-	Apocarotenoid	82,345.33
12.	16.79	263.8863	$C_{18}H_{36}O$	2-Pentadecanone, 6,10,14-trimethyl-	Ketone	1520,735.33
13.	16.97	263.7692	$C_{20}H_{40}O$	3,7,11,15-Tetramethyl-2-hexadecen-1-ol	Diterpenoid	19,984.50
14.	25.67	218.8406	$C_{15}H_{23}N$	3-Cyano-3-octyl-1,4-cyclohexadiene		98,440.00
15.	5.24	105.0696	C_8H_{14}	4-Methyl-1,5-Heptadiene	Alkene	238,594.00
16.	12.47	221.1901	$C_{15}H_{24}O$	6,10-Dodecadien-1-yn-3-ol, 3,7,11-trimethyl-	Fatty alcohol	132,884.67

Table 13. *Cont.*

	RT (min)	Observed Ion *m*/*z*	MF	Name	MC	FC
17.	20.45	263.8287	$C_{21}H_{36}O_4$	9,12,15-Octadecatrienoic acid, 2,3-dihydroxypropyl ester, (Z,Z,Z)-	Lineolic acid	24,402.00
18.	21.75	288.2451	$C_{32}H_{54}O_2$	9,19-Cyclolanostan-3-ol, acetate, (3β)-	Cycloartanol	185,601.00
19.	3.21	43.0106	$C_2H_6N_2O$	Acetic acid, hydrazide	N-nitroso compound	9,648.50
20.	3.40	130.9333	$C_2H_4O_3$	Acetic acid, hydroxy-	Hydroxy acid	16,192.00
21.	8.01	136.0518	$C_8H_8O_2$	Benzeneacetic acid	Benzene	823,393.50
22.	20.33	218.8824	$C_{11}H_{16}FNO_3$	Benzeneethanamine, 2-fluoro-β,3,4-trihydroxy-N-isopropyl-	Organofluorine compound	461,586.67
23.	21.65	274.2253	$C_{20}H_{34}O_2$	Butyl 6,9,12-hexadecatrienoate	No records	120,874.00
24.	20.40	263.7774	$C_{20}H_{30}O_2$	cis-5,8,11,14,17-Eicosapentaenoic acid	Fatty acid	67,970.33
25.	14.77	218.7973	$C_{15}H_{24}O$	cis-Z-α-Bisabolene epoxide	Sesquiterpenoid	163,987.00
26.	29.61	224.8923	$C_6H_{18}O_3Si_3$	Cyclotrisiloxane, hexamethyl-	Organosilicon	37,777.00
27.	6.10	130.9737	$C_{10}H_{11}N_3O_2$	dl-7-Azatryptophan	L-alpha-amino acid	5,636.50
28.	27.58	430.3826	$C_{29}H_{50}O_2$	dl-α-Tocopherol	Resorcinol	308,112.50
29.	18.43	218.9230	$C_{20}H_{42}$	Eicosane	Alkane	773,942.50
30.	28.37	401.3748	$C_{30}H_{50}O_2$	Ergost-5-en-3-ol, acetate, (3β,24R)-	Triterpenoid	400,755.50
31.	16.60	134.1088	$C_{12}H_{18}$	Geijerene	Monoterpenoid	506,492.50
32.	4.79	68.9660	$C_3H_8O_3$	Glycerin	Sugar alcohol	1247,390.50
33.	20.35	263.9279	$C_{27}H_{56}$	Heptacosane	Alkane	459,191.00
34.	13.54	154.1719	$C_{16}H_{34}$	Hexadecane	Alkane	887,579.50
35.	2.58	32.0644	H_4N_2	Hydrazine	Non-metal compound	16,395.00
36.	21.65	218.9095	$C_{15}H_{24}O$	Isoaromadendrene epoxide	Sesquiterpenoid	87,763.50
37.	17.91	278.2969	$C_{20}H_{40}O$	Isophytol	Diterpenoid	581,608.33
38.	21.36	263.8432	$C_{22}H_{34}O_2$	Methyl 6,9,12,15,18-heneicosapentaenoate	Methyl ester	222,155.00
39.	19.47	263.8150	$C_{18}H_{30}O_2$	Methyl 8,11,14-heptadecatrienoate	Methyl ester	143,481.00
40.	2.63	32.0319	CH_4O	Methyl Alcohol	Alcohol	2542,812.29
41.	16.70	218.9458	$C_{20}H_{38}$	Neophytadiene	Diterpenoid	455,672.53
42.	17.92	218.9160	$C_{18}H_{36}O$	Octadecanal	Fatty aldehyde	7,428.50
43.	22.38	340.2405	$C_{23}H_{32}O_2$	Phenol, 2,2′-methylenebis[6-(1,1-dimethylethyl)-4-methyl-	Diterpenoid	98,778.00

Table 13. *Cont.*

	RT (min)	Observed Ion *m/z*	MF	Name	MC	FC
44.	12.20	206.1665	$C_{14}H_{22}O$	Phenol, 2,6-bis(1,1-dimethylethyl)-	Sesquiterpenoid	26,409.00
45.	17.09	263.7937	$C_{22}H_{23}NO_4$	Phthalic acid, 4-cyanophenyl heptyl ester	Ester	863,842.00
46.	23.33	279.1599	$C_{33}H_{56}O_4$	Phthalic acid, heptadecyl 2-propylpentyl ester	Ester	192,600.50
47.	18.14	279.1561	$C_{20}H_{30}O_4$	Phthalic acid, heptyl pentyl ester	Ester	7570,367.00
48.	2.96	31.4619	H_4Si	Silane	Non-metal compound	14,625.00
49.	29.96	412.3726	$C_{29}H_{48}O$	Stigmast-4-en-3-one	Steroid	315,755.67
50.	25.39	231.2112	$C_{30}H_{50}$	Supraene	Triterpenoid	784,372.00
51.	15.80	218.9575	$C_{14}H_{28}O_2$	Tetradecanoic acid	Fatty acid	201,837.50
52.	7.28	86.0223	C_4H_6S	Thiophene, 2,3-dihydro-	Dihydrothiophene	156,903.67
53.	13.54	218.8948	$C_{13}H_{28}$	Tridecane	Alkane	208,627.00
54.	17.65	228.2039	$C_{14}H_{28}O_2$	Tridecanoic acid, methyl ester	Methyl ester	395,572.00
55.	12.99	157.1222	$C_{11}H_{22}O_2$	Undecanoic acid	Methyl ester	51,909.00
56.	12.87	157.1011	$C_{15}H_{20}$	α-Calacorene	Sesquiterpenoid	30,917.33
57.	29.63	431.3858	$C_{31}H_{52}O_3$	α-Tocopheryl acetate	Triterpenoid	199,285.00
58.	21.51	218.7617	$C_{15}H_{24}O$	β-Santalol	Sesquiterpenoid	80,032.50
59.	28.98	414.3873	$C_{29}H_{50}O$	β-Sitosterol	Triterpenoid	833,435.33

Table 14. Compounds identified in leaf ethanol extracts of *Turraea floribunda*.

	RT (min)	Observed Ion *m/z*	MF.	Name	MC	FC
1.	28.27	218.8544	$C_{13}H_{20}N_2SSi$	1,2-Benzisothiazol-3-amine, TBDMS derivative	Sugar	21,941.25
2.	16.77	130.9077	$C_{16}H_{30}O_2$	2,15-Hexadecanedione	Fatty acid	8,739.00
3.	2.79	42.9883	C_2H_5ClO	2-Chloroethanol	Chloroethanol	17,013.50
4.	17.66	218.9181	$C_9H_{16}BrNO$	2-Piperidinone, N-[4-bromo-n-butyl]-	Delta-lactam	212,874.00
5.	16.78	218.8178	$C_{13}H_{26}O$	2-Undecanone, 6,10-dimethyl-	Fatty aldehyde	331,058.75
6.	30.93	250.8218	$C_{28}H_{46}O_2$	4,4′-bi-4H-pyran, 2,2′,6,6′-tetrakis(1,1-dimethylethyl)-4,4′-dimethyl-		13,508.50
7.	27.65	206.9513	$C_{24}H_{36}O_2Si_2$	4-Methyl-2,4-bis(p-hydroxyphenyl)pent-1-ene, 2TMS derivative	Bisphenol A	25,492.75
8.	28.52	207.8478	$C_{17}H_{30}OSi$	4-tert-Octylphenol, TMS derivative	Alkylbenzene	23,331.67

Table 14. *Cont.*

	RT (min)	Observed Ion *m*/*z*	MF.	Name	MC	FC
9.	6.56	144.0417	$C_6H_8O_4$	4H-Pyran-4-one, 2,3-dihydro-3,5-dihydroxy-6-methyl-	Fatty acid	123,337.50
10.	28.19	263.7777	$C_9H_{27}AsO_3Si_3$	Arsenous acid, tris(trimethylsilyl) ester	Trialkylheterosilane	17,467.00
11.	21.85	218.9263	$C_{11}H_{16}FNO_3$	Benzeneethanamine, 2-fluoro-β,3,4-trihydroxy-N-isopropyl-	Organofluorine compound	197,067.50
12.	28.20	208.8548	$C_6H_{18}O_3Si_3$	Cyclotrisiloxane, hexamethyl-	Organosilicon	10,533.67
13.	18.93	130.8948	$C_{10}H_{11}N_3O_2$	dl-7-Azatryptophan	L-alpha-amino acid	13,803.00
14.	2.87	32.0230	H_4N_2	Hydrazine	Non-metal compound	29,112.33
15.	2.89	33.0078	H_3NO	Hydroxylamine	Amine	19,835.67
16.	17.92	218.9493	$C_{20}H_{40}O$	Isophytol	Diterpenoid	126,936.00
17.	2.59	32.0438	CH_4O	Methyl Alcohol	Alcohol	3945,937.00
18.	15.78	185.1534	$C_{10}H_{20}O_2$	n-Decanoic acid	Fatty acid	56,292.00
19.	18.17	256.2398	$C_{16}H_{32}O_2$	n-Hexadecanoic acid	Fatty acid	1236,320.33
20.	8.69	142.0773	$C_{11}H_{10}$	Naphthalene, 2-methyl-	Naphthalene	16,237.00
21.	16.71	137.1323	$C_{20}H_{38}$	Neophytadiene	Diterpenoid	212,701.60
22.	20.27	118.9582	$C_9H_{19}NO$	Nonanamide	Amide	135,588.33
23.	18.14	278.1516	$C_{20}H_{30}O_4$	Phthalic acid, heptyl pentyl ester	Ester	4220,463.00
24.	19.59	278.2971	$C_{20}H_{40}O$	Phytol	Diterpenoid	332,925.75
25.	28.57	412.3722	$C_{29}H_{48}O$	Stigmasterol	Steroid	263,092.00
26.	19.68	218.8909	$C_{14}H_{28}O_2$	Tridecanoic acid, methyl ester	Methyl ester	162,963.00
27.	28.28	218.8983	$C_{18}H_{45}AsO_3Si_3$	Tris(tert-butyldimethylsilyloxy)arsane	Ester	23,852.50
28.	17.66	199.1695	$C_{12}H_{24}O_2$	Undecanoic acid, methyl ester	Methyl ester	230,369.50
29.	28.97	417.0367	$C_{31}H_{52}O_2$	β-Sitosterol acetate	Triterpenoid	330,908.00

Table 9 shows the results of acetone extracts of *M. azedarach*; twenty-six compounds were identified. Of these, two are classified as esters, alkanes (three), diterpenoids (two), methyl esters (two), non-metal compounds (two), organosilicons (two), and triterpenoid (two). Thirty-three compounds were identified in ethanolic extracts of *M. azedarach*, shown in Table 10. Four compounds are classified as esters, diterpenoids (three), fatty acids (three), fatty amides (three), hydrocarbons (two), ketones (two), steroids (two), triterpenoids (two), and three compounds were unclassified.

Thirty-nine compounds were identified in acetone extracts of *T. dregeana* (Table 11), most of which are diterpenoids (six), esters (four), triterpenoids (four), alkanes (three), fatty acids (two), non-metal compounds (two), steroids (two), and one compound was unclassified. Forty-three compounds were identified in ethanolic extracts of *T. dregeana* (Table 12), with most of the compounds in the classes: diterpenoids (seven), sesquiterpenoids (five), fatty acids (four), triterpenoids (four), steroids (three), alcohols (two), esters (two), fatty amides (two), and one compound was unclassified.

Acetone leaf extracts of *T. floribunda* (Table 13) had sixty compounds, of which seven are diterpenoids (seven), sesquiterpenoids (seven), alkanes (four), methyl esters (four), triterpenoids (four), non-metal compounds (three), esters (three), fatty acids (two), fatty alcohols (two), hydrocarbons (two), and three compounds were unclassified. Table 14 shows thirty compounds identified in ethanol extracts of *T. floribunda*; most of the chemical compounds belong to the chemical classes: fatty acids (four), diterpenoids (three), esters (two), methyl esters (two), non-metal compounds (two), and one compound was unclassified.

Table 15 shows forty-four compounds identified in acetone extracts of *T. obtusifolia*; chemical classes with the most chemical compounds are: fatty acids (six), sesquiterpenoids (five), alkanes (three), diterpenoids (three), triterpenoids (three), esters (two), non-metal compounds (two), steroids (two), and two compounds were unclassified. There were forty-six compounds identified in ethanolic extracts of *T. obtusifolia* (Table 16), chemical classes with the most chemical compounds: sesquiterpenoids (seven), diterpenoids (five), fatty acids (five), methyl esters (three), steroids (three), fatty alcohols (two), resorcinols (two), and five compounds were unclassified.

Table 15. Compounds identified in leaf acetone extracts of *Turraea obtusifolia*.

	RT (min)	Observed Ion *m*/*z*	MF	Name	MC	FC
1.	15.00	220.1821	$C_{15}H_{24}O$	(1R,2R,4S,6S,7S,8S)-8-Isopropyl-1-methyl-3-methylenetricyclo[4.4.0.02,7]decan-4-ol	Sesquiterpenoid	126,668.00
2.	15.10	263.8326	$C_{18}H_{26}O$	1,3-Bis-(2-cyclopropyl,2-methylcyclopropyl)-but-2-en-1-one	2-benzopyran	92,518.50
3.	14.33	218.9465	$C_{15}H_{24}O$	10,10-Dimethyl-2,6-dimethylenebicyclo[7.2.0]undecan-5β-ol		219,693.33
4.	8.86	130.9685	$C_{10}H_{16}O$	2,4-Decadienal	Aldehyde	75,217.75
5.	16.78	179.1793	$C_{13}H_{26}O$	2-Undecanone, 6,10-dimethyl-	Fatty aldehyde	255,603.50
6.	11.98	202.1713	$C_{15}H_{22}$	3,5,11-Eudesmatriene	Sesquiterpenoid	56,152.67
7.	21.79	263.8648	$C_{21}H_{40}O_2$	4,8,12,16-Tetramethylheptadecan-4-olide	Beta-diketone	410,582.00
8.	30.47	281.8219	$C_{17}H_{30}OSi$	4-tert-Octylphenol, TMS derivative	Alkylbenzene	27,817.50
9.	14.78	218.8204	$C_{15}H_{24}O$	6,10-Dodecadien-1-yn-3-ol, 3,7,11-trimethyl-	Fatty alcohol	206,334.00
10.	15.85	218.1667	$C_{15}H_{22}O$	7-Isopropenyl-1,4a-dimethyl-4,4a,5,6,7,8-hexahydro-3H-naphthalen-2-one		186,966.33
11.	20.00	263.9515	$C_{20}H_{34}O_2$	8,11,14-Eicosatrienoic acid, (Z,Z,Z)-	Fatty acid	13,480.00
12.	19.94	280.2397	$C_{18}H_{32}O_2$	9,12-Octadecadienoic acid (Z,Z)-	Fatty acid	44,571.00
13.	29.97	422.3937	$C_{32}H_{52}O_2$	9,19-Cycloergost-24(28)-en-3-ol, 4,14-dimethyl-, acetate, (3β,4α,5α)-	Triterpenoid	119,424.50
14.	16.95	263.8819	$C_{20}H_{30}O_5$	Andrographolide	Butyrolactone	182,421.67
15.	21.37	204.1875	$C_{15}H_{24}$	Azulene, 1,2,3,5,6,7,8,8a-octahydro-1,4-dimethyl-7-(1-methylethenyl)-, [1S-(1α,7α,8aβ)]-	Sesquiterpenoid	235,288.00
16.	8.67	142.0774	$C_{11}H_{10}$	Benzocycloheptatriene	Benzenoid	17,979.50

Table 15. *Cont.*

	RT (min)	Observed Ion *m*/*z*	MF	Name	MC	FC
17.	27.85	218.8211	$C_6H_{18}O_3Si_3$	Cyclotrisiloxane, hexamethyl-	Organosilicon	19,618.33
18.	10.01	130.9654	$C_{10}H_{11}N_3O_2$	dl-7-Azatryptophan	L-alpha-amino acid	12,483.25
19.	13.94	218.8738	$C_{22}H_{32}O_2$	Doconexent	Fatty acid	40,765.00
20.	18.43	263.7630	$C_{20}H_{42}$	Eicosane	Alkane	644,244.67
21.	11.70	202.1715	$C_{15}H_{22}$	Eudesma-2,4,11-triene	Sesquiterpenoid	186,595.60
22.	20.31	263.9065	$C_{16}H_{33}NO$	Hexadecanamide	Fatty amide	235,968.00
23.	20.35	218.7788	$C_{16}H_{34}$	Hexadecane	Alkane	444,080.00
24.	2.59	32.0455	H_4N_2	Hydrazine	Non-metal compound	27,402.00
25.	17.91	263.7523	$C_{20}H_{40}O$	Isophytol	Diterpenoid	180,211.33
26.	14.93	220.1819	$C_{15}H_{24}O$	Ledene oxide-(II)	Sesquiterpenoid	165,643.67
27.	2.86	32.0231	CH_4O	Methyl Alcohol	Alcohol	3308,314.78
28.	16.70	218.9564	$C_{20}H_{38}$	Neophytadiene	Diterpenoid	239,419.44
29.	18.21	256.2402	$C_{16}H_{32}O_2$	n-Hexadecanoic acid	Fatty acid	1312,119.00
30.	16.22	218.7640	$C_{15}H_{32}$	Pentadecane	Alkane	703,400.00
31.	6.40	130.9444	$C_6H_{12}O_3$	Pentanoic acid, 2-hydroxy-3-methyl-	Fatty acid	374,290.67
32.	17.09	263.7686	$C_{21}H_{23}NO_6$	Phthalic acid, heptyl 4-nitrophenyl ester	Ester	403,612.00
33.	18.14	279.1556	$C_{20}H_{30}O_4$	Phthalic acid, heptyl pentyl ester	Ester	4790,918.75
34.	19.59	279.2999	$C_{20}H_{40}O$	Phytol	Diterpenoid	423,228.75
35.	28.57	412.3719	$C_{29}H_{48}O$	Stigmasterol	Steroid	467,141.50
36.	15.79	185.1536	$C_{14}H_{28}O_2$	Tetradecanoic acid	Fatty acid	105,645.50
37.	3.07	70.0287	C_2H_4OS	Thioacetic acid	Alkylthiol	27,616.00
38.	17.66	227.2008	$C_{14}H_{28}O_2$	Tridecanoic acid, methyl ester	Fatty acid ester	449,472.00
39.	19.68	218.8289	$C_{12}H_{24}O_2$	Undecanoic acid, methyl ester	Methyl ester	180,225.75
40.	27.58	430.3823	$C_{29}H_{50}O_2$	Vitamin E	Resorcinol	262,653.50
41.	29.64	432.3904	$C_{31}H_{52}O_3$	α-Tocopheryl acetate	Triterpenoid	295,293.67
42.	25.67	420.3571	$C_{29}H_{50}O_4$	α-Tocospiro A	Steroid	141,624.33
43.	28.98	414.3868	$C_{29}H_{50}O$	β-Sitosterol	Triterpenoid	999,333.33

Table 16. Compounds identified in leaf ethanol extracts of *Turraea obtusifolia*.

	RT (min)	Observed Ion m/z	MF	Name	MC	FC
1.	13.98	220.1814	$C_{15}H_{24}O$	(1R,3E,7E,11R)-1,5,5,8-Tetramethyl-12-oxabicyclo[9.1.0]dodeca-3,7-diene	Epoxide	360,103.67
2.	20.96	275.2379	$C_{20}H_{34}O$	(E)-3-Methyl-5-((1R,4aR,8aR)-5,5,8a-trimethyl-2-methylenedecahydronaphthalen-1-yl)pent-2-en-1-ol	Diterpenoid	115,266.00
3.	21.30	263.7396	$C_{17}H_{32}O$	(R)-(-)-14-Methyl-8-hexadecyn-1-ol	Fatty alcohol	73,991.50
4.	14.35	218.8756	$C_{15}H_{24}O$	10,10-Dimethyl-2,6-dimethylenebicyclo[7.2.0]undecan-5β-ol		385,059.67
5.	17.93	218.8876	$C_{20}H_{40}O$	1-Hexadecen-3-ol, 3,5,11,15-tetramethyl-	Diterpenoid	315,859.50
6.	12.74	177.0783	$C_{11}H_{16}O_2$	2(4H)-Benzofuranone, 5,6,7,7a-tetrahydro-4,4,7a-trimethyl-	Benzofuran	93,776.33
7.	12.38	155.0938	$C_8H_{13}NO_2$	2-Hydroxy-1-(1′-pyrrolidiyl)-1-buten-3-one		99,138.00
8.	16.80	179.1793	$C_{13}H_{26}O$	2-Undecanone, 6,10-dimethyl-	Fatty aldehyde	295,979.67
9.	11.99	202.1717	$C_{15}H_{22}$	3,5,11-Eudesmatriene	Sesquiterpenoid	84,655.00
10.	16.73	178.9410	$C_{20}H_{40}O$	3,7,11,15-Tetramethyl-2-hexadecen-1-ol	Diterpenoid	23,305.00
11.	21.81	263.8249	$C_{21}H_{40}O_2$	4,8,12,16-Tetramethylheptadecan-4-olide	Beta-diketone	348,560.00
12.	6.57	144.0418	$C_6H_8O_4$	4H-Pyran-4-one, 2,3-dihydro-3,5-dihydroxy-6-methyl-	Fatty acid	842,545.00
13.	28.80	280.8152	$C_{17}H_{30}OSi$	4-tert-Octylphenol, TMS derivative	Alkylbenzene	31,758.67
14.	28.39	400.3725	$C_{28}H_{48}O$	5-Cholestene-3-ol, 24-methyl-	Steroid	548,943.50
15.	13.48	218.8472	$C_{15}H_{24}O$	6,10-Dodecadien-1-yn-3-ol, 3,7,11-trimethyl-	Fatty alcohol	153,763.25
16.	15.88	218.1668	$C_{15}H_{22}O$	7-Isopropenyl-1,4a-dimethyl-4,4a,5,6,7,8-hexahydro-3H-naphthalen-2-one		307,202.33
17.	20.97	272.2511	$C_{18}H_{30}O_2$	9,12,15-Octadecatrienoic acid, (Z,Z,Z)-	Methyl ester	923,805.50
18.	19.49	218.9427	$C_{19}H_{32}O_2$	9,12,15-Octadecatrienoic acid, methyl ester, (Z,Z,Z)-	Methyl ester	152,852.00
19.	19.88	263.7534	$C_{18}H_{32}O_2$	9,12-Octadecadienoic acid (Z,Z)-	Fatty acid	14,775.50
20.	2.95	32.0576	$C_2H_4O_3$	Acetic acid, hydroxy-	Hydroxy acid	8,158.50
21.	13.85	218.8142	$C_{15}H_{24}O$	Bergamotol, Z-α-trans-	Monoterpenoid	48,437.33
22.	13.60	218.8457	$C_{15}H_{24}O$	Caryophyllene oxide	Sesquiterpenoid	487,571.00
23.	14.61	218.8863	$C_{15}H_{24}O$	cis-Z-α-Bisabolene epoxide	Sesquiterpenoid	177,591.67
24.	31.24	218.9091	$C_6H_{18}O_3Si_3$	Cyclotrisiloxane, hexamethyl-	Organosilicon	22,405.75
25.	29.66	430.3832	$C_{29}H_{50}O_2$	dl-α-Tocopherol	Resorcinol	429,663.00
26.	17.67	213.1853	$C_{13}H_{26}O_2$	Dodecanoic acid, methyl ester	Methyl ester	353,733.33
27.	11.72	202.1716	$C_{15}H_{22}$	Eudesma-2,4,11-triene	Sesquiterpenoid	160,053.60
28.	13.27	130.9365	$C_{12}H_9Cl_3O_4$	Fumaric acid, ethyl 3,4,5-trichlorophenyl ester		53,322.00
29.	3.46	58.0088	$C_4H_8O_4$	Glycolaldehyde dimer	Pentose	11,108.50
30.	14.96	220.1826	$C_{15}H_{24}O$	Ledene oxide-(II)	Sesquiterpenoid	335,514.67

Table 16. *Cont.*

	RT (min)	Observed Ion m/z	MF	Name	MC	FC
31.	14.61	263.9254	$C_{19}H_{32}O_3$	Methyl 2-hydroxy-octadeca-9,12,15-trienoate	Fatty acid	365,830.00
32.	2.97	32.0260	CH_4O	Methyl Alcohol	Alcohol	3178,893.00
33.	16.72	221.1896	$C_{20}H_{38}$	Neophytadiene	Diterpenoid	260,778.86
34.	18.26	256.1901	$C_{16}H_{32}O_2$	n-Hexadecanoic acid	Fatty acid	5461,473.67
35.	20.34	156.0941	$C_9H_{19}NO$	Nonanamide	Amide	370,402.80
36.	12.24	206.1660	$C_{14}H_{22}O$	Phenol, 2,6-bis(1,1-dimethylethyl)-	Sesquiterpenoid	60,234.00
37.	18.16	278.1520	$C_{20}H_{30}O_4$	Phthalic acid, heptyl pentyl ester	Ester	7217,745.00
38.	19.61	278.2960	$C_{20}H_{40}O$	Phytol	Diterpenoid	507,674.67
39.	7.29	130.9626	$C_7H_{13}NO_2$	Pyrrolidin-1-propionic acid	Proline	87,679.50
40.	7.28	133.1012	$C_6H_{12}ClN$	Pyrrolidine, 1-(2-chloroethyl)-	Haloalkyl	88,402.00
41.	28.60	412.3717	$C_{29}H_{48}O$	Stigmasterol	Steroid	585,313.00
42.	20.16	227.2011	$C_{14}H_{28}O_2$	Tetradecanoic acid	Fatty acid	200,040.00
43.	14.81	219.9886	$C_{15}H_{24}O$	trans-Z-α-Bisabolene epoxide	Sesquiterpenoid	242,292.25
44.	27.60	430.3830	$C_{29}H_{50}O_2$	Vitamin E	Resorcinol	309,983.50
45.	25.67	421.3605	$C_{29}H_{50}O_4$	α-Tocospiro A	Steroid	220,431.00
46.	29.01	414.3884	$C_{29}H_{50}O$	β-Sitosterol	Triterpenoid	1141,657.00

3. Discussion

Most of the botanical extracts tested for their insecticidal activities proved to be effective repellents, feeding deterrents, and contact toxic against the *S. frugiperda* and *P. xylostella* larvae. Repellence, feeding deterrence, and contact toxicity of *E. capensis*, *T. dregeana*, *Turraea floribunda*, and *T. obtusifolia* extracts are recorded for the first time in this study. *Melia azedarach* was used as a positive control in this study as it is a well-known insecticidal plant in the Meliaceae family. The species has been proven to be an excellent insecticide against *S. frugiperda* [24–31]. In addition, *M. azedarach* extracts were found to be an effective botanical insecticide against *P. xylostella* in studies by Charleston et al. [32], Charleston et al. [12], Chen et al. [33], Chen et al. [34], Defagó et al. [35], Dilawari et al. [36], Dilawaxi et al. [37], Kumar et al. [38], Patil and Goud [39], Qiu et al. [40], Rani et al. [41], Sharma et al. [42], and Singh et al. [43].

Plant extracts with repellent activities are those with compounds that have irritating effects, causing insects to move away from them [44]. All plant extracts evaluated had repellence against the *S. frugiperda* and *P. xylostella* larvae, except for the ethanolic extracts of *T. floribunda* that had attractancy against the two tested larvae. However, there were interspecific differences as the botanical extracts were more susceptible as repellents to the *P. xylostella* larvae than to the *S. frugiperda* larvae (Tables 1 and 2). Accordingly, seven extracts displayed repellency against *P. xylostella* larvae as follows: one in class V, three in IV, and five in III. In comparison, extracts displayed repellency against *S. frugiperda* according to the following level of activity: one in class V, two in IV, and one in III. It is not surprising that *M. azedarach* extracts were found to have the highest repellent activity against both *S. frugiperda* and *P. xylostella* larvae in this study, as this plant is known to have excellent repellent and insecticidal properties against several insect pests in several studies. Interestingly, *T. dregeana* recorded the same repellence activity as *M. azedarach* against both

S. frugiperda and *P. xylostella* larvae. Against *S. frugiperda*, acetone extracts repelled 71% of the larvae (Table 1); meanwhile, against *P. xylostella*, acetone and ethanol extracts repelled 65% of the larvae (Table 2). *Trichilia dregeana* extracts in the study by Adinew [45] were found to have a highly positive protectant ability against *Sitophilus zeamais* Motschulsky (Maize weevil), which is also a major pest of maize similar to *S. frugiperda*. Extracts of *T. floribunda* moderately repelled the *S. frugiperda* larvae, while *E. capensis* and *T. obtusifolia* extracts recorded the lowest repellence activity.

Plants with antifeeding activities have compounds that, once consumed, cause the insects to stop feeding and eventually die due to starvation [44]. A study by Farag et al. [46] suggested that the plant extracts with feeding deterrence activity act as a stomach poison when ingested by insects. These feeding deterrent compounds could help reduce crop damage [18]. *Melia azedarach* aqueous extracts, followed by *T. obtusifolia* (aqueous and ethanol) and *T. floribunda* aqueous extracts, recorded the highest feeding deterrence activity against the *S. frugiperda* larvae. It does not come as a surprise that *Turraea* species recorded high feeding deterrence activity as in the study by Chimbe and Galley [47], another species of the genus, *Turraea nilotica* Kotschy & Peyr., was found to be effective against *Sitophilus oryzae* (rice weevil) larvae. Several studies also evaluated other species of the genus *Trichilia* for antifeedant properties. *Trichilia elegans* A.Juss. [48], *T. pallens* C.DC. [49], *T. pallida* Sw. [49], and *T. roka* (Forssk.) Chiov. [50] were found to have antifeedant activities against *S. frugiperda* larvae. Surprisingly, all *T. dregeana* extracts used in this study inhibited more *P. xylostella* larval feeding than *M. azedarach* extracts. This is contrary to the studies by Charleston et al. [32] and Dilawari et al. [36], where *M. azedarach* extracts recorded the highest antifeedant properties against the *P. xylostella* larvae. In this study, aqueous extracts of *T. obtusifolia* and ethanolic extracts of *E. capensis* also recorded high feeding deterrence activity against the *P. xylostella* larvae, with feeding deterrence coefficients of 86.74 and 85.79, respectively. The repellence activity of *E. capensis* coincides with that in the study by Champagne [51], in which the extracts acted as growth inhibitors and were toxic to *Peridroma saucia* Hübner (variegated cutworm) larvae. *Trichilia silvatica* C.DC. extracts were reported as good antifeedants against *P. xylostella* larvae [52].

Aqueous extracts of *E. capensis* and *T. floribunda* caused the highest *S. frugiperda* larval mortality, with recorded LC_{50} values of 0.14 mg/kg and 0.56 mg/kg, respectively. In the current study, all extracts of *M. azedarach* were less toxic to the *S. frugiperda* larvae (with an LC_{50} of 707.95 mg/kg). These results are contrary to the results obtained in the study by Bullangpoti et al. [26], where *M. azedarach* ethanolic extracts caused high mortality against the *S. frugiperda* with a recorded a lower LC_{50} value of 1.4 g L^{-1}. *Ekebergia capensis* and *T. dregeana* extracts caused the least mortality to the larvae. However, in the study by Rioba and Stevenson [53], two members of the genus *Trichilia, T. pallens* C.DC., and *T. pallida* Sw., were found to cause high larval mortality against the *S. frugiperda* larvae. *Trichilia trijuga* Vell. extracts were found to be toxic to the *Crocidolomia binotalis* (cabbage cluster caterpillar) larvae [54] and *T. americana* (Sessé & Moc.) T.D.Penn. was toxic to the *Trichoplusia ni* (cabbage looper) and *Pseudaletia unipuncta* (armyworm moth) larvae [10]. On the other hand, all three extracts of *M. azedarach* and aqueous extracts of *T. obtusifolia* were more lethal to the *P. xylostella* larvae, with LC_{50} values of 0.14 mg/kg and 1.78 mg/kg, respectively. *Ekebergia capensis*, *T. dregeana*, and *T. floribunda* extracts caused insignificant toxicity against the *P. xylostella* larvae. This is contrary to this present study, as higher levels (LC_{50} value of 691.83 and 707.95 mg/kg) of the extracts of *T. dregeana* were needed to kill 50% of the larvae. *Trichilia emetica* methanol extracts resulted in high *P. xylostella* larval mortality with a recorded LC_{50} value of 0.94 mg.m^{-1} in the study by Munyemana and Alberto [55]. There may be a relationship between the toxicity against the *P. xylostella* of *Turraea* species screened in this study with the study of Essoung et al. [56] and Essoung et al. [57], where *T. floribunda* and other *Turraea* species *T. abyssinica* Hochst., *T. nilotica* Kotschy & Peyr., and *T. wakefieldii* Oliv. extracts were toxic to *Tuta obsoluta* (tomato leafminer) larvae. Growth inhibitory and toxicity activity of eight *Trichilia* species *T. americana* (Sesse & Mocino) Pennington, *T. connaroides* (Wright & Am.), *T. glabra* L., *T. havanensis* Jacq., T. *hirta* L., *T. martiana* C.DC, *T.*

pleeana (A. Juss.) C.DC, and *T. quadrijuga* subsp. *cinerascens* (C.DC) Pennington extracts were evaluated on *Peridroma saucia* (variegated cutworm) and *Spodoptera litura* (cotton leafworm).

In the present work, ethanol extracts yielded the highest number of chemical compounds except for *T. floribunda*, where acetone extracts yielded 60 compounds, whereas ethanol yielded 30 compounds. This coincides with the antifeedant results, as ethanol extracts had better repellence, feeding deterrence, and contact toxicity than acetone extracts. Four chemical compounds were present in acetone and ethanol extracts of all five Meliaceae species studied: methyl alcohol, neophytadiene, phytol, and β-sitosterol. The tridecanoic acid methyl ester was present in all plant extracts except in ethanolic extracts of *T. dregeana*. The terpene derivatives phytol (present in all plant extracts in the current study) have been reported to have insecticidal [58] and pesticidal activities [59]. After all the chemical compounds identified in GC-MS analysis of plant extracts were classified, it was found that eight classes were common in all ethanol extracts. These were alcohols, diterpenoids, esters, fatty acids, fatty aldehydes, methyl esters, steroids, and triterpenoids. The five species' most common classes in acetone extracts were alcohol, alkane, diterpenoid, ester, non-metal compound, organosilicon, and triterpenoid. All five plant species evaluated (either aqueous, acetone, or ethanol extracts) had repellence, feeding deterrence, and contact toxicity activity against *S. frugiperda* and *P. xylostella* larvae to some extent. The GC-MS analysis results strongly support these results as the two most well-known groups, phenols, and terpenes, known to have insecticidal and antifeedant properties, were present in all the plant extracts. *Trichilia dregeana* extracts exhibited excellent repellence activity and feeding deterrence against the two test larvae as the positive control, *M. azedarach* extracts. GC-MS analysis revealed that ethanol extracts of *T. dregeana* contained a high number of chemical classes that are terpenes (i.e., diterpenoid, sesquiterpenoid, triterpenoid, and steroid) and phenols (i.e., gingerdione). In acetone extracts of *T. dregeana*, four terpenes were identified (i.e., diterpenoid, sesquiterpenoid, triterpenoid, and steroid), as well as four phenols (i.e., 7-hydroxycoumarin, alkylbenzene, gingerdione, and resorcinol). Chemical compound phenol, 2,2′-methylenebis[6-(1,1-dimethylethyl)-4-methyl- identified in ethanolic extracts of *T. dregeana* was reported to have repellent, larvicidal, adulticidal, and oviposition deterrence activities against insects in a study by Chen et al. [60]. In studies by Curcino-Vieira et al. [61] and Tan and Luo [62], chemical compounds such as coumarins, diterpenes, flavonoids, glycosylated lignans, limonoids, monoterpenes, sesquiterpenes, steroids, and triterpenes isolated from the genus *Trichilia* were found to have insect feeding activities [63–65], and they may be toxic to insects [66,67]. *Ekebergia capensis* extracts exhibited good repellence, feeding deterrence, and contact toxicity against the test insects. GC-MS analysis revealed that ethanol extracts of *E. capensis* contained 50 compounds, of which 16 are terpenes belonging to diterpenoid, ergosterol, sesquiterpenoid, and steroid chemical classes. Conversely, acetone extracts identified thirty-three compounds, of which nine are terpenes (belonging to classes diterpenoid, sesquiterpenoid, and triterpenoid), and one is a phenol (cholesterol). The two members of the genus *Turraea, T. floribunda*, and *T. obtusifolia*, recorded minor activities in the antifeedant testing against the test insects. The presence of different chemical classes of compounds such as diterpenoids, flavonoids, limonoids, and terpenoids in some *Turraea* spp. have been associated with insecticidal activities in previous studies by Essoung et al. [56]; Ndung'u et al. [68]; Udenigwe et al. [69]; Yuan et al. [70]; Xu et al. [71]; and Zanin et al. [72]. Chemical groups other than phenols and terpenes, which have been recorded to have insecticidal, antifeedant, and insect repellent activities, have also been identified in the current study. For example, 9,12-otadecadienoic acid (Z,Z)- present in all *T. obtusifolia* extracts was reported to have insect-repellent properties in the study by Paulpriya et al. [59].

4. Materials and Methods

4.1. Antifeedant and Insecticidal Analysis

4.1.1. Sample Preparations

Leaves were dried under shade at room temperature (25 °C), then ground into a fine powder using an electric grinder. Extraction was carried out according to the procedures of Warthen et al. [73], with some slight modifications. Ten grams of each powdered sample were extracted in 100 mL of water, acetone, and ethanol separately for 72 h at room temperature. After extraction, the solutions were filtered through Whatman No.40 filter paper, and the solvents were removed using a rotary evaporator. Methanol was used to dissolve the organic residues, where 0.5% and 1.0% solutions were prepared for each sample.

4.1.2. Insects Selection and Rearing

S. frugiperda and *P. xylostella* second instar larvae strains (between 3 to 7 days old) were obtained from the Agricultural Research Council- Vegetable and Ornamental Plants (ARC- VOPI) in Pretoria, where they were reared, and the information on their age was also obtained.

4.1.3. Repellence Bioassay

The repellence bioassay of the plant samples was assessed using Standard Method Number 3, described by McDonald et al. [74], with some modifications. Repellence tests were conducted using Whatman No.40 filter papers as opposed to the strips of aluminum foil laminated to 40 lb. kaft paper, as described in the study by McDonald et al. [74]. The substrata were prepared by cutting a filter paper in half and placing it in 0.5% and 1.0% solutions of the plant extracts for 1 min, and then allowing it to air dry at room temperature overnight. Each half of the treated disk was attached lengthwise, edge to edge, to an untreated half-disk of the filter paper with cellulose tape and placed in a petri dish (Figure 1A,B). To avoid cannibalism in a petri dish, five larvae of each insect were placed in the middle of each filter paper circle and covered. For five hours, at hourly intervals, individuals that settled on each half of the filter paper disk were counted, and the experimental design was run once. The average of the counts was converted to express the percentage repulsion (PR) as follows:

$$PR = 2 \times (C - 50) \quad (1)$$

where C is the percentage of insects on the untreated half of the disk. Positive percentage repulsion values expressed repellence, and negative percentage repulsion values expressed attractancy. The averages of the percentage repulsion were then assigned different classes using the scale as follows [75] (Table 17):

Table 17. Scale used to assign different classes of percentage repulsion values [75].

Class	Percentage Repulsion
0	>0.01 to <0.1
I	0.1–20
II	20.1–40
III	40.1–60
IV	60.1–80
V	80.1–100

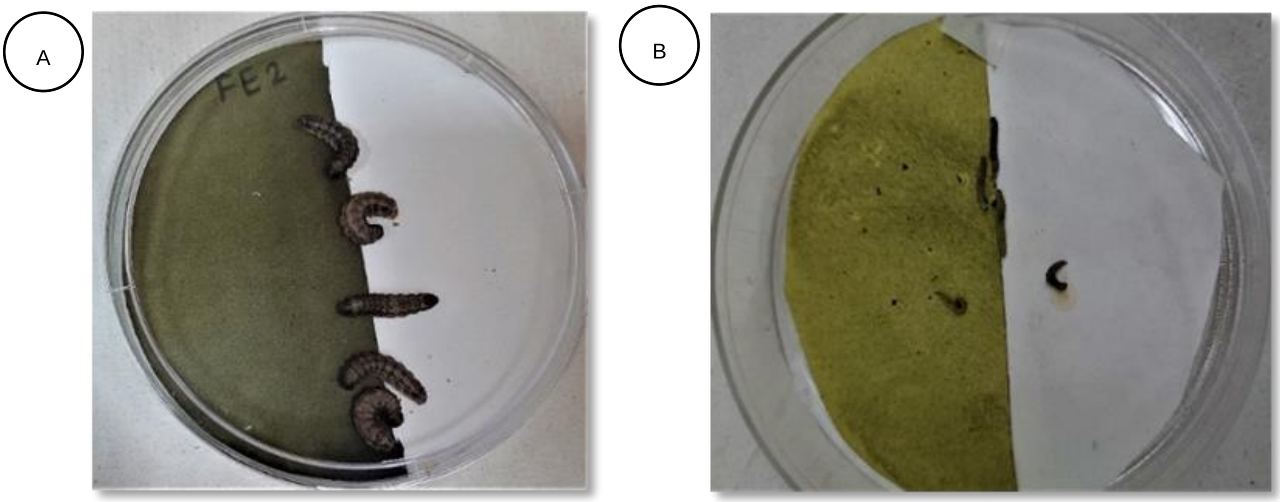

Figure 1. (**A**) Treated half and untreated half of filter paper with *S. frugiperda* larvae. (**B**) Treated half and untreated half of filter paper with *P. xylostella* larvae.

4.1.4. Feeding Deterrence Test

The potency of the feeding deterrence effect of plant leaf extracts against *S. frugiperda* and *P. xylostella* was determined by using the leaf disk bioassay. Maize and cabbage leaves were used as the test food for *S. frugiperda* and *P. xylostella*, respectively. The leaves were soaked in either water only (control leaf disks K) or in a 1% plant extract solution of aqueous, acetone, and ethanol separately (treated leaf disks E). The leaf disks (Figure 2A,B) were allowed to air dry at room temperature for about 30 min and weighed before they were presented to the larvae in petri dishes for 24 h, during which they were serving as the sole food source. The feeding behaviour of the larvae was recorded under three different conditions: (1) pure food, which comprised two control leaves (KK) (control test); (2) food with one control leaf (K) and one treated leaf (E) (choice test); and (3) food with two treated leaves (EE) (no choice test). After 24 h, the remaining leaves were reweighed, and mean percentages of feeding deterrence (FD) were calculated for each plant extract based on the weight of leaves before and after the tests. FD was calculated as follows:

$$\mathrm{FD} = (\mathrm{C} - \mathrm{T}/\mathrm{C} + \mathrm{T}) \times 100 \tag{2}$$

C = weight of control leaves; T = weight of treated leaves.

After the FD values were calculated, three coefficients for the feeding deterrent activity from all three tests for each plant extract were calculated as follows [75]:

1. Absolute deterrence coefficient

$$\mathrm{A} = (\mathrm{KK} - \mathrm{EE}/\mathrm{KK} + \mathrm{EE}) \times 100 \tag{3}$$

2. Relative deterrence coefficient

$$\mathrm{R} = (\mathrm{K} - \mathrm{E}/\mathrm{K} + \mathrm{E}) \times 100 \tag{4}$$

3. Total deterrence coefficient

$$\mathrm{T} = \mathrm{A} + \mathrm{R} \tag{5}$$

Values of the total deterrence coefficient (A) served as an index of the feeding deterrence activity which was expressed on a scale between 0 and 200. Plant extracts with a total deterrence coefficient of between 150–200 were marked ++++; 100–150, +++; 50–100, ++, and 0–50 + [75].

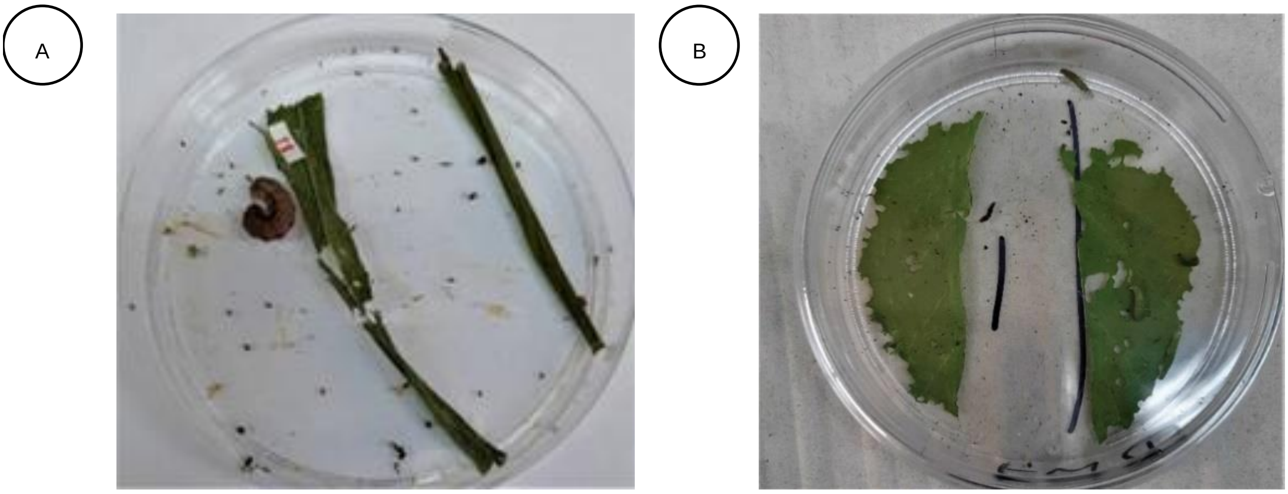

Figure 2. (**A**) Maize leaf disk for the feeding deterrence assay against *S. frugiperda* after 24 h. (**B**) Cabbage leaf disk for the feeding deterrence assay against *P. xylostella* after 24 h.

4.1.5. Topical Application Bioassay

The topical treatment assay tested the direct contact toxicity of the plant extracts, using Standard Method Number 1 described by McDonald et al. [74] with some modifications. Plant extract solutions of 0.5% and 1% were used for this test. Larvae were chilled for 10 min instead of being anesthetized with carbon dioxide in a Buchner funnel for about 5 min, as described in the study by McDonald et al. [74]. The immobilized larvae were picked up individually with forceps. Ten microliters of each plant extract solution were applied to the dorsum of each larva. Five larvae were treated at each dose and then transferred to a petri dish. After 24 h, the larvae were examined, and those that did not respond to gentle touch were considered dead. The number of dead larvae was recorded, and corrected mortality rates were calculated using the formula:

$$\text{Percent larval mortality} = (\text{number of dead larvae}/\text{total number of treated larvae}) \times 100 \quad (6)$$

Probit analysis [76] was used to analyse concentration-mortality data.

4.2. Gas Chromatography-Mass Spectrometry (GC-MS) Analysis

GC-MS analysis was used to identify chemical compounds present in all five selected Meliaceae species. The patterns of the mass spectra fragmentation and their retention indices were compared with the ones stored in the computer library to identify the chemical components found in the plant extracts [77].

4.2.1. Sample Preparation

One gram of powdered samples was extracted in acetone and ethanol for 24 h at room temperature. The extracts were centrifuged at 13,000× *g* rpm for 10 min at 10 °C. Whatman No.1 filter paper was used to filter the solutions, and a rotary evaporator was used to evaporate or concentrate the solvents. One milliliter of methanol was used to dissolve the organic residues. The solutions were transferred into dark amber vials using syringe filters.

4.2.2. Gas Chromatography-High-Resolution-Time-of-Flight Mass Spectrometry (GC-HRTOF- MS) Analyses

The samples were analysed on the GC-HRTOF- MS system equipped with an Agilent 7890A gas chromatograph (Agilent Technologies, Inc., Wilmington, DE, USA). This system operates in high-resolution, equipped with a Gerstel MPS multipurpose autosampler (Gerstel Inc., Germany) and capillary column (Rxi- 5 ms- 30 m × 0.25 mm ID × 0.25 μm). For each plant extract, a volume of 1 μL was injected in a spitless mode. The program was started at 70 °C, held for 0.5 min, ramped at 10 °C/min to 150 °C, held for 2 min, ramped at 10 °C/min to 330 °C, and held for 3 min for the column to bake out. The samples were analysed at an MS data acquisition rate of 13 spectra/s, m/z range of 30–1000, electron ionization at 70 eV, ion source temperature was set at 250 °C, and the system extraction frequency was set at 1.25 kHz. Solvent blanks were also used to observe for contamination and impurities. Compounds were identified by matching the generated spectra with the NIST, Mainlib, and Feihn reference library databases on ChromaTOF-HRT® (LECO Corporation, St. Joseph, MI, USA). Subsequent retention time alignment, matched filtration, peak picking, detection, and matching were conducted on a data station equipped with the ChromaTOF-HRT® software (LECO Corporation, St. Joseph, MI, USA). Parameters adopted for processing included a signal-to-noise ratio (S/N) of 100, a similarity match above 70%, and data presented in Tables 7–16 representing only compounds occurring at least twice in triplicate injections. The collected GC-HRTOF-MS dataset was converted to mzML format using the LECO ChromaTOF-HRT software and then processed (peak picking and alignment) on the XCMS open-source tool.

5. Conclusions

Meliaceae species are abundant large tree species, so they would be suitable to supply very large-scale production of botanical insecticides; thus, their potential use in controlling insect pests is promising. This study provides potential evidence that further confirms the findings of many previous reports that Meliaceae members can be used as repellents, insecticides, and antifeedants to control *S. frugiperda* and *P. xylostella* insects, two of the most important agricultural pests that mostly attack crops which form part of the primary staple food. All extracts of the five evaluated species indicated repellence to the *S. frugiperda* and *P. xylostella* larvae, except for the ethanolic extracts of *T. floribunda*, which showed attraction to both the larvae. All extracts evaluated exhibited feeding deterrence to the *S. frugiperda* and *P. xylostella* larvae to some extent, except for the ethanol extracts of *T. floribunda*, which had inert antifeeding compounds. Aqueous extracts of *E. capensis* and *T. floribunda* were more toxic to the *S. frugiperda* larvae, and all extracts of *M. azedarach* were more toxic to the *P. xylostella* larvae. The GC-MS analysis results strongly support the insecticidal activities of the evaluated extracts as the two most well-known groups, phenols and terpenes, known to have insecticidal and antifeedant properties, were present in all the plant extracts. Therefore, this further corroborates the recorded traditional uses of these plants as insecticides and antifeedants. Plants that have indicated the most promising results are *E. capensis*, *T. floribunda*, and *T. obtusifolia*. These plants should be subjected to further quantitative phytochemical studies focusing on isolating and identifying active compounds rather than simply screening the plant extracts for insecticidal and antifeedant activity, as plant extracts may contain many compounds along with those that may cause negative side effects and toxicity. Further research should also be conducted regarding their safe use and non-target effects, and to determine if they can maintain yield at comparable levels to synthetic pesticides. Field trial evaluations of insecticidal and antifeedant plant extracts may also need to be undertaken to assess their impact on crop yield and damage and evaluate insect resistance issues in comparison to synthetic pesticides. This study's results are significant as they will generate new and alternative natural products that can help improve biological effectiveness, lower residuals, increase nontoxic agricultural products, and decrease their presence in foods.

Author Contributions: Conceptualization, A.N.M. and K.C.S.; writing—original draft preparation, K.C.S.; writing, review, and editing, A.N.M. and K.C.S. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by the National Research Foundation (NRF), grant number 114686.

Data Availability Statement: Not applicable.

Acknowledgments: The authors are grateful to the University of Johannesburg for the logistical and financial support.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Khan, S.; Taning, C.N.T.; Bonneure, E.; Mangelinckx, S.; Smagghe, G.; Shah, M.M. Insecticidal activity of plant-derived extracts against different economically important pest insects. *Phytoparasitica* **2017**, *45*, 113–124. [CrossRef]
2. Stevenson, P.C.; Isman, M.B.; Belmain, S.R. Pesticidal plants in Africa: A global vision of new biological control products from local uses. *Ind. Crops Prod.* **2017**, *110*, 2–9. [CrossRef]
3. Kalpana, P.; Kaur, V.; Gahlyan, S.; Jangra, A.; Pradeep, A.; Rani, M.; Maken, S. Exploring the phytochemicals of Delphinium ajacis and their applications in biocontrol activity against some plant pathogens. *J. Chem. Pharm. Res.* **2016**, *8*, 11–18.
4. Kabdwal, B.C.; Sharma, R.; Tewari, R.; Tewari, A.K.; Singh, R.P.; Dandona, J.K. Field efficacy of different combinations of Trichoderma harzianum, Pseudomonas fluorescens, and arbuscular mycorrhiza fungus against the major diseases of tomato in Uttarakhand (India). *Egypt. J. Biol. Pest Control.* **2019**, *29*, 1–10. [CrossRef]
5. Thapa, C.B. Survey of Integrated Pest Management (IPM) Practice in Vegetable Crops of Rupandehi District, Western Nepal. *Int. J. Appl. Sci. Biotechnol.* **2017**, *5*, 237–242. [CrossRef]
6. Karunamoorthi, K. Medicinal and Aromatic Plants: A Major Source of Green Pesticides/Risk-Reduced Pesticides. *Med. Aromat. Plants* **2012**, *1*, 2164-0412. [CrossRef]
7. Gunnell, D.; Eddleston, M.; Phillips, M.R.; Konradsen, F. The global distribution of fatal pesticide self-poisoning: Systematic review. *BMC Public Health* **2007**, *7*, 357. [CrossRef]
8. Rangiah, K.; Varalaxmi, B.A.; Gowda, M. UHPLC-MS/SRM method for quantification of neem metabolites from leaf extracts of Meliaceae family plants. *Anal. Methods* **2016**, *8*, 2020–2031. [CrossRef]
9. Isman, M.; Arnason, J.; Towers, G. *Chemistry and Biological Activity of Ingredients of Other Species of Meliaceae. The Neem Tree: Azadichta indica A. Juss and Other Meliaceous Plants: Sources of Unique Natural Products for Integrated Pest Management, Medicine, Industry and Other Purposes*; VCH: Weinheim, Germany, 1995; pp. 652–666.
10. Akhtar, Y.; Yeoung, Y.R.; Isman, M.B. Comparative bioactivity of selected extracts from Meliaceae and some commercial botanical insecticides against two noctuid caterpillars, Trichoplusia ni and Pseudaletia unipuncta. *Phytochem. Rev.* **2007**, *7*, 77–88. [CrossRef]
11. Senthil, N. Physiological and biochemical effect of neem and other Meliaceae plants secondary metabolites against Lepidopteran insects. *Front. Physiol.* **2013**, *4*, 359.
12. Charleston, D.S.; Kfir, R.; Dicke, M.; Vet, L.E. Impact of botanical extracts derived from Melia azedarach and Azadirachta indica on populations of Plutella xylostella and its natural enemies: A field test of laboratory findings. *Biol. Control.* **2006**, *39*, 105–114. [CrossRef]
13. Rattan, R.S.; Sharma, A. Plant Secondary Metabolites in the Sustainable Diamondback Moth Plutella xylostella L. Management. *Indian J. Fundam. Appl. Life Sci.* **2011**, *1*, 295–309.
14. Amoabeng, B.W.; Gurr, G.M.; Gitau, C.W.; Nicol, H.I.; Munyakazi, L.; Stevenson, P.C. Tri-Trophic Insecticidal Effects of African Plants against Cabbage Pests. *PLoS ONE* **2013**, *8*, e78651. [CrossRef]
15. Machekano, H.; Mvumi, B.; Nyamukondiwa, C. Diamondback Moth, *Plutella xylostella* (L.) in Southern Africa: Research Trends, Challenges and Insights on Sustainable Management Options. *Sustainability* **2017**, *9*, 91. [CrossRef]
16. Risco, G.V.S.; Idrogo, C.R.; Kato, M.J.; Díaz, J.S.; Armando, J., Jr.; Paredes, G.E.D. Larvicidal activity of Piper tuberculatum on Spodoptera frugiperda (Lepidoptera: Noctuidae) under laboratory conditions. *Rev. Colomb. Entomol.* **2012**, *38*, 35–41. [CrossRef]
17. Sisay, B.; Tefera, T.; Wakgari, M.; Ayalew, G.; Mendesil, E. The Efficacy of Selected Synthetic Insecticides and Botanicals against Fall Armyworm, *Spodoptera frugiperda*, in Maize. *Insects* **2019**, *10*, 45. [CrossRef]
18. Phambala, K.; Tembo, Y.; Kasambala, T.; Kabambe, V.H.; Stevenson, P.C.; Belmain, S.R. Bioactivity of Common Pesticidal Plants on Fall Armyworm Larvae (*Spodoptera frugiperda*). *Plants* **2020**, *9*, 112. [CrossRef]
19. Overton, K.; Maino, J.L.; Day, R.; Umina, P.A.; Bett, B.; Carnovale, D.; Ekesi, S.; Meagher, R.; Reynolds, O.L. Global crop impacts, yield losses and action thresholds for fall armyworm (*Spodoptera frugiperda*): A review. *Crop Prot.* **2021**, *145*, 105641. [CrossRef]
20. Adeniyi, S.A.; Orjiekwe, C.L.; Ehiagbonare, J.E.; Arimah, B.D. Preliminary phytochemical analysis and insecticidal activity of ethanolic extracts of four tropical plants (Vernonia amygdalina, Sida acuta, Ocimum gratissimum and Telfaria occidentalis) against beans weevil (Acanthscelides obtectus). *Int. J. Phys. Sci.* **2010**, *5*, 753–762.
21. Pino, O.; Sánchez, Y.; Rojas, M.M. Plant secondary metabolites as an alternative in pest management. I: Background, research approaches and trends. *Rev. Protección Veg.* **2013**, *28*, 81.
22. Fischer, D.; Imholt, C.; Pelz, H.J.; Wink, M.; Prokop, A.; Jacob, J. The repelling effect of plant secondary metabolites on water voles, Arvicola amphibius. *Pest Manag. Sci.* **2013**, *69*, 437–443. [CrossRef] [PubMed]
23. Chaudhary, S.; Kanwar, R.K.; Sehgal, A.; Cahill, D.M.; Barrow, C.J.; Sehgal, R.; Kanwar, J.R. Progress on Azadirachta indica Based Biopesticides in Replacing Synthetic Toxic Pesticides. *Front. Plant Sci.* **2017**, *8*, 610. [CrossRef] [PubMed]
24. Berlitz, D.L.; Azambuja, A.O.D.; Sebben, A.; Oliveira, J.V.D.; Fiuza, L.M. Mortality of Oryzophagus oryzae (Costa Lima, 1936) (Coleoptera: Curculionidae) and Spodoptera frugiperda (J E Smith, 1797) (Lepidoptera: Noctuidae) Larvae Exposed to Bacillus thuringiensis and Extracts of Melia azedarach. *Braz. Arch. Biol. Technol.* **2012**, *55*, 725–731. [CrossRef]

25. Breuer, M.; Schmidt, G. Studies on the effect of Melia azedarach extracts on Spodoptera frugiperda (JE Smith)(Lepidoptera: Noctuidae). *Mitt. Dtsch. Ges. Allg. Angew. Entomol.* **1990**, *7*, 419–429.
26. Bullangpoti, V.; Wajnberg, E.; Audant, P.; Feyereisen, R. Antifeedant activity of Jatropha gossypifolia and Melia azedarach senescent leaf extracts on Spodoptera frugiperda (Lepidoptera: Noctuidae) and their potential use as synergists. *Pest Manag. Sci.* **2012**, *68*, 1255–1264. [CrossRef]
27. Hernandez, C.; Vendramim, J. Bioactivity evaluation of aqueous extracts of Meliaceae to Spodoptera frugiperda (JE Smith). *Rev. Agric.* **1997**, *72*, 305–318.
28. Jiménez-Durán, A.; Barrera-Cortés, J.; Lina-García, L.P.; Santillan, R.; Soto-Hernández, R.M.; Ramos-Valdivia, A.C.; Ponce-Noyola, T.; Ríos-Leal, E. Biological Activity of Phytochemicals from Agricultural Wastes and Weeds on Spodoptera frugiperda (J.E. Smith) (Lepidoptera: Noctuidae). *Sustainability* **2021**, *13*, 13896. [CrossRef]
29. Maroneze, D.M.; Gallegos, D.M.N. Effect of Melia azedarach aqueous extract on the development of immature and reproductive stages of Spodoptera frugiperda (J. E. Smith, 1797) (Lepidoptera: Noctuidae). *Semin. Ciências Agrárias* **2009**, *30*, 537–549.
30. Scapinello, J.; Oliveira, J.V.; Ribeiros, M.L.; Tomazelli, O., Jr.; Chiaradia, L.A.; Dal Magro, J. Effects of supercritical CO2 extracts of Melia azedarach L. on the control of fall armyworm (Spodoptera frugiperda). *J. Supercrit. Fluids* **2014**, *93*, 20–26. [CrossRef]
31. Scapinello, J.; Oliveira, J.V.D.; Chiaradia, L.A.; Tomazelli, O., Jr.; Niero, R.; Dal Magro, J. Insecticidal and growth inhibiting action of the supercritical extracts of Melia azedarach on Spodoptera frugiperda. *Rev. Bras. Eng. Agrícola Ambient.* **2014**, *18*, 866–872. [CrossRef]
32. Charleston, D.S.; Kfir, R.; Vet, L.E.M.; Dicke, M. Behavioural responses of diamondback moth *Plutella xylostella* (Lepidoptera: Plutellidae) to extracts derived from *Melia azedarach* and *Azadirachta indica*. *Bull. Entomol. Res.* **2005**, *95*, 457–465. [CrossRef] [PubMed]
33. Chen, C.; Chang, S.J.; Cheng, L.L.; Hou, R.F. Effects of chinaberry fruit extract on feeding, growth and fecundity of the diamondback moth, Plutella xylostella L.(Lep.; Yponomeutidae). *J. Appl. Entomol.* **1996**, *120*, 341–345. [CrossRef]
34. Chen, C.C.; Chang, S.J.; Hou, R.F.; Cheng, L.L. Deterrent effect of the chinaberry extract on oviposition of the diamondback moth, Plutella xylostella (L.)(Lep.; Yponomeutidae). *J. Appl. Entomol.* **1996**, *120*, 165–169. [CrossRef]
35. Defagó, M.T.; Dumón, A.; Avalos, D.S.; Palacios, S.M.; Valladares, G. Effects of Melia azedarach extract on Cotesia ayerza, parasitoid of the alfalfa defoliator Colias lesbia. *Biol. Control.* **2011**, *57*, 75–78. [CrossRef]
36. Dilawari, V.; Singh, K.; Dhaliwal, G. Effects of Melia azedarach L. on oviposition and feeding of Plutella xylostella L. *Int. J. Trop. Insect Sci.* **1994**, *15*, 203–205. [CrossRef]
37. Dilawaxi, V.; Singh, K.; Dhaliwal, G. Sensitivity of Diamondback Moth, *Plutella xylostella* L. to *Melia azedarach* L. *Pestic. Res. J.* **1994**, *6*, 71–74.
38. Kumar, R.; Sharma, K.; Kumar, D. Studies on ovicidal effects of some plant extracts against the diamondback moth, *Plutella xylostella* (L.) infesting cauliflower cro. *Biol. Forum Int. J.* **2009**, *1*, 47–50.
39. Patil, R.S.; Goud, K.B. Efficacy of methanolic plant extracts as ovipositional repellents against diamondback moth, *Plutella xylostella* (L.). *J. Entomol. Res.* **2003**, *27*, 13–18.
40. Qiu, Y.-T.; Loon, J.J.A.; Roessingh, P. Chemoreception of oviposition inhibiting terpenoids in the diamondback moth *Plutella xylostella*. *Entomol. Exp. Appl.* **1998**, *87*, 143–155. [CrossRef]
41. Rani, M.; Suhag, P.; Kumar, R.; Singh, R.; Kalidhar, S.B. Chemical components and biological efficacy of Melia azedarach Stems. *J. Med. Aromat. Plant Sci.* **1999**, *21*, 1043–1047.
42. Sharma, A.; Kaushal, P.; Sharma, K.C.; Kumar, R. Bioefficacy of some plant products against Diamond back moth *Plutella xylostella* L. (Lepidoptera: Yponomeutidae). *J. Entomol. Res.* **2006**, *30*, 213–217.
43. Singh, G.; Kaur, V.; Singh, D. Lethal and sublethal effects of different ecotypes of Melia azedarach against *Plutella xylostella* (Lepidoptera: Plutellidae). *Int. J. Trop. Insect Sci.* **2006**, *26*, 92–100. [CrossRef]
44. Castillo, L.E.; Jiménez, J.; Delgado, M. Secondary metabolites of the Annonaceae, Solanaceae and Meliaceae families used as biological control of insects. *Trop. Subtrop. Agroecosystems* **2010**, *12*, 445–462.
45. Adinew, B. Comparative Efficacy of Jatropha Curcas and Trichilia Dregeana Seed Oil on Sitophilus Zeamais in Stored Maize Grain. *Elixir Entomol.* **2017**, *111*, 48802–48806.
46. Farag, M.; Ahmed, M.H.; Yousef, H.; Abdel-Rahman, A.H. Repellent and Insecticidal Activities of *Melia azedarach* L. against Cotton Leafworm, Spodoptera littoralis (Boisd.). *Z. Für Nat. C* **2011**, *66*, 129–135. [CrossRef] [PubMed]
47. Chimbe, C.; Galley, D. Evaluation of material from plants of medicinal importance in Malawi as protectants of stored grain against insects. *Crop Prot.* **1996**, *15*, 289–294. [CrossRef]
48. Longhini, R.; Lonni, A.A.; Sereia, A.L.; Krzyzaniak, L.M.; Lopes, G.C.; Mello, J.C.P.D. Trichilia catigua: Therapeutic and cosmetic values. *Rev. Bras. De Farmacogn.* **2017**, *27*, 254–271. [CrossRef]
49. Bogorni, P.C.; Vendramim, J.D. Sublethal effect of aqueous extracts of Trichilia sp on Spodoptera frugiperda (JE Smith)(Lepidoptera: Noctuidae) development on maize. *Neotrop. Entomol.* **2005**, *34*, 311–317. [CrossRef]
50. Kubo, I.; Klocke, J. An insect growth inhibitor fromTrichilia roka (Meliaceae). *Experientia* **1982**, *38*, 639–640. [CrossRef]
51. Champagne, D.E.; Isman, M.B.; Downum, K.R.; Towers, G.H. Insecticidal and growth-reducing activity of foliar extracts from Meliaceae. *Chemoecology* **1993**, *4*, 165–173. [CrossRef]
52. Couto, I.F.; Fuchs, M.L.; Pereira, F.F.; Mauad, M.; Scalon, S.P.; Dresch, D.M.; Mussury, R.M. Feeding preference of *Plutella xylostella* for leaves treated with plant extracts. *An. Acad. Bras. Ciências* **2016**, *88*, 1781–1789. [CrossRef] [PubMed]

53. Rioba, N.B.; Stevenson, P.C. Opportunities and scope for botanical extracts and products for the management of fall armyworm (spodoptera frugiperda) for smallholders in africa. *Plants* **2020**, *9*, 207. [CrossRef] [PubMed]
54. Prijono, D. Insecticidal activity of meliaceous seed extracts against Crocidolomia binotalis Zeller (Lepidoptera: Pyralidae). *Bul. HPT* **1998**, *10*, 1–7.
55. Munyemana, F.; Alberto, A.L. Evaluation of larvicidal activity of selected plant extracts against *Plutella xylostella* (Lepidoptera: Plutellidae) larvae on cabbage. *Adv. Med. Plant Res.* **2017**, *5*, 11–20. [CrossRef]
56. Essoung, F.; Chhabra, S.C.; Mba'ning, B.M.; Mohamed, S.A.; Lwande, W.; Lenta, B.N.; Ngouela, S.A.; Tsamo, E.; Hassanali, A. Larvicidal activities of limonoids from *Turraea abyssinica* (Meliaceae) on *Tuta absoluta* (Meyrick). *J. Appl. Entomol.* **2018**, *142*, 397–405. [CrossRef]
57. Essoung Ehawa, F.R.; Mohamed, S.A.; Hassanali, A.; Chhabra, S.C. Bioassay-Guided Isolation of Active Phytochemicals Against *Tuta absoluta* (Meyrick) from *Turraea floribunda* and *Caesalpinia welwitschiana*. In *Sustainable Management of Invasive Pests in Africa*; Springer: Berlin/Heidelberg, Germany, 2020; pp. 11–29.
58. Cruz-Estrada, A.; Gamboa-Angulo, M.; Borges-Argáez, R.; Ruiz-Sánchez, E. Insecticidal effects of plant extracts on immature whitefly Bemisia tabaci Genn.(Hemiptera: Aleyroideae). *Electron. J. Biotechnol.* **2013**, *16*, 6.
59. Paulpriya, K.; Tresina, P.; Mohan, V. Assessment of bioactive constituents by GC-MS of Crotalaria longipes Wight & Arn.: An endemic plant. *Int. J. Pharmacogn. Phytochem. Res.* **2014**, *15*, 4.
60. Chen, Y.; Dai, G. Acaricidal, repellent, and oviposition-deterrent activities of 2, 4-di-tert-butylphenol and ethyl oleate against the carmine spider mite Tetranychus cinnabarinus. *J. Pest Sci.* **2015**, *88*, 645–655. [CrossRef]
61. Curcino Vieira, I.J.; da Silva Terra, W.; dos Santos Gonçalves, M.; Braz-Filho, R. Secondary Metabolites of the Genus Trichilia: Contribution to the Chemistry of Meliaceae Family. *Am. J. Anal. Chem.* **2014**, *5*, 91–121. [CrossRef]
62. Tan, Q.-G.; Luo, X.-D. Meliaceous limonoids: Chemistry and biological activities. *Chem. Rev.* **2011**, *111*, 7437–7522. [CrossRef]
63. Li, X. Recent studies on insecticidal activities of limonoids from meliaceous plants. *Insect Sci.* **1999**, *6*, 283–288. [CrossRef]
64. RamÍrez, M.; Toscano, R.A.; Arnason, J.; Omar, S.; Cerda-GarcÍa-Rojas, C.M.; Mata, R. Structure, conformation and absolute configuration of new antifeedant dolabellanes from *Trichilia trifolia*. *Tetrahedron* **2000**, *56*, 5085–5091. [CrossRef]
65. Simmonds, M.S.; Stevenson, P.C.; Porter, E.A.; Veitch, N.C. Insect Antifeedant Activity of Three New Tetranortriterpenoids from *Trichilia pallida*. *J. Nat. Prod.* **2001**, *64*, 1117–1120. [CrossRef] [PubMed]
66. Liu, S.-B.; Chen, H.Q.; Feng, G.; Guo, Z.K.; Cai, C.H.; Wang, J.; Mei, W.L.; Dai, H.F. A new insecticidal havanensin-type limonoid from the roots of *Trichilia sinensis* Bentv. *Nat. Prod. Res.* **2018**, *32*, 2797–2802. [CrossRef]
67. Matos, A.P.; Nebo, L.; Vieira, P.C.; Fernandes, J.B.; Silva, M.F.D.G.F.D.; Rodrigues, R.R. Constituintes químicos e atividade inseticida dos extratos de frutos de *Trichilia elegans* e *T. catigua* (Meliaceae). *Química Nova* **2009**, *32*, 1553–1556. [CrossRef]
68. Ndung′u, M.W.; Kaoneka, B.; Hassanali, A.; Lwande, W.; Hooper, A.M.; Tayman, F.; Zerbe, O.; Torto, B. New mosquito larvicidal tetranortriterpenoids from *Turraea wakefieldii* and *Turraea floribunda*. *J. Agric. Food Chem.* **2004**, *52*, 5027–5031. [CrossRef]
69. Udenigwe, C.C.; Ata, A.; Samarasekera, R. Glutathione S-Transferase Inhibiting Chemical Constituents of Caesalpinia bonduc. *Chem. Pharm. Bull.* **2007**, *55*, 442–445. [CrossRef]
70. Yuan, C.-M.; Tang, G.H.; Wang, X.Y.; Zhang, Y.; Cao, M.M.; Li, X.H.; Li, Y.; Li, S.L.; Di, Y.T.; He, H.P.; et al. New steroids and sesquiterpene from *Turraea pubescens*. *Fitoterapia* **2013**, *90*, 119–125. [CrossRef]
71. Xu, X.; Yuan, J.; Zhou, X.; Li, W.; Zhu, N.; Wu, H.; Li, P.; Sun, Z.; Yang, J.; Ma, G. Cassane diterpenes with oxygen bridge from the seeds of Caesalpinia sappan. *Fitoterapia* **2016**, *112*, 205–210. [CrossRef]
72. Zanin, J.L.B.; De Carvalho, B.A.; Salles Martineli, P.; Dos Santos, M.H.; Lago, J.H.G.; Sartorelli, P.; Viegas, C., Jr.; Soares, M.G. The genus Caesalpinia L.(Caesalpiniaceae): Phytochemical and pharmacological characteristics. *Molecules* **2012**, *17*, 7887–7902. [CrossRef]
73. Warthen, J.D.; Stokes, J.B.; Jacobson, M.; Kozempel, M.F. Estimation of Azadirachtin Content in Neem Extracts and Formulations. *J. Liq. Chromatogr.* **1984**, *7*, 591–598. [CrossRef]
74. McDonald, L.L.; Guy, R.H.; Speirs, R.D. *Preliminary Evaluation of New Candidate Materials as Toxicants, Repellents, and Attractants Against Stored-Product Insects*; US Agricultural Research Service: Washington, DC, USA, 1970.
75. Talukder, F.A.; Howse, P.E. Deterrent and insecticidal effects of extracts of pithraj, *Aphanamixis polystachya* (Meliaceae), against *Tribolium castaneum* in storage. *J. Chem. Ecol.* **1993**, *19*, 2463–2471. [CrossRef] [PubMed]
76. Finney, D.J. *Probit Analysis*; Cambridge University Press: Cambridge, UK, 1971.
77. Al-Marzoqi, A.H.; Hameed, I.H.; Idan, S.A. Analysis of bioactive chemical components of two medicinal plants (Coriandrum sativum and Melia azedarach) leaves using gas chromatography-mass spectrometry (GC-MS). *Afr. J. Biotechnol.* **2015**, *14*, 2812–2830.