AkiNik

American Journal of Essential Oils and Natural Products

Available online at www.essencejournal.com

AJEONP American Journal of Essential Oils and Natural Products

ISSN: 2321-9114
AJEONP 2019; 7(3): 27-30

Received: 20-05-2019
Accepted: 22-06-2019

Layla G Sharp
Department of Chemistry, University of Alabama in Huntsville, Huntsville, AL 35899, USA

Prabodh Satyal
Aromatic Plant Research Center, 230 N 1200 E, Suite 100, Lehi, UT 84043

William N Setzer
(1) Aromatic Plant Research Center, 230 N 1200 E, Suite 100, Lehi, UT 84043
(2) Department of Chemistry, University of Alabama in Huntsville, Huntsville, AL 35899, USA

Corresponding Author:
William N Setzer
(1) Aromatic Plant Research Center, 230 N 1200 E, Suite 100, Lehi, UT 84043
(2 Department of Chemistry, University of Alabama in Huntsville, Huntsville, AL 35899, USA

The volatile components of the aerial parts of *Acalypha rhomboidea* Raf. (Euphorbiaceae)

Layla G Sharp, Prabodh Satyal and William N Setzer

Abstract
The essential oils from the aerial parts of *Acalypha rhomboidea*, growing wild in north Alabama, were obtained by hydrodistillation and analyzed by gas chromatography – mass spectrometry. The essential oils were dominated by green leaf volatiles, mainly (2*E*)-hexenal (52.7-53.2%), (3*Z*)-hexenol (7.6-12.3%), and hexanal (5.3-5.8%). In addition, the diterpenoid phytol (11.3-15.1%) was also abundant in the essential oils.

Keywords: Three-seeded mercury, rhombic copper-leaf

1. Introduction
The genus *Acalypha* L. (Euphorbiaceae) is made up of around 450 species [1]. Numerous members of this genus are used in traditional herbal medicine, particularly in Africa, against a wide variety of human ailments [2]. *Acalypha rhomboidea* Raf., the common three-seeded mercury, is a common weedy species native to eastern North America [3]. The plant is an annual herb that grows from a taproot up to 1.5 m tall, with alternate rhombic-ovate to rhombic-lanceolate leaves, pistillate flowers within a lobed bract near the base of the leaf petiole [4] (see Figure 1). Unlike most members of the Euphorbiaceae, the sap of *A. rhomboidea* is clear rather than milky. There have been no reports on traditional use of *A. rhomboidea*, nor have there been any previous reports on the phytochemistry of this plant.

Fig 1: *Acalypha rhomboidea* growing in north Alabama (photograph by W.N. Setzer).

2. Materials and Methods
2.1 Plant Material
Plant material was obtained from *A. rhomboidea* growing wild in Huntsville, Alabama (34°38′46.23″ N, 86°33′27.25″ W, elevation 190 m) on July 22, 2018, 6:00 am. The plant was identified by W.N. Setzer; a voucher specimen has been deposited in the University of Alabama in Huntsville herbarium (WNS-ACRH-2018). The fresh aerial parts (62.75 and 27.72 g) were each hydrodistilled for 4 h using a Likens-Nickerson apparatus with continuous extraction with CH_2Cl_2 to obtain the clear colorless essential oils (43 and 11 mg, respectively).

2.2 Gas Chromatography – Mass Spectrometry

The essential oils were analyzed by gas chromatography-mass spectrometry (GC-MS) using a Shimadzu GCMS-QP2010 Ultra operated in the electron impact (EI) mode (electron energy = 70 eV), scan range = 40–400 atomic mass units, scan rate = 3.0 scans/s, and GC-MS solution software (Shimadzu Scientific Instruments, Columbia, MD, USA). The GC column was a ZB-5ms fused silica capillary column with a (5% phenyl)-polymethylsiloxane stationary phase and a film thickness of 0.25 µm, a length of 30 m, and an internal diameter of 0.25 mm (Phenomenex, Torrance, CA, USA). The carrier gas was helium with a column head pressure of 552 kPa and flow rate of 1.37 mL/min. The injector temperature was 250 °C and the ion source temperature was 200 °C. The GC oven temperature was programmed for 50 °C initial temperature, then temperature was increased at a rate of 2 °C/min to 260 °C. A 1% w/v solution of the sample was prepared in dichloromethane and 0.1 µL was injected with a splitting mode (10:1). Identification of the oil components was based on their retention indices determined by reference to a homologous series of *n*-alkanes, and by comparison of their mass spectral fragmentation patterns with those reported in the literature [5] and our own in-house library [6].

3. Results and Discussion

The essential oil compositions of two samples of the aerial parts of *A. rhomboidea* are summarized in Table 1. The essential oils were dominated by "green leaf volatiles" [7] (70.9-75.1%), primarily (2*E*)-hexenal (52.7-53.2%), (3*Z*)-hexenol (7.6-12.3%), and hexanal (5.3-5.8%), in addition to the diterpene phytol (11.3-15.1%). Monoterpenoids (2.4-2.8%) and sesquiterpenoids (trace-0.3%) made up a small percentage of the essential oils.

Table 1: Chemical composition of the essential oil from the aerial parts of *Acalypha rhomboidea*.

RI[a]	Compound	Percent Composition[b]	
		#1	#2
799	(3*Z*)-Hexenal	0.8	2.2
801	Hexanal	5.8	5.3
841	(2*Z*)-Hexenal	1.7	1.9
848	(2*E*)-Hexenal	53.2	52.7
850	(3*Z*)-Hexenol	12.3	7.6
861	(2*Z*)-Hexenol	0.3	0.4
864	1-Hexanol	0.8	0.6
879	(*E*)-2,2-Dimethyl-3-Decene	tr[c]	0.1
902	Heptanal	0.3	0.3
927	Isoamyl isobutyrate	tr	0.1
932	α-Pinene	tr	0.1
944	1-Methyl-2-propylcyclohexane	0.2	0.3
978	1-Octen-3-ol	tr	0.1
1004	(3*Z*)-Hexenyl acetate	0.2	0.2
1043	Benzene acetaldehyde	0.5	0.9
1098	Linalool	1.9	1.9
1104	Nonanal	0.6	0.6
1111	Phenylethyl alcohol	---	0.7
1194	α-Terpineol	0.5	0.8
1350	Eugenol	0.1	0.3
1377	(*E*)-β-Damascenone	---	0.2
1434	Unidentified[d]	1.0	1.6
1522	β-Sesquiphellandrene	0.3	tr
1800	Octadecane	tr	0.1
1833	Neophytadiene	0.4	0.3
1838	Phytone	0.2	0.7
1859	(*Z*)-1,3-Phytadiene	0.1	0.1
1876	(*E*)-1,3-Phytadiene	0.2	0.2
1900	Nonadecane	0.2	0.4
1955	Palmitic acid	1.1	2.3
2000	Eicosane	0.1	0.3
2114	(*E*)-Phytol	15.1	11.3
2130	α-Linolenic acid	---	0.9
2300	Tricosane	tr	0.3
2500	Pentacosane	0.8	1.2
2700	Heptacosane	0.9	1.3
	Green leaf volatiles	75.1	70.9
	Monoterpenoids	2.4	2.8
	Sesquiterpenoids	0.3	tr
	Diterpenoids	15.9	12.7
	Alkanes	2.0	3.7
	Others	2.9	6.9
	Total Identified	98.4	96.5

[a] RI = Retention Index determined with reference to a homologous series of *n*-alkanes on an ZB-5ms column.
[b] Percentages are based on total ion current without standardization.
[c] tr = "trace" (< 0.05%).
[d] MS(EI): 208(9%), 193(9%), 180(11%), 178(28%), 165(16%), 151(10%), 137(20%), 133(35%), 124(18%), 119(20%), 109(29%), 105(36%), 95(52%), 81(29%), 67(30%), 53(20%), 43(100%).

The volatile phytochemistry of *A. rhomboidea* is very different from those reported for other *Acalypha* species (see Table 2). However, (*E*)-phytol and hexenol (isomer not identified) were found to be among the major components in *A. indica* from Malaysia [8].

Table 2: Major chemical components in the essential oils of *Acalypha* species.

Acalypha species	Plant part(s)	Geographical location	Major components	Ref.
A. hispida Burm. f.	leaves	Ibadan, Nigeria	Palmitic acid (14.7%), 6,10,14-trimethyl-2-pentadecanone (13.4%), geranial (12.9%), neral (11.0%), triacontane (5.8%), tetracosane (5.3%), nonanal (5.2%)	[9]
A. hispida Burm. f.	flowers	Ibadan, Nigeria	15,16-epoxylabda-13(16),14-dien-8α-ol (12.8%), 8,14-cedran oxide (12.2%), curcumene (10.1%), ethyl vanillin (6.9%), 1-hexadecene (8.4%)	[10]
A. indica L.	whole plant	Selangor, Malaysia	(*E*)-phytol (38.6%), hexenol (17.5%), decane (10.3%), 2-methyldodecane (6.8%)	[8]
A. ornata Hochst. ex A. Rich.	leaves	Ibadan, Nigeria	viridiflorene (2.7%), thymohydroquinone (2.3%)[a]	[11]
A. plicata Müll. Arg.	leaves	Mérida, Venezuela	15,16-epoxylabda-13(16),14-dien-8α-ol (20.9%%), bicyclogermacrene (8.5%) τ-muurolol (6.1%), β-caryophyllene (6.0%) *epi*-bicyclosesquiphellandrene (5.5%)	[12]
A. segetalis Müll. Arg.	whole plant	Ibadan, Nigeria	neophytadiene isomer III (33.6%), neophytadiene isomer II (14.7%), α-pinene (8.5%)	[13]
A. segetalis Müll. Arg.	leaves	Ibadan, Nigeria	α-pinene (29.8%), 1,8-cineole (16.2%), (*E*)-phytol (11.8%), δ-3-carene (9.8%)	[14]
A. torta Pax & K. Hoffm.	leaves	Ibadan, Nigeria	(*E*,*E*,*Z*)-1,5,9-cyclododecatriene[b] (16.6%), hexyl tiglate (9.7%), *N*-(4-methoxyphenyl)nicotinamide[b] (8.9%), spiro[3,3]heptane-2,6-dione[b] (7.7%), β-terpineol (6.7%)	[15]
A. wilkesiana Müll. Arg.	leaves	Ibadan, Nigeria	Geranial (36.1%), neral (30.7%), triacontane 5.8%), heptacosane (5.5%), dicetyl (5.3%)	[9]

[a] Only 54.6% of the essential oil composition was identified.
[b] This compound not found in the *Dictionary of Natural Products* [16]; identification is in doubt.

4. Conclusions

This is the first phytochemical investigation of *Acalypha rhomboidea*. The essential oil, obtained in low yield from the aerial parts, was dominated by green leaf volatiles and diterpenoids.

Acknowledgments

This work was carried out as part of the activities of the Aromatic Plant Research Center (APRC, https://aromaticplant.org/).

References

1. Mabberley DJ. Mabberley's Plant Book, 3rd Ed. Cambridge University Press, UK, 2008.
2. Seebaluck R, Gurib-Fakim A, Mahomoodally F. Medicinal plants from the genus *Acalypha* (Euphorbiaceae)–A review of their ethnopharmacology and phytochemistry. Journal of Ethnopharmacology. 2015; 159:137-157.
3. Missouri Botanical Garden. Tropicos.org, http://www.tropicos.org accessed on 21 April, 2019.
4. Radford AE, Ahles HE, Bell CR. Manual of the Vascular Flora of the Carolinas. University of North Carolina Press, Chapel Hill, NC, USA, 1968.
5. Adams RP. Identification of Essential Oil Components by Gas Chromatography / Mass Spectrometry, 4th Ed. Allured Publishing, Carol Stream, Illinois, 2007.
6. Satyal P. Development of GC-MS Database of Essential Oil Components by the Analysis of Natural Essential Oils and Synthetic Compounds and Discovery of Biologically Active Novel Chemotypes in Essential Oils. Ph.D. Thesis, University of Alabama in Huntsville, Huntsville, AL, USA, 2015.
7. Ruther J. Retention index database for identification of general green leaf volatiles in plants by coupled capillary gas chromatography – mass spectrometry. Journal of Chromatography A. 2000; 890:313-319.
8. Suri R, Abu Bakar H, Noor Rehan A, Rsnah O, Normah A. Preliminary studies on the analysis of fatty acids, essential oils and flavonoids in *Acalypha indica* L. Journal of Tropical Agriculture and Food Science. 2004; 32(2):163-169.
9. Aboaba S, Omotoso O. Chemical constituents, toxicity and larvicidal activity of the essential oil from the leaves of *Acalypha hispida* and *Acalypha wilkesiana* in south-west Nigeria. Elixir Applied Chemistry. 2012; 52:11263-11265.
10. Onocha PA, Oloyede GK, Afolabi QO. Chemical composition, cytotoxicity and antioxidant activity of essential oils of *Acalypha hispida* flowers. International Journal of Pharmacy. 2011; 7(1):144-148.
11. Onocha PA, Oloyede GK, Olasunkanmi GS. Chemical composition, brine shrimp toxicity and free-radical scavenging activity of leaf essential oil of *Acalypha ornata* (Hochst). Advances in Environmental Biology. 2011; 5(1):188-193.
12. Meccia G, Rosquete C, Rojas LB, San Feliciano A. New labdane derivative from the essential oil of *Acalypha plicata* Müll. Arg. Flavour and Fragrance Journal. 2006; 21:559-561.
13. Aboaba SA, Aiyelaagme OO, Ekundayo O. Chemical composition, toxicity and larvicidal activity of the essential oil from the whole plant of *Acalypha segetalis* from south-west Nigeria. Natural Product Communications. 2010; 5(3):481-483.
14. Ogunwande IA, Essien EE, Ogunbinu AO, Adebayo M, Karioti A, Saroglou V *et al*. Essential oil constituents of *Klainedoxa gabonensis* Pierre ex Engl (Irvingiaceae), *Brachystegia nigerica* Hoyle et A. Jones (Caesalpinioideae) and *Acalypha segetalis* (Muell.) Arg. (Euphorbiaceae). Journal of Essential Oil Research. 2008; 20(3):211-215.
15. Onocha PA, Oloyede GK. Chemical composition and free radical scavenging activity of leaf essential oils of

Acalypha torta. Advances in Environmental Biology, 2011, 2626-2631.
16. Dictionary of Natural Products on DVD, v. 27:2. CRC Press, Boca Raton, Florida, USA, 2018.