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Research article

VOLATILE OIL COMPOSITION FROM STEMS, LEAVES AND FLOWERS OF *DUCROSIA FLABELLIFOLIA* BOISS. FROM NORTHERN BORDER OF SAUDI ARABIA

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ABSTRACT: The volatile oils composition of stems, leaves and flowers of *Ducrosia flabellifolia* Boiss. from northern border of Saudi Arabia were investigated by gas chromatography coupled with mass spectrometry. A total of 52 compounds have been identified from the different fractions studied, representing about 90% of total oil of each one. Aerial parts shared most of the main components although qualitative and quantitative differences have been detected. Decanal and dodecanal could be considered as chemical markers of this species, where they were representing 58.8% , 64.84% and 66.46% of stems, leaves and flowers oils, respectively. The aldehyde hydrocarbons fraction was predominant in stems (65.11%), leaves (65.39%) and flowers (67.3%), followed by the monoterpenes hydrocarbons fraction in Leaves (9.37%) and flowers (5.53%) and Oxygenated sesquiterpenes in stem (10.83%).

Keywords: *Ducrosia flabellifolia*, *Apiaceae*, essential oil, decanal, dodecanal.

INTRODUCTION

Ducrosia flabellifolia Boiss. Popularly known in Saudi Arabia as Al-Haza or Haza is a perennial leafy, herbaceous and branched plant belongs to *Apiaceae*. *Ducrosia flabellifolia* is characterized from *D. anethifolia* growing in Saudi Arabia by its three lobed leaves with flabelliform, cuneate, flat segments and its yellow flowers, 1mm wide in umbellules 8mm wide (Collenette, 1999; Chaudhary, 2001 and Al-Hassan, 2006). Although Mozaffarian (2006) reported *D. flabellifolia* as an endemic species to Iran, the plant reported to grow as rare species in volcanic cinders in middle and north of Saudi Arabia (Collenette, 1999; Chaudhary, 2001 and Al-Hassan, 2006) and the desert areas of eastern Jordan (Al-Eisawi 1982; Al-Shudiefat *et al.*, 2014). In Jordan, *D. flabellifolia* has been used in folk medicine as a valuable pain killer, especially in the treatment of dental pain, possessing pain relieving and sedative properties when the aerial parts are smoked in form of cigarettes (Al-Shudiefat *et al.*, 2014).

Few reports on phytochemical composition of *D. flabellifolia* have been published. The main components of *D. flabellifolia* volatile oil were found to be decanal, dodecanal, decanol, (2E)-tridecen-1-al,α- and β-pinene (Shahabipour *et al.*, 2013; Al-Shudiefat *et al.*, 2014). Moreover LC/MS-MS analysis revealed the presence of quercetin, fisetin, kaempferol, luteolin, apigenin and their derivatives in the ethanol extract (Talib *et al.*, 2013).
Regarding to biological activity, the volatile oil of *D. flabellifolia* was screened for its antimicrobial and antioxidant activities (Al-Shudiefat *et al.*, 2014). The oil exhibited the best activity against *C. albicans* and *S. aureus*, whereas weak activity was detected against *E.coli* and *P. aeruginosa*. No antioxidant activity could be detected. Cytotoxic activity assessed on three human cancer cell lines (K562, LS180 and MCF-7) showed that essential oil from *D. flabellifolia* had a moderate to weak activity (Shahabipour *et al.*, 2013). Talib *et al.* (2013) reported that the ethanol extract of *D. flabellifolia* inhibits proliferation of breast cancer cells by inducing apoptosis.

The aim of this study was to determine and compare the compositions of the stems, leaves and flowers oils of *D. flabellifolia* growing wild in northern border of Saudi Arabia.

MATERIALS AND METHODS

Plant material

Aerial parts of *Ducrosia flabellifolia* Boiss. were collected from Umm Wu' al mountain (lat 31°47' N., long 38°54' E.), 20 km north of Turaif, located at the northern border region of Saudi Arabia. Identification of plant material based on Collenette (1999) and Chaudhary (2001), which was confirmed by Dr. Hamdan Al-Hassan, Camel and range Research Center at Al-jouf , Saudi Arabia. Voucher specimen was deposited in the herbarium of northern border university faculty of science.

Isolation of volatile oils

The volatile oils of fresh stems, leaves and flowers (100 g each) of *D. flabellifolia* were extracted separately by hydrodistillation for 4 h. The essential oil content (%w/w) was estimated on a fresh weight basis. The oil samples obtained were dehydrated over anhydrous sodium sulfate and stored at 4°C in dark.

Gas Chromatography–Mass Spectrometry (GC-MS)

GC/MS analyses of the volatile oils were performed using an Agilent 6890 gas chromatograph equipped with an Agilent 5973 mass spectrometric detector; with a direct capillary column Hp-5ms (30m X 0.32 mm X 0.25 um film thickness). Samples were injected under the following conditions: Helium was used as carrier gas at approximately 1 ml/min., pulsed splitless mode, the solvent delay was 3 min. and the injection volume was 1.0 ul. The mass spectrometric detector was operated in electron impact ionization mode operating at 70 eV. ionization energy, scanning from m/z 50 to 500. The ion source temperature was 230 °C and the quadruple temperature was 150°C. The electron multiplier voltage (EM voltage) was maintained 1250 v above auto tune. The instrument was manually tuned using perfluorotributyl amine (PFTBA). The GC temperature program was started at 60 °C then elevated to 280 °C at rate of 8°C / min. and 10 min. hold at 280 °C the detector and injector temperature were set at 280 and 250 °C, respectively.

Identification of volatile oils constituents

Identification of the volatile oils and constituents was done on the basis of retention time and retention index using a homologous series of *n*-alkanes (C_{10}–C_{32}) under identical experimental conditions, mass spectra library search (Wiley7n.1 and Wiley7 NIST.05.L), and by comparing the mass spectral and retention data with the literature (Adams, 1995). The relative amounts of individual components were calculated based on the GC peak area.

RESULTS AND DISCUSSION

The chemical composition of natural volatile oils can be correlated with many factors, viz. geographical conditions, climatic conditions, isolation methods, origin, stages of development, and the plant parts processed (Pandey *et al*., 2014). The volatile oils obtained by hydrodestillation of fresh stems, leaves and flowers of *D. flabellifolia* collected from northern border region of Saudi Arabia, were pale yellow in color, yielded 0.33%, 0.45% and 0.4%, respectively based on fresh weight. The components identified from stems, leaves and flowers of *D. flabellifolia*, their retention indices and their percentage composition are summarized in Table 1, where all the compounds are arranged in order of their elution on Hp-5ms column. A total of 52 compounds have been identified from the different fractions studied, representing about 90% of the total oil for each one. We have found qualitative and quantitative differences between the studied fractions although both of them share practically most of their principal constituents. The oils from the stems, leaves and flowers showed decanal (38.18%, 50.02% and 47.92% respectively) and dodecanal (20.62%, 14.54 and 18.54%, respectively) as major components.

Table 1: Volatile oils composition of stems, leaves and flowers of *D. flabellifolia* from northern border region of Saudi Arabia

S. No	RI	Compound	Content %		
			Stems	Leaves	Flowers
1	900	Nonane	0.28	0.37	T
2	934	α-pinene	2.05	4.36	2.61
3	973	Sabinene	-	0.35	-
4	977	β –pinene	-	-	0.26
5	989	Myrcene	t	2,02	1.43
6	1021	p – cymene	t	-	-
7	1026	Limonen	0.36	1.76	1.23
8	1059	γ -T erpinene	-	0.3	-
9	1070	Octanol	-	-	0.25
10	1087	Fenchone	-	-	1.67
11	1087	α –Terpinolene	-	0.58	-
12	1095	6- Camphenone	-	1.03	-
13	1127	α –Campholenal	-	-	0.23
14	1140	Trans – limonene oxide	-	-	0.39
15	1156	Citronellal	-	1.1	1.19
16	1170	Nonanol	-	0.26	0.18
17	1179	Terpin-4-ol	-	0.27	0.31
18	1187	α- Terpineol	-	0.31	0.34
19	1206	Decanal	38.18	50.02	47.92
20	1228	Citronellol	0.21	0.64	0.71
21	1255	Geraniol	-	-	0.31
22	1259	Z- Cinnamyl alcohol	-	0.24	-
23	1272	1-Decanol	2.04	4.07	4.34
24	1308	Undecanal	-	0.32	0.22
25	1315	2-Methoxy-4-vinylphenol	-	1.29	0.56
26	1354	Citronellyl acetate	-	0.15	0.1
27	1370	p-methyl anisate			0.35
28	1374	Undecanol	0.1	2.11	1.12
29	1412	Dodecanal	20.62	14.82	18.54
30	1472	Dodecanol	-	-	0.94
31	1485	β –Ionone	0.6	0.06	-
32	1495	Trans-methyl isoeugenol	0.86	0 .62	0.45
33	1512	Ionole	2.37	0.42	0.28
34	1526	δ-Cadinene		-	0.06
35	1550	Elemol	0.26	0.09	0.13
36	1560	Germacerne B	0.13	0.45	0.05
37	1572	Dodecanoic acid	0.27	-	-
38	1580	Tridecanol	-	-	0.14
39	1613	Tetradecanal	6.31	0.23	0.62
40	1621	α- Eudesm-4-en-11-ol	0.48	0.16	0.24
41	1632	γ –Eudesmol	1.1	0.16	0.22
42	1651	β- Eudesmol	5.83	0.43	0.47

Table-1 cont……..

S. No	RI	Compound	Content %		
			Stems	Leaves	Flowers
43	1722	E, E- Farnesol 2	0.06	0.26	0.59
44	1780	z-9-pentadecenol	2.14	0.28	0.39
45	1800	Octadecane	-	0.07	0.08
46	1880	Pentadecanoic acid, 14-methyl-, methyl ester	0.4	0.07	
47	1915	Oxacycloheptadecan -2-one	-	-	0.19
48	1960	Hexadecanoic acid	0.84	0.7	0.82
49	2110	z-9-Octadecenoic acid methyl ester	2.63	0.1	0.1
50	2120	Phytol	-	0.05	-
51	2140	linoleic acid	0.94	0.27	0.13
52	2500	Pentacosane	-	-	0.06
		Aldehyde hydrocarbons	65.11	65.39	67.3
		Monoterpenes hydrocarbons	2.48	9.37	5.53
		Oxygenated monoterpenes	0.21	3.35	5.15
		Sesquiterpenes hydrocarbons	0.13	0.45	0.11
		Oxygenated Sesquiterpenes	10.83	1.58	1.98
		Other classes	10.30	9.89	10.15
		Total identified (%)	89.16	91.03	90.25
t: trace (<0.05%).					
Retention index calculated on HP-5MS column or obtained from the literature (Adams, 1995).					

Stems oil showed the lowest chemical diversity, where 24 compounds were identified representing 89.13% of the oil. In addition to decanal (38.18%) and dodecanal (20.62%), tetradecanal (6.31%), β-eudesmol (5.83%), z-9-octadecenoic acid methyl ester (2.63%) z-9-pentadecenol (2.14%), α-pinene (2.05%), decanol (2.04%) and γ-eudesmol (1.1%) showed remarkable ratio.

The leaves and flowers oils compositions were quite similar, where 38 compounds representing 90.79 %were identified in leaves oil. The main compounds of leaves oil were decanal (50.02%), dodecanal (14.82%), α-pinene (4.36%), decanol (4.07%), myrcene (2.02%), limonene (1.76%), 2-methoxy-4-vinylphenol (1.54%), citronellal (1.1%) and 6- camphenone (1.03%).

On the other hand, flowers oil showed the richest chemical diversity, where 42 compounds were identified representing 90.79% of the oil. Decanal (47.92%), dodecanal (18.54%), decanol (4.34%), α-pinene (2.61%), fenchone (1.67%), myrcene (1.43%), limonene (1.23%), and citronellal (1.19%) were the main compounds of flowers oil.

The comparative results clearly indicated that, dodecanoic acid (0.27%) and p– cymene (0.03%) were detected in Stems oil only. Also dodecanal, tetradecanal (6.31%), β-eudesmol (5.83%) , z-9-Octadecenoic acid methyl ester, (2.63%) , z-9-pentadecenol (2.14%) and γ- eudesmolfound to be higher in stems oil. Similarly sabinene (0.35%), γ-terpinene (0.3), 6- camphenone (1.03%), z-cinnamyl alcohol (0.24%) and phytol (0.05%) were characteristic to leaves oil. While β-pinene (0.26%) , octanol (0.25%)α –Campholenal(0.23%), Trans – limonene oxide (0.39 a%), geraniol (0.31%), p-methyl anisate (0.35%), dodecanol (0.94%), tridecanol (0.14%), Oxacycloheptadecan-2-one (0.19%) and pentacosane (0.06%) were detected in flowers oil only.

Phytochemical studies on genus *Ducrosia* essential oil revealed that aliphatic aldehyde and monoterpenes hydrocarbons are the main constituents of these oils (Sefidkon and Javidtash, 2002, Rustaiyan *et al.*, 2006; Mostafavi *et al.*, 2008; Mostafavi *et al.*, 2010; Shahabipour *et al.*, 2013; and Al-Shudiefat *et al.*, 2014). The chemical classes of the studied oils are reported in Table (1) revealed that, the aldehyde hydrocarbons was predominant in stems (65.11%), leaves (65.39%) and flowers (67.3%). The monoterpenes hydrocarbons and oxygenated monoterpenes fractions showed higher percentage composition in oils of leaves (9.37% and 3.35%, respectively) and flowers (5.53% and 5.15%, respectively) compared to stem (2.48% and 0.21%, respectively). Contrary oxygenated sesquiterpenes fractions were more abundant in Stems oil (10.83%) than leaves (1.58%) and flowers oils.

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