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Essential Oil Composition of Endemic *Arabis purpurea* Sm. & *Arabis cypria* Holmboe (Brassicaceae) from Cyprus

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Abstract: There are very few reports on the phytochemistry of the *Arabis* L. (Brassicaceae) species in the literature. Here we present essential oil composition of aerial parts of two endemic *Arabis* species from Cyprus. The essential oils of *Arabis purpurea* Sm. and *Arabis cypria* Holmboe afforded very low oil yields (< 0.01% (v/w) yield). Sixty six compounds were identified in the essential oil of *A. purpurea* that represent 82.75 ± 0.21 % (*n* = 3) of the oil. The major components of the oil were nonacosane 16.18 ± 0.13 %, heptacosane 14.91 ± 0.17 %, hexahydrofarnesyl acetone 12.44 ± 0.10 % and phytol 7.36 ± 0.10 % (*n* = 3). Forty three compounds were identified in the essential oil of *A. cypria* which represent 81.28 ± 1.55 % (*n* = 3) of the oil. The major components of the oil were nonacosane 20.25 ± 0.47 %, heptacosane 9.13 ± 1.88 %, hexahydrofarnesyl acetone 9.03 ± 0.44 % and 1-tetradecanol 4.38 ± 2.60 % (*n* = 3). To the best of our knowledge this is the first report on the essential oil compositions of these species.

Key words: Brassicaceae, *Arabis purpurea* Sm., *Arabis cypria* Holmboe, nonacosane, hexhydrofarnesyl acetone, heptacosane, phytol

1 Introduction

The genus *Arabis* L. (Brassicaceae) is represented with four species in Cyprus including *A. purpurea* Sm., *A. cypria* Holmboe, *A. verna* (L.) R. Br., *A. kennedyae* Meikle.[1, 2]. Except *A. verna* all of the *Arabis* species are endemic in Cyprus[2]. Previously glucosinolates from various *Arabis* species were reported comprehensively. 8-(Methylsulfinyl) octyl isothiocyanate (hirsutin), (*R*)-8-methylsulphinyl-3-oxooctyl isothiocyanate, 7-methylthioheptyl glucosinolate, 8-methyloctyl glucosinolate, 8-methylthio-3-oxooctyl glucosinolate were isolated from the seeds of *A. hirsuta* (L.) and 9-(methylsulfinyl) nonyl isothiocyanate (arabin) was isolated from the seeds of *A. alpina* L.[3, 4]. Additionally an HPLC analysis of *A. alpina* seeds afforded cinnamoylcholine derivatives as well as 3,5-dimethoxy-4-hydroxycinnamoylcholine[5]. In a very comprehensive study 297 wild plant species including 14 *Arabis* species were investigated for their glucosinolate composition of the seeds and glucosinolates including alkyl, methylsulphenyl, methylthio, methylsulphinyl, oxazolidinethione and aromatic types were reported from the *Arabis* species[6]. A study on *A. purpurea* and *A. kennedyae* seeds from Cyprus, reports identification of 6-methylthiohexyl, 7-methylthioheptyl and allyl, 3-methylthiopropyl, 6-methylthiohexyl, 7-methylthioheptyl glucosinolates from these species respectively[7].

Anthocyanins from the flowers of *Arabis blepharophylla* Hook. & Arn. were reported as cyanidin 3-(*trans-p*-coumaroyl)-sambubioside-5-(malonyl)-glucoside, cyanidin 3-(*trans*-sinapoyl)-sambubioside-5-(malonyl)-glucoside, cyanidin 3-(*cis-p*-coumaroyl)-sambubioside-5-(malonyl)-glucoside, cyanidin 3-(*trans-p*-coumaroyl)-sambubioside-5-glucoside, cyanidin 3-(*trans*-sinapoyl)-sambubioside-5-glucoside[8]. Another report indicates that inoculation of the *A. lyrata* (L.) leaves with *Pseudomonas syringae* pv. *maculicola* or *Cochliobolus carbonum* initiates the production of camalexin in the leaves[9].

Volatiles of *Arabis lyrata* (Syn = *Arabidopsis lyrata*) was reported to contain phenyl acetaldehyde, benzaldehyde, 3,5-dimethoxytolune, 1-phenyl ethanol, (α,β)-di-

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methyl phenylethanol, 3-hexanol, 5-hexen-1-ol, decane, myrcene and *cis*-ocimene[10]. Volatiles of *Puccinia monoica* Arthur infected and non-infected *A. crandalii* Robinson, *A. lignifera* A. Nelson, *A. gunnisoniana* Rollins, *A. demissa* Greene, *A. drummondii* A. Gray and *A. holboellii* Hornem were investigated to determine the floral scent production by the fungi. This fungi is reported to mimic the flowers by producing fungal pseudoflowers in order to attract the pollinators to disperse its spores. Fungal pseudoflowers reported to have a distinct volatile substances including aromatic alcohols, aldehydes and esters[11]. This research also reports the volatile composition of non-infected *Arabis* species as containing aromatics: benzaldehyde, benzyl alcohol (*A. holboellii*), indole (*A. demissa*), sesquiterpene: caryophyllene (*A. holboellii*), and mainly fatty acid derivatives: 1-hexanol, *n*-hexanal, (*Z*)-3-hexenal, (*Z*)-3-hexenyl acetate, (*Z*)-3-hexenyl 3-methyl butylate, isopropyl iso-thiocyanate and octadecanal distributed in different fresh tissues of the plants including flowers and leaves[11].

As summarized above *Arabis* species contains interesting natural substances. However, according to our literature survey we have not encountered any reports on the essential oil composition of any *Arabis* species. This prompted us to investigate the essential oil composition of *A. purpurea* and *A. cypria*. In the scope of our phytochemical and biological activity screening of the Cyprus plants, here we report the essential oil composition of *A. purpurea* and *A. cypria* for the first time.

2 Materials and Methods

2.1 Plant Materials

Plant materials were collected during the flowering period; *A. cypria* on 15.02.2015 from Mt. Beşparmak (600 m) and *A. purpurea* on 20.03.2015 from Mt. Olympos (1900 m) in Cyprus. Voucher specimens of *A. cypria* and *A. purpurea* have been deposited at the Herbarium center in the Near East University, Cyprus (Voucher Specimen numbers: 5723 and 6402 respectively) Plant species were identified by Dr. Salih Gücel (Near East University).

2.2 Isolation of the Oil

Aerial parts (flowers, stems and leaves included;100 g each) of the air dried plant was subjected to hydrodistillation for 3 h, using a Clevenger-type apparatus to produce essential oils. Condenser of the Clevenger was attached to a microchiller that was set to 4℃. *A. purpurea* and *A. cypria* afforded oils from the aerial parts with $<0.01\%$ (v/w) yields. The oils were recovered with 1 mL *n*-hexane and preserved in amber vials under −20℃ until the day they were analyzed.

2.3 GC/MS analysis

The GC-MS analysis was performed with an Agilent 5975C Inert XL EI/CI MSD system operating in EI mode. Essential oil samples were diluted 1/10 (v/v) with *n*-hexane. Injector and MS transfer line temperatures were set at 250℃. Split ratio was set to 50:1. Innowax FSC column (60 m × 0.25 mm, 0.25 m film thickness) and helium as carrier gas (1 mL/min) were used in both GC/MS analyses. Oven temperature was programmed to 60℃ for 10 min. and raised to 220℃ at rate of 4℃/min. Temperature kept constant at 220℃ for 10 min. and then raised to 240℃ at a rate of 1℃/min. Mass spectra were recorded at 70 eV with the mass range *m/z* 35 to 425. Relative percentage amounts of the separated compounds were calculated from integration of the peaks in MS chromatograms. Identification of essential oil components were carried out by comparison of their relative retention indices (RRI) obtained by series of *n*-alkanes (C5 to C30) to the literature and with mass spectra comparison[12−37]. Mass spectra comparison was done by computer matching with commercial Wiley 8th Ed./NIST 05 Mass Spectra library, Adams Essential Oil Mass Spectral Library and Pallisade 600K Complete Mass Spectra Library. The analysis was carried out in triplicate and the results were given as the mean ± standard deviation.

3 Results and Discussion

The essential oil composition of *A. purpurea* and *A. cypria* are given in Table 1. Essential oil of the aerial parts of *A. purpurea* was analysed with GC/MS and sixty six compounds were identified comprising 82.75 ± 0.21% (n = 3) of the oil. The yield of the essential oil was $<0.01\%$ (v/w) which is very low. The major components of the oil were nonacosane 16.18 ± 0.13%, heptacosane 14.91 ± 0.17%, hexahydrofarnesyl acetone 12.44 ± 0.10% and phytol 7.36 ± 0.10%. Additionally 1-tetradecanol 2.42 ± 0.28%, farnesyl acetone 2.20 ± 0.03%, pentacosane 1.84 ± 0.04%, triacontane 1.62 ± 0.06% and nonanoic acid 1.41 ± 0.13% were also encountered in considerable amounts. The highest portion of the oil was composed of fatty acid derivatives 50.36 ± 0.25% and oxygenated sesquiterpenes 17.80 ± 0.08%. The third largest substance class in the oil was the diterpenes 8.78 ± 0.05% and oxygenated monoterpenes 3.79 ± 0.21%.

The essential oil of the aerial parts of *A. cypria* afforded forty three compounds were identified comprising 81.28 ± 1.55% (n = 3) of the oil. The essential oil yield of *A. cypria* was very low $<0.01\%$ (v/w). The main components of the essential oil were nonacosane 20.25 ± 0.47%, heptacosane 9.13 ± 1.88%, hexahydrofarnesyl acetone 9.10 ± 0.44% and 1-tetradecanol 4.38 ± 2.60%. The oil also contained triacontane 2.72 ± 0.26%, farnesyl acetone 2.46 ± 0.09%, diiso-

Table 1 Essential oil composition of *Arabis purpurea* and *Arabis cypria* aerial parts oil from Cyprus.

No	RRI[1]	RRI Lit.[2]	Compound	Arabis purpurea					Arabis cypria					Identification method[6]	Literature[7]
				I[3]	II	III	Mean[4]	SD[5]	I	II	III	Mean	SD		
1	1210	1213	1,8-Cineole	0.2	0.17	0.19	0.19	0.02	–	–	–	–	–	RI, MS	12)
2	1344	1345	3-Octyl acetate	0.12	0.13	0.13	0.13	0.01	–	–	–	–	–	RI, MS	13)
3	1399	1348	6-methyl-5-hepten-2-one	0.08	0.09	0.09	0.09	0.01	–	–	–	–	–	RI, MS	14)
4	1402	1400	Nonanal	0.52	0.54	0.51	0.52	0.02	0.18	0.20	0.17	0.18	0.02	RI, MS	15)
5	1400	1400	Tetradecane	0.11	0.12	0.12	0.12	0.01	–	–	–	–	–	RI, MS, Ac	
6	1444	1461	2,3,7-Trimethyldecane	1.37	1.38	1.36	1.37	0.01	0.34	0.38	0.35	0.36	0.02	RI, MS	16)
7	1459	1463	Heptanol	0.13	0.14	0.13	0.13	0.01	–	–	–	–	–	RI, MS	17)
8	1491	1490	2-Ethyl-1-hexanol	0.07	0.08	0.08	0.08	0.01	–	–	–	–	–	RI, MS	18)
9	1500	1500	Pentadecane	0.21	0.21	0.20	0.21	0.01	–	–	–	–	–	RI, MS, Ac	
10	1505	1506	Decanal	0.47	0.48	0.46	0.47	0.01	–	–	–	–	–	RI, MS	12)
11	1528	1532	Camphor	0.45	0.47	0.44	0.45	0.02	–	–	–	–	–	RI, MS	12)
12	1559	1562	1-Octanol	0.11	0.12	0.12	0.12	0.01	–	–	–	–	–	RI, MS	17)
13	1580	1573	(*E,E*)-3,5-Octadiene-2-one	0.13	0.13	0.12	0.13	0.01	–	–	–	–	–	RI, MS	19)
15	1582	1589	Isocaryophyllene	–	–	–	–	–	0.21	0.31	0.23	0.25	0.05	RI, MS	20)
15	1590	1597	Bornyl acetate	0.12	0.13	0.13	0.13	0.01	–	–	–	–	–	RI, MS	12)
16	1600	1600	Hexadecane	0.22	0.22	0.23	0.22	0.01	0.28	0.36	0.29	0.31	0.04	RI, MS, Ac	
17	1610	1612	β-Caryophyllene	0.59	0.62	0.61	0.61	0.02	0.67	0.80	0.72	0.73	0.07	RI, MS	12)
18	1634	1638	β-Cyclocitral	0.12	0.12	0.12	0.12	0.00	–	–	–	–	–	RI, MS	17)
19	1654	1655	(*E*)-2-Decanal	0.12	0.12	0.12	0.12	0.00	–	–	–	–	–	RI, MS	17)
20	1662	1664	1-Nonanol	0.60	0.62	0.60	0.61	0.01	–	–	–	–	–	RI, MS	12)
21	1673	1671	(*E*)-β-Farnesene	0.19	0.20	0.20	0.20	0.01	–	–	–	–	–	RI, MS	17)
22	1676	1681	(*Z*)-3-Hexenyl tiglate	0.26	0.28	0.27	0.27	0.01	0.19	0.21	0.20	0.20	0.01	RI, MS	21)
23	1685	1687	α-Caryophyllene (= α-Humulene)	0.09	0.14	0.10	0.11	0.03	0.51	0.60	0.52	0.54	0.05	RI, MS	12)
24	1700	1700	Heptadecane	0.22	0.23	0.21	0.22	0.01	–	–	–	–	–	RI, MS, Ac	
25	1701	1704	γ-Muurolene	–	–	–	–	–	0.69	0.84	0.71	0.75	0.08	RI, MS	17)
26	1704	1706	α-Terpineol (= p-menth-1-en-8-ol)	0.20	0.21	0.20	0.20	0.01	0.70	0.77	0.72	0.73	0.04	RI, MS	22)
27	1711	1719	Borneol	0.36	0.38	0.36	0.37	0.01	0.25	0.48	0.29	0.34	0.12	RI, MS	12)
28	1724	1726	Germacrene D	0.14	0.14	0.13	0.14	0.01	1.60	1.77	1.64	1.67	0.09	RI, MS	22)
29	1730	1733	γ-Amorphene	–	–	–	–	–	0.23	0.26	0.24	0.24	0.02	RI, MS	23)
30	1737	1737	β-Bisabolene	0.28	0.32	0.26	0.29	0.03	–	–	–	–	–	RI, MS	17)
31	1737	1740	α-Muurolene	–	–	–	–	–	0.45	0.50	0.48	0.48	0.03	RI, MS	12)
32	1752	1751	1-Heptadecene	0.08	0.15	0.06	0.10	0.05	–	–	–	–	–	RI, MS	24)
33	1764	1766	1-Decanol	0.42	0.43	0.40	0.42	0.02	–	–	–	–	–	RI, MS	17)
34	1771	1772	δ-Cadinene	0.26	0.25	0.22	0.24	0.02	0.91	1.00	0.92	0.94	0.05	RI, MS	17)
35	1775	1776	γ-Cadinene	0.16	0.16	0.13	0.15	0.02	0.44	0.49	0.45	0.46	0.03	RI, MS	17)
36	1800	1800	Octadecane	–	–	–	–	–	0.18	0.19	0.19	0.19	0.01	RI, MS, Ac	
37	1824	1827	(*E,E*)-2,4-Decadienal	0.28	0.30	0.27	0.28	0.02	–	–	–	–	–	RI, MS	17)
38	1851	1849	Calamenene	0.20	0.21	0.19	0.20	0.01	0.50	0.58	0.60	0.56	0.05	RI, MS	17)
39	1865	1868	(*E*)-Geranylacetone	1.56	1.56	1.52	1.55	0.02	0.88	1.00	0.92	0.93	0.06	RI, MS	15)
40	1900	1900	Nonadecane	0.13	0.17	0.13	0.14	0.02	–	–	–	–	–	RI, MS, Ac	
41	1932	1933	Tetradecanal	0.19	0.17	0.16	0.17	0.02	–	–	–	–	–	RI, MS	20)
42	1937	1941	α-Calocorene	0.1	0.09	0.08	0.09	0.01	–	–	–	–	–	RI, MS	17)
43	1955	1958	(*E*)-β-ionone	2.57	2.25	2.17	2.33	0.21	1.43	1.59	1.50	1.51	0.08	RI, MS	20)
44	1970	1973	1-Dodecanol	0.50	0.52	0.47	0.50	0.03	0.65	0.71	0.70	0.69	0.03	RI, MS	17)
45	1988	1969	(*E*)-2-Tridecanal	0.24	0.23	0.23	0.23	0.01	–	–	–	–	–	RI, MS	25)
46	2007	2008	Caryophyllene oxide	–	–	–	–	–	0.81	0.94	1.08	0.94	0.14	RI, MS	12)
47	2039	2041	Pentadecanal	0.68	0.69	0.66	0.68	0.02	–	–	–	–	–	RI, MS	26)
48	2073	2077	1-Tridecanol	0.14	0.14	0.13	0.14	0.01	0.21	0.29	0.24	0.25	0.04	RI,MS	20)
49	2100	2100	Heneicosane	0.55	0.56	0.54	0.55	0.01	0.71	0.79	0.70	0.73	0.05	RI,MS,Ac	
50	2134	2131	Hexahydrofarnesyl acetone	12.39	12.55	12.38	12.44	0.10	8.69	9.56	9.04	9.10	0.44	RI,MS	12)

Table 1 Continued.

No	RRI[1]	RRI Lit.[2]	Compound	Arabis purpurea					Arabis cypria					Identification method[6]	Literature[7]
				I[3]	II	III	Mean[4]	SD[5]	I	II	III	Mean	SD		
51	2141	2133	Cedrenol	0.32	0.33	0.33	0.33	0.01	–	–	–	–	–	RI, MS	[27]
52	2146	2135	Hexadecanal	0.34	0.55	0.35	0.41	0.12	–	–	–	–	–	RI, MS	[17]
53	2151	2161	Muurola-4,10(14)-diene-1-ol	–	–	–	–	–	1.11	1.01	1.01	1.04	0.06	RI, MS	[28]
54	2168	2198	1-Docesene	0.9	0.80	0.98	0.89	0.09	–	–	–	–	–	RI, MS	[29]
55	2176	2179	1-Tetradecanol	2.61	2.09	2.55	2.42	0.28	4.64	1.66	6.84	4.38	2.60	RI, MS	[14]
56	2186	2187	*T*-Cadinol	0.89	0.68	0.96	0.84	0.15	1.65	0.48	1.70	1.28	0.69	RI, MS	[17]
57	2195	2192	Nonanoic acid	1.4	1.28	1.54	1.41	0.13	–	–	–	–	–	RI, MS	[12]
58	2195	2205	Thymol	–	–	–	–	–	1.57	0.79	1.64	1.33	0.47	RI, MS	[12]
59	2200	2200	Docosane	0.41	0.37	0.47	0.42	0.05	–	–	–	–	–	RI, MS, Ac	
60	2234	2230	*n*-Hexylsalicylate	0.12	0.13	0.24	0.16	0.07	–	–	–	–	–	RI, MS	[30]
61	2250	2255	α-Cadinol	–	–	–	–	–	2.15	1.62	1.96	1.91	0.27	RI, MS	[12]
62	2251	2250	α-Eudesmol	0.41	0.42	0.52	0.45	0.06	–	–	–	–	–	RI, MS	[12]
63	2280	2247	Sclareoloxide	0.53	0.51	0.62	0.55	0.06	–	–	–	–	–	RI, MS	[31]
64	2280	2287	1-Pentadecanol	–	–	–	–	–	0.97	0.80	0.89	0.89	0.09	RI, MS	[15]
65	2300	2300	Tricosane	0.76	0.78	0.84	0.79	0.04	1.60	1.33	1.39	1.44	0.14	RI, MS, Ac	
66	2339	2345	Galaxolide I	–	–	–	–	–	0.40	0.27	0.25	0.31	0.08	RI, MS	[32]
67	2375	2377	Manoyl oxide	–	–	–	–	–	1.11	1.20	1.15	1.15	0.05	RI, MS	[33]
68	2384	2384	Farnesyl acetone (= farnesyl acetone c)	2.23	2.19	2.17	2.20	0.03	2.38	2.56	2.44	2.46	0.09	RI, MS	[17]
69	2392	2396	13-*epi*-Manoyl oxide	0.93	0.84	0.82	0.86	0.06	1.96	2.13	2.00	2.03	0.09	RI, MS	[23]
70	2400	2400	Tetracosane	0.24	0.04	0.03	0.10	0.12	–	–	–	–	–	RI, MS, Ac	
71	2500	2500	Pentacosane	1.88	1.83	1.81	1.84	0.04	1.39	1.17	1.11	1.22	0.15	RI, MS, Ac	
72	2522	2524	Abietatriene	–	–	–	–	–	1.00	1.09	1.03	1.04	0.05	RI, MS	[34]
73	2555	2592	Diisobutyl phthalate	–	–	–	–	–	2.18	2.34	2.26	2.26	0.08	RI, MS	[35]
74	2589	2607	1-Octadecanol	0.46	0.48	0.50	0.48	0.02							[36]
75	2617	2622	Phytol	7.26	7.46	7.37	7.36	0.10	2.08	2.01	1.90	2.00	0.09	RI, MS	[17]
76	2655	2617	Tridecanoic acid	0.1	0.08	0.01	0.06	0.05	–	–	–	–	–	RI, MS	[17]
77	2700	2700	Heptacosane	14.75	14.91	15.08	14.91	0.17	8.38	11.26	7.74	9.13	1.88	RI, MS, Ac	
78	2797	2795	1-Eicosanol	0.67	0.64	0.66	0.66	0.02	1.37	1.39	1.33	1.36	0.03	RI, MS	[37]
79	2900	2900	Nonacosane	16.15	16.32	16.07	16.18	0.13	19.73	20.63	20.40	20.25	0.47	RI, MS, Ac	
80	3000	3000	Triacontane	1.61	1.56	1.68	1.62	0.06	2.48	2.70	2.99	2.72	0.26	RI, MS, Ac	
			Monoterpenes	–	–	–	–	–	–	–	–	–	–		
			Oygenated Monoterpenes	4.02	3.73	3.61	3.79	0.21	3.95	3.63	4.15	3.91	0.26		
			Sesquiterpenes	2.01	2.13	1.92	2.02	0.11	6.21	7.15	6.51	6.62	0.48		
			Oxygenated Sesquiterpenes	17.80	17.73	17.88	17.80	0.08	17.67	17.17	18.15	17.66	0.49		
			Diterpenes	8.72	8.81	8.81	8.78	0.05	6.55	6.70	6.33	6.53	0.19		
			Fatty Acid Derrivatives	50.35	50.11	50.61	50.36	0.25	43.30	44.07	45.53	44.30	1.13		
			Others	–	–	–	–	–	2.18	2.34	2.26	2.26	0.08		
			Total	82.90	82.51	82.83	82.75	0.21	79.86	81.06	82.93	81.28	1.55		

[1] RRI: Relative retention indices calculated against n-alkanes (C5-C30).

[2] RRI Lit.: Relative retention time given in the literature for the compound in similar columns and analysis conditions.

[3] The results of the analysis in each replicate.

[4,5] The analysis were carried out in triplicate results are given as mean % area ± standard deviation (SD), calculated from MS data.

[6] Identification method: RI: identification based on the relative retention times (RRI) of genuine compounds on the HP Innowax column and the literature data; MS: identification based on MS comparison with the database or the literature data[12-37], Ac: Identification is done according to RRI and MS values of the authentic compounds.

[7] Citation of the RRI literature value.

butyl phthalate 2.26 ± 0.08%, 13-*epi*-manoyl oxide 2.03 ± 0.09%, phytol 2.00 ± 0.09%, α-cadinol 1.91 ± 0.27, germacrene D 1.67 ± 0.09%, *E*-β-ionone 1.51 ± 0.08%, eicosanol 1.36 ± 0.03%, pentacosane 1.22 ± 0.15%, manoyl oxide 1.15 ± 0.04%, muurola-4,10(14)-diene-1-ol 1.04 ± 0.06% and abietatriene 1.04 ± 0.05% compounds in considerable amounts. The essential oil of *A. cypria* was dominated by fatty acid derivatives 44.30 ± 1.13% and oxygenated sesquiterpenes 17.66 ± 0.49%. Additionally oxygenated monoterpenes 3.91 ± 0.26%, sesquiterpenes 6.62 ± 0.48% and diterpenes 6.53 ± 0.19% were also present in the essential oil in considerable amounts.

Both *Arabis* oils contained high amounts of fatty acid derivatives and oxygenated sesquiterpenes. The previous results indicate existence of high amounts of *n*-hexane derivatives including hexanal, 1-hexanol, 2-ethyl hexanol, hexyl acetate, 5-hexen-1-ol, (*Z*)-3-hexen-1-ol, (*Z*)-3-hexenal, (*Z*)-3-hexenyl acetate, (*Z*)-3-hexenyl butyrate and (*Z*)-3-hexenyl 3-methyl butyrate in *A. lyrata*, *A. holboellii*, *A. demissa*, *A. crandallii*, *A. lignifera*, *A. drummondii* and *A. gunnisoniana* volatiles[10, 11]. The essential oils of *A. purpurea* and *A. cypria* also contains low amounts of *n*-hexane derivatives namely (*Z*)-3-hexenyl tiglate (0.27 ± 0.01%, 0.20 ± 0.01% respecitively) and 2-ethyl-1-hexanol (0.08 ± 0.01% *A. purpurea*). Another similarity is the caryophyllene content of *A. holboellii* which is also observed in *A. purpurea* and *A. cypria*[11].

4 Conclusion

The essential oil of the aerial parts of *A. purpurea* and *A. cypria* is investigated for the first time. According to our literature survey this is the first report on the essential oil composition of any *Arabis* species. Previously only volatiles of couple of *Arabis* species were reported. In the composition of the investigated oils we have not encountered any isothiocyanates which are the hydrolysis products of glucosinolates.

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