

ESSENTIAL OIL FROM KAZAKHSTAN *Artemisia* SPECIES

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Essential oil from the aerial part of Siberian wild and cultivated *Artemisia dracuncululus* L. (AD, tarragon) was studied previously by GC–MS. The main components were identified as methylhavicol, 1-phenyl-2,4-hexadiyne, spatulenol, and caryophyllene- α -oxide [1]; from Italy, essential oil contained the main components estragol (70.1%), caryophyllene (14.3), and *trans*-ocimene (9.4) and was highly active and inhibited aggregation of erythrocytes [2]; from Iran, the main components were anethole (21.1%), α -*trans*-ocimene (20.6), and limonene (12.4) and sedative and anticonvulsive effects were observed [3]. Essential oil from raw material from China contained the main components 3,7-dimethyl-1,3,7-octatriene (38.4%), α -pinene (37.0), and 1-methoxy-4-(2-propenyl)benzene (8.6) [4]. According to various researchers, the main components of essential oil from this sage species are estragol and methylhavicol [5–8]; elemicin (50%) and methyleugenol (17.6%) [9]; methylhavicol and methyleugenol [10]. Sabinene (37–85%) and myrcene (8–10) dominated in oil obtained from Kazakhstan raw material [11].

The principal components of *A. gmelinii* Web. (AG) according to the literature [12] were artemisia ketone and cineole. The composition of oil from various natural populations and introduced species has been studied in detail [13]. According to this study, the principal components of AG essential oil were yomogi alcohol (up to 24%), 1,8-cineole (up to 32), camphor (up to 40), borneol (up to 24), artemisic acetate (up to 20), and chrysanthenylacetate (up to 73).

The compositions of essential oils from *A. marschalliana* Spreng. (AM), *A. proceriformis* Krasch. (AP), and *A. armeniaca* Lam. (AA) have not been reported.

Raw material for the studies of AD and AP was collected near Yntymak reservoir in Karaganda Oblast on June 15, 2001; of AM and AG, in Karkaralin Region of Karaganda Oblast on June 16, 2001; of AA, in AO SPC Fitokhimiya botanical garden on June 14, 2001. All samples were collected during budding. Samples were identified (Nos. 1999.09.01.02.07, 1984.08.00.02.01, 1996.09.01.02, 2001.06.16.01.04, and 2001.06.16.01, respectively) and preserved in the herbarium voucher of AO SPC Fitokhimiya.

Essential oil was obtained from dried and ground aerial parts of the plants by steam distillation in a Clevenger apparatus for 2 h. The yields were 0.2% for AD; 0.2, AM; 0.4, AG; 0.42, AP; and 0.17, AA.

GC–MS analysis of essential oil was performed under conditions analogous to those previously reported [14]. Table 1 lists the identified components and their percent content.

Table 1 shows that the principal components of AP essential oil were α -thujone (66.3) and β -thujone (23.4); of AA, spatulenol (30.5), limonene (7.7), and β -elemene (6.9); of AD, sabinene (20.2), *trans*-3(1-butenyl)isocoumarin (10.3), terpinen-4-ol (8.7), and myrcene (6.2); of AM, 1,8-cineole (13.5), camphor (9.8), α -thujone (5.7), and artemisia ketone (4.4); of AG, 1,8-cineole (28.5), camphor (11.3), borneol (9.3), and α -thujone (8.6).

Thus, the component composition of five sage species growing in Kazakhstan was investigated. The essential oil compositions of AM, AP, and AA were studied for the first time.

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TABLE 1. Essential Oil Composition of *Artemisia* Species

Component*	Retention index	Content, %				
		AA	AP	AD	AM	AG
Hexanal	3.730	–	–	–	0.1	–
1,3-Octadiene	4.246	–	–	0.1	–	–
<i>trans</i> -2-Hexenal	4.864	–	–	–	0.1	–
<i>cis</i> -Salvene	4.873	–	–	–	–	0.1
Hexanol-1 + <i>p</i> -xylene (~1:2)	5.277	–	–	0.1	–	–
<i>o</i> -Xylene	5.896	–	–	0.1	–	–
Santolinatriene	6.308	–	–	–	0.1	–
Tricyclene	6.704	–	–	–	0.1	0.1
α -Thujene	6.876	–	–	1.7	0.3	0.1
α-Pinene	7.082	3.4	–	4.2	4.1	0.1
α -Fenchene	7.469	–	–	0.4	–	–
Camphene	7.520	–	–	0.1	1.3	1.8
Verbenene	7.701	–	–	0.1	–	0.1
Benzaldehyde	7.950	–	–	0.1	0.1	–
Sabinene	8.389	2.1	1.3	20.2	0.8	0.2
β-Pinene	8.457	1.1	–	3.7	1.7	0.1
Oct-1-en-3-ol	8.517	–	–	–	0.1	0.1
6-Methyl-5-hepten-2-one	8.793	–	–	–	0.1	–
2,3-Dehydro-1,8-cineole	8.879	–	–	–	0.3	0.3
β-Myrcene	8.956	6.2	–	6.2	0.6	–
Yomogi alcohol	9.214	–	–	–	0.4	–
α -Phellandrene	9.343	–	–	0.2	–	0.3
α-Terpinene	9.772	–	–	3.1	0.2	1.0
Trimethylbenzene	9.944	–	–	0.1	–	–
<i>p</i>-Cymene	10.039	3.5	0.6	1.5	2.1	3.7
Limonene	10.185	7.7	–	3.3	1.0	–
1,8-Cineol	10.262	1.1	3.1	0.3	13.5	28.5
Santolina alcohol	10.460	–	–	–	0.2	–
<i>cis</i> - β -Ocimene	10.537	–	–	0.7	0.6	–
<i>trans</i> - β -Ocimene	10.898	–	–	1.2	0.9	–
γ-Terpinene	11.251	–	0.5	4.9	0.9	1.4
Artemisia ketone	11.345	–	–	–	4.4	–
<i>cis</i> -Sabinene hydrate	11.509	–	–	0.6	0.4	0.1
Artemisia alcohol	12.119	–	–	–	1.1	–
Terpinolene	12.274	–	–	1.2	0.2	0.2
<i>p</i> -Cymenene	12.282	–	–	–	–	0.1
<i>trans</i> -Sabinene hydrate	12.600	–	–	0.6	0.3	0.1
Linalool	12.704	–	–	–	0.7	0.1
Perillene	12.747	–	–	0.6	–	–
3-(4-Methyl-3-pentenyl)furan	12.819	6.3	–	–	–	–
α-Thujone	12.884	–	66.3	–	5.7	8.6
β-Thujone	13.262	–	23.4	–	1.4	1.0
<i>cis</i> - <i>p</i> -Menth-2-en-1-ol	13.426	–	–	0.6	0.2	2.5
Chrysanthenone	13.580	–	–	–	–	0.1
α -Campholenic aldehyde	13.632	–	–	0.3	0.1	–
<i>trans</i> -Pinocarveol	14.062	–	0.4	0.2	0.4	–
<i>trans</i> -Sabinol	14.089	–	0.4	0.6	–	–
<i>trans</i> - <i>p</i> -Menth-2-en-1-ol	14.113	–	–	–	–	1.8
Camphor	14.242	–	–	–	9.8	11.3
<i>trans</i> -Verbenol	14.251	–	–	0.2	–	–
<i>p</i> -Menth-3-en-8-ol	14.388	–	–	–	0.1	–
Camphene hydrate	14.397	–	–	–	–	0.1
Sabinaketone	14.698	–	–	0.4	–	–
Pinocarvone	14.887	–	–	0.1	–	–

TABLE 1. (continued)

Component*	Retention index	Content, %				
		AA	AP	AD	AM	AG
<i>cis</i> -Chrysanthenol	14.895	–	–	–	–	1.4
Borneol	14.990	–	–	–	3.3	9.3
<i>p</i> -Mentha-1,5-dien-8-ol	15.059	–	–	–	–	–
Lavandulol	15.076	–	–	0.2	0.8	–
Terpinen-4-ol	15.463	1.4	2.0	–	2.6	3.3
Naphthalene	15.540	–	–	8.7	–	–
<i>m</i> -Cymen-8-ol	15.695	–	–	0.3	0.1	0.2
Cryptone	15.701	–	–	0.4	–	–
α -Terpineol	15.884	1.9	–	0.2	2.4	0.7
<i>cis</i> -Piperitol	16.056	–	–	0.7	–	0.8
Myrtenol	16.073	–	–	–	0.2	–
<i>trans</i> -Piperitol	16.477	–	–	0.6	0.1	0.9
Fragranol	16.718	–	–	0.4	0.5	–
<i>trans</i> -Carveol	16.864	–	–	–	0.3	0.1
Bornylformate	17.182	–	–	0.2	–	0.2
Citronellol	17.208	–	–	–	0.2	–
<i>cis</i> -Hexenyl-3-methylbutanoate	17.508	–	–	0.3	–	–
Pulegone	17.569	–	–	0.1	0.7	–
Cuminic aldehyde	17.577	–	–	–	–	0.3
Carvone	17.723	0.9	–	0.4	–	0.1
Geraniol	18.102	–	–	0.1	0.2	–
Piperitone	18.119	–	–	0.1	–	0.2
Piperitone epoxide	18.119	–	–	–	–	0.3
<i>cis</i> -Chrysanthenylacetate	18.342	–	–	–	0.1	0.1
Phellandral	18.763	–	–	–	–	–
Mentha-1,3-dien-7-ol	18.987	–	–	0.3	–	–
Bornylacetate	19.185	–	–	0.2	1.1	3.4
Cuminic alcohol + 2-methylnaphthalene	19.314	–	–	0.4	–	–
Thymol	19.382	–	–	0.5	0.8	0.5
Peryillic alcohol	19.571	–	–	–	–	–
Carvacol	19.623	–	–	0.2	0.2	–
Ascaridol	19.829	–	–	–	–	0.2
1-Methylnaphthalene	19.881	–	–	–	–	–
<i>p</i> -Mentha-1,4-dien-7-ol	20.586	–	–	0.1	–	–
α-Terpenylacetate	21.291	–	–	0.6	–	0.1
α -Longipinene	21.299	–	–	–	–	–
Citronellylacetate	21.428	–	–	0.2	0.5	–
Eugenol	21.531	–	–	1.4	0.5	–
Nerylacetate	21.789	–	–	0.1	–	–
α -Copaene	22.141	–	–	0.7	0.2	–
Sabinypropionate	22.313	–	–	–	–	0.1
Geranylacetate	22.417	–	–	–	0.3	–
β-Elemene	22.666	6.9	–	1.1	0.4	–
<i>cis</i> -Jasmone	22.528	–	–	–	0.3	0.3
Methyleugenol	23.070	–	–	0.1	0.7	–
Dimethylnaphthalene	23.388	–	–	–	–	–
Caryophyllene	23.525	–	–	0.1	0.8	0.1
β -Copaene	23.826	–	–	0.7	0.1	–
Humulene	24.591	–	–	–	0.1	–
β -Farnesene	24.703	–	–	0.1	0.1	–
Allo-aromadendrene	24.815	–	–	0.1	0.1	–
γ -Decalactone	25.004	–	–	–	–	–
γ -Muurolene	25.313	–	1.0	0.2	0.3	–
Germacrene D	25.451	–	–	–	2.9	0.3

TABLE 1. (continued)

Component*	Retention index	Content, %				
		AA	AP	AD	AM	AG
<i>trans</i> - β -Ionone	25.588	–	–	0.2	–	–
β -Selinene	25.597	2.3	–	–	0.5	0.3
Pentadecene-1	25.769	–	–	0.1	–	–
α -Zingiberene	25.915	–	–	0.1	–	–
Bicyclogermacrene	25.881	–	–	0.2	1.0	–
α -Muurolene	26.018	–	–	–	0.2	–
<i>trans,trans</i> - α -Farnesene	26.276	–	–	–	0.1	–
β -Bisabolene	26.293	–	–	–	–	0.3
γ -Cadinene	26.448	–	–	–	0.1	–
δ -Cadinene	26.723	–	–	–	0.4	–
Artedouglasia oxide C	26.723	–	–	–	–	0.9
β -Sesquiphellandrene	26.740	–	–	0.5	–	–
Artedouglasia oxide A	27.075	–	–	–	–	1.1
Laciniata furanone H	27.479	–	–	–	–	0.3
Artedouglasia oxide D	27.797	–	–	–	–	0.4
<i>trans</i> -Nerolidol	27.901	–	–	0.1	0.5	0.4
Palustrol	28.012	–	–	0.1	–	–
<i>cis</i> -3-Hexenylbenzoate	28.107	–	–	0.1	–	–
Spatulenol	28.330	30.5	–	3.0	3.5	0.5
Caryophyllene oxide	28.485	1.9	–	1.7	1.2	1.1
Davanone	28.605	–	–	–	–	0.1
Salvia-4(14)-en-1-ol	28.786	–	–	–	0.5	–
Ledol	29.061	–	–	0.1	–	–
Humulen-6,7-epoxide	29.224	–	–	0.2	0.4	0.1
γ -Eudesmol	29.835	–	–	–	0.7	0.1
Carylphylla-4(12),8(13)-dien-5-a-ol	29.989	–	–	–	–	0.1
Epi- α -cadinol	30.032	–	–	–	0.5	–
Epoxyalloaromadendrene	30.041	–	–	0.3	–	–
α - Muurolol	30.135	6.0	–	–	0.4	–
β -Eudesmol	30.359	–	–	0.2	0.8	2.8
α -Cadinol	30.496	–	–	–	1.0	–
Neointermedeol	30.600	–	–	0.2	–	–
14-Hydroxycaryophyllene	30.935	–	–	0.2	–	–
α -Bisabolol	31.296	–	–	–	1.8	–
Eudesma-4(15),7-dien-1-ol	31.365	–	–	0.1	–	–
4-(1,5-Dimethyl-4-hexenyl)-2-cyclohexen-1-one	31.442	–	–	0.3	–	–
<i>ap</i> -Curcumen-15-al	32.095	–	–	0.1	–	–
Chamazulene	32.525	–	–	–	–	0.6
Benzylbenzoate	33.436	–	–	0.1	–	–
<i>trans</i>-3(1-Butenyl)-isocoumarin	34.940	–	–	10.3	–	–
Hexahydrofarnesylacetone	35.533	–	–	0.1	0.2	–
<i>cis</i> -3(1-Butenyl)-isocoumarin	36.393	–	–	1.9	–	–
Phytol	41.920	–	–	–	0.4	–
Tricosane	42.417	2.7	–	–	–	–

*Bold denotes principal components; AA, *A. armeniaca*; AP, *A. proceriformis*; AD, *A. dracunculus*; AM, *A. marschalliana*; AG, *A. gmelinii*.

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