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VARIABILITY OF ESSENTIAL OIL COMPOSITION OF *Echinophora tenuifolia* SUBSP. *sibthorpiana* TUTIN BY HARVEST LOCATION AND YEAR AND OIL STORAGE

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The genus *Echinophora* (Apiaceae) is represented in the flora of Turkey by six species including three endemics [1]. The plant is also used in folk medicine to heal wounds and to treat gastric ulcers due to its antifungal, carminative, and digestive properties [2]. In previous works, the characteristic compounds of pickling herb oil were methyl eugenol, α-phellandrene, δ-3-carene, and *p*-cymene [3–7]. In this paper, the composition of pickling herb essential oils of the plants from two years and localities is reported. Two samples of stored essential oil were also included.

The unflowered plant samples of wild growing *E. tenuifolia* ssp. *sibthorpiana* were collected from Konya and Kutahya in Turkey in July 2001 and 2002. The air-dried samples were kept at room temperature. Ground samples were subjected to hydrodistillation for 3 h using a Clevenger-type apparatus. The essential oils were dried over anhydrous sodium sulfate. The yields (v/w) calculated on a dry weight basis were 1.0 and 2.4% for 2001, and 1.0 and 0.76% for 2002 year samples from Konya and Kutahya, respectively. In addition to four fresh ones, two essential oil samples from 2001 were stored in the refrigerator for one year prior to analysis. For identification of components, analytical GC was performed on a DELSI 121 C apparatus fitted with a flame ionization detector and a CP WAX 51 fused silica column (25 m $\times$ 0.3 mm; 0.25 μm film thickness).

The oil content on a dry weight basis varied from 0.76% to 2.4% (v/w). The components identified by GC and GC-MS in the oils are listed in Table 1 (The essential oil of the plant collected from Konya in 2001 (1), in 2002 (5) from Kutahya in 2001 (2), in 2002 (6); one-year stored essential oil of the plant collected from Konya in 2001 (3); from Kutahya in 2001 (4)). The major consituents of all samples were methyl eugenol, δ-3-carene, and *p*-cymene. The sample from Konya in 2002 was rich in δ-3-carene, mentha-1,5-dien-8-ol, verbenone, *o*-cymen-8-ol, and isophorone, but they did not contain caryophyllene oxide. Plant location caused considerable variation of the major component percentage of the essential oils. It was interesting to find that the stored Konya sample was also relatively rich in methyl eugenol, but δ-3-carene was present at a low percentage. Also, δ-3-carene (61.44%) was the main component in Konya 2002 sample. These considerations and different contents of δ-3-carene indicated the probable variety or chemotype of the plant.

Significant variations occurred in the components of Konya essential oil stored for one year in the refrigerator. *trans*-2-Caren-4-ol formed in the stored sample. Methyl eugenol and especialy δ-3-carene decreased in the stored Kutahya sample, but *p*-cymene increased. The component percentages of both samples in 2002 were found to be similar, but different constituents and relative amounts were established. These differences existed between localities.

Some reports on the essential oil composition of *E.tenuifolia* ssp. *sibthorpiana* from various locations were previously published. Akgul and Chialva [3] reported the main compounds as α-phellandrene (51%), methyl eugenol (25%), δ-3-carene (5.7%), β-phellandrene (5%), and *p*-cymene (4.3%). Baser [7] found the major components to be α-phellandrene (52%), *p*-cymene (13%), and methyl eugenol (13%). Baser et al. [4] also reported α-phellandrene, *p*-cymene, and methy eugenol as the principal compounds. Ozcan *et al*. [5] determined methyl eugenol, δ-3-carene, *p*-cymene, and α-phellandrene in the essential oil from plants growing in Konya. Aridogan *et al*. [8] found that the oil contained mainly α-phellandrene, methyl eugenol and *p*-cymene. The main compounds of the oils from plants collected in three different stages were δ-3-carene, methyl eugenol, and α-phellandrene, and the April sample was composed of more components [6].

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TABLE 1. Percentage Composition of the Essential Oils from Wild Pickling Herb (*Echinophora tenuifolia* subsp. *sibthorpiana*)

Compound	RT	Samples*					
		1	2	3	4	5	6
α-Thujene	8.22	0.08	0.06	-	-	0.21	0.21
α-Pinene	8.35	0.15	0.22	-	-	0.52	0.28
Thuja-2,4(10)-diene	8.76	-	-	-	-	0.03	-
Camphene	8.84	-	-	-	-	-	0.04
Hept-2-enal	9.21	-	-	-	-	0.01	-
Benzaldehyde	9.32	-	-	0.02	-	0.06	0.03
Verbenane	9.69	-	-	-	0.13	1.31	0.46
Myrcene	10.51	0.31	0.68	0.4	-	2.09	0.99
δ-3-Carene	11.38	18.45	25.70	4.79	2.27	61.64	20.45
α-Terpinene	11.59	-	0.02	-	-	0.03	0.04
o-Cymene	11.67	0.03	0.04	0.03	1.82	0.16	0.05
p-Cymene	11.78	4.63	0.96	0.48	-	2.32	5.98
Limonene	11.90	-	0.52	0.15	-	1.46	2.08
cis-β-Ocimene	12.17	0.03	0.04	-	-	0.04	0.12
Benzene acetaldehyde	12.29	-	-	-	-	0.04	0.04
trans-β-Ocimene	12.49	0.04	0.01	-	-	0.03	0.09
γ-Terpinene	12.83	0.02	0.11	0.04	-	0.16	0.09
cis-Sabinene hydrate	13.09	-	-	-	-	0.01	0.01
cis-3,7-Dimethyl-2,6-dienal	13.36	-	-	-	-	0.02	-
m-Cymene	13.60	0.04	0.07	0.10	0.13	0.15	0.06
Mentha-2,4(8)-diene	13.71	0.06	-	0.02	-	0.61	0.20
p-Cymene	13.81	0.11	0.07	0.12	0.14	-	-
p-Mentha-1,3,8-triene	14.52	-	-	-	-	0.01	0.05
Verbenol	14.85	-	-	-	-	0.04	-
8-Methyl-3,7-nonadien-2-one	15.08	-	-	-	-	0.04	-
Limonene oxide	15.35	0.06	0.24	-	-	0.12	0.03
Terpinolene epoxide	15.58	-	0.06	0.03	0.73	0.06	0.04
Cyclohepta-2,4-dien-1-one	15.77	-	-	0.05	-	0.13	0.03
Mentha-1,5-dien-8-ol	16.22	1.75	0.21	0.70	0.29	2.79	1.01
trans-2-Caren-4-ol	16.65	-	0.44	0.41	0.40	0.87	0.43
o-Cymen-8-ol	16.96	1.10	0.90	0.53	0.86	1.64	0.75
p-Cymen-8-ol	17.05	-	-	0.39	0.54	0.79	0.46
α-Phellandrene epoxide	17.13	1.20	0.11	0.10	0.63	0.60	1.22
Isophorone	17.17	0.59	-	-	-	2.17	-
Eucarvone	17.99	0.15	0.12	0.74	1.03	0.86	-
Carvone	18.57	0.03	0.02	0.04	0.07	0.04	0.06
Carvotanacetone	18.68	0.10	-	-	0.11	0.02	0.02
Piperitone	18.81	0.78	0.26	0.25	0.47	0.91	0.74
3-Caren-10-al	19.09	0.04	0.02	0.04	0.12	0.06	0.05
Cuminol	20.06	-	-	0.09	0.08	-	-
Thymol	20.29	0.09	0.03	0.19	0.33	0.07	0.04
Carvacrol	20.48	0.57	0.39	0.30	2.17	0.52	0.48
Chaviberol	22.09	-	-	0.08	-	0.34	0.02
β-Elemene	22.59	-	-	-	-	-	-
cis-Jasmone	22.79	0.06	-	0.05	0.22	0.4	0.08
Methyl eugenol	23.13	57.65	64.90	80.65	55.56	9.61	36.06
trans-β-Farnesene	24.22	-	-	-	-	0.02	-
Germacrene D	24.90	-	-	-	-	0.15	0.08
β-Selinene	25.05	-	-	0.04	-	0.45	0.30
α-Selinene	25.25	-	-	-	-	0.07	-
Myristicin	25.87	0.02	0.06	0.12	0.05	0.04	0.02
Spathulenol	27.24	-	-	-	-	0.02	0.02
Caryophyllene oxide	27.44	0.10	-	-	0.70	-	0.11
Carotol	27.69	-	-	-	-	0.02	-
Methyl coniferaldehyde ether	31.63	0.18	0.12	0.22	0.24	0.02	0.03
Neophytadiene	32.78	0.13	0.06	0.10	-	0.04	0.04
Pentadecan-2-one	32.90	-	0.02	0.37	0.76	0.12	0.02

Our results were generally similar to the literature findings with respect to the major components except for minor differences in the research parameters and confirmed the effect of different localities and collection years of the plant and oil storage on the yield and composition of the essential oil.

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