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CHEMICAL PROPERTIES OF HAWTHORN (*Crataegus* L. spp.) TAXA NATURALLY DISTRIBUTED IN WESTERN ANATOLIA PART OF TURKEY

KEMIJSKA SVOJSTVA SVOJTI GLOGA (*Crataegus* L. spp.) PRIRODNO RASPROSTRANJENIH U ZAPADNOJ ANATOLIJI U TURSKOJ

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Summary

Chemical properties of *Crataegus pentagyna* subsp. *pentagyna, C. orientalis* subsp. *orientalis, C. orientalis* subsp. *szovitsii*, *C. tanacetifolia*, *C. azarolus* var. *aronia, C. monogyna* var. *lasiocarpa*, *C. monogyna* var. *monogyna* taxa that are naturally distributed in Western Anatolia were determined in this study. Leaf and flower samples collected from Izmit, Sakarya, Balıkesir, Izmir, Kütahya, Muğla and Isparta provinces of Western Anatolia to determine volatile components in 2010-2014 period were dried at room temperature. Volatile components that were obtained by dry phase microextraction (SPME) method in Süleyman Demirel University Central Laboratories were determined in Gas chromatography–mass spectrometry (GC-MS). A total of 81 volatile components belonging to 7 hawthorn taxa were determined. Volatile oil components that were identified at highest ratios were benzaldehyde (82.54%) butyraldehyde (38.27%) and (E)2-hexenal (21.67%) components.

Moisture values of hawthorn seeds samples that were collected from sample areas during ripening period were determined. Fatty acid composition was determined in with Gas Chromatography-Flame Ionization Detector (GC-FID) using standard fatty acid mixture. Moisture values of hawthorn seeds varied between 14.49%-36.33%. 10 fatty acid compositions belonging to 7 hawthorn taxa were determined, the highest were linoleic (64.23%), oleic (39.36%) and palmitic acid (8.16%) respectively.

KEY WORDS: *Crataegus*, volatile component, benzaldehyde, linoleic acid, Western Anatolia, Turkey

INTRODUCTION
UVOD

Turkey has a very rich flora with approximately 11.000 registered plant species (Davis et al., 1988; Güner et al.; 2000, Erik and Tarıkahya, 2004). Flora of Turkey is intriguing not only due to high number of species but also due to high number of endemic species (Ekim et al., 1989).

Various unnatural products have been and are entering our lives in addition to medicines (Rodopman, 1990). Strong

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reactions caused by synthetic medicines and pollution caused by pharmaceutical industry have made herbal treatment important today (Bulut, 2006). Plants used as herbal drugs in treatment in traditional and modern medicine are called „Medicinal Plants" (Baydar, 2007). Turkey has a high number of medicinal and aromatic plants due to its rich flora. Plants have been used by local people for treatment purposes, as food, tea, spices, dye, insecticide, for treatment of animal diseases, as resin, glue and as volatile fixed oils, beverage and for cosmetics industry as a part of our long traditional cultural diversity (Faydaoğlu and Sürücüoğlu, 2011).

Pharmacologic studies carried out on these medicines based on their purpose of use have scientifically explained some biological effects (Baydar, 2007). Plants are characteristically composed of mostly high-molecular-weight substances such as carbohydrates, oil, protein, cellulose, lignin and pectin, which are called primary metabolites. Apart from primary metabolites which have functions that are essential to growth and development plants also contain small moleculare weight secondary metabolites such as alkaloids, volatile oils, glycosides, heterocyst, steroids, flavonoids, tannins, phenols, color substances and resins, which are sometimes at unmeasurable levels and are not essential in terms of the vitality of plants. Therapeutic activity of a medicinal plant arises from these bioactive substances. Plants which are rich in terms of secondary metabolites mostly fall into the group of medical and aromatic plants (Baydar, 2007).

Certain parts (leaf, flower, sprout, fruit, root) of hawthorn (*Crataegus*) species, which are one of the widely used plants among the public, are traditionally used to treat various diseases. Dried flower and fruits of hawthorn are prepared as tea and used to treat tonsillitis, coughing, poor coronary activity, cardiac pain, tachycardia, renal diseases, arteriosclerosis, liver pain and hemorrhoids (Baytop, 1984; Karadeniz, 2004; Meriçli, 1994). Hawthorn, which has been used as traditional medicine, has drew attention from the world of science and various studies have been carried out. Previous studies reported that different taxa of hawthorn have antiarrhythmic effect (Garjani et al., 2000); hypotensive effect and increase coronary blood flow (Birman et al., 2001), they have anti-ischemic (Al Makdessi et al., 1999) anti-inflammatory (Bor et al., 2012), antioxidant effect (Bahorun et al., 1994; Bahorun et al., 1996; Bor et al., 2012) they protect vascular integrity (Miller, 1998), have antiviral (Shahat

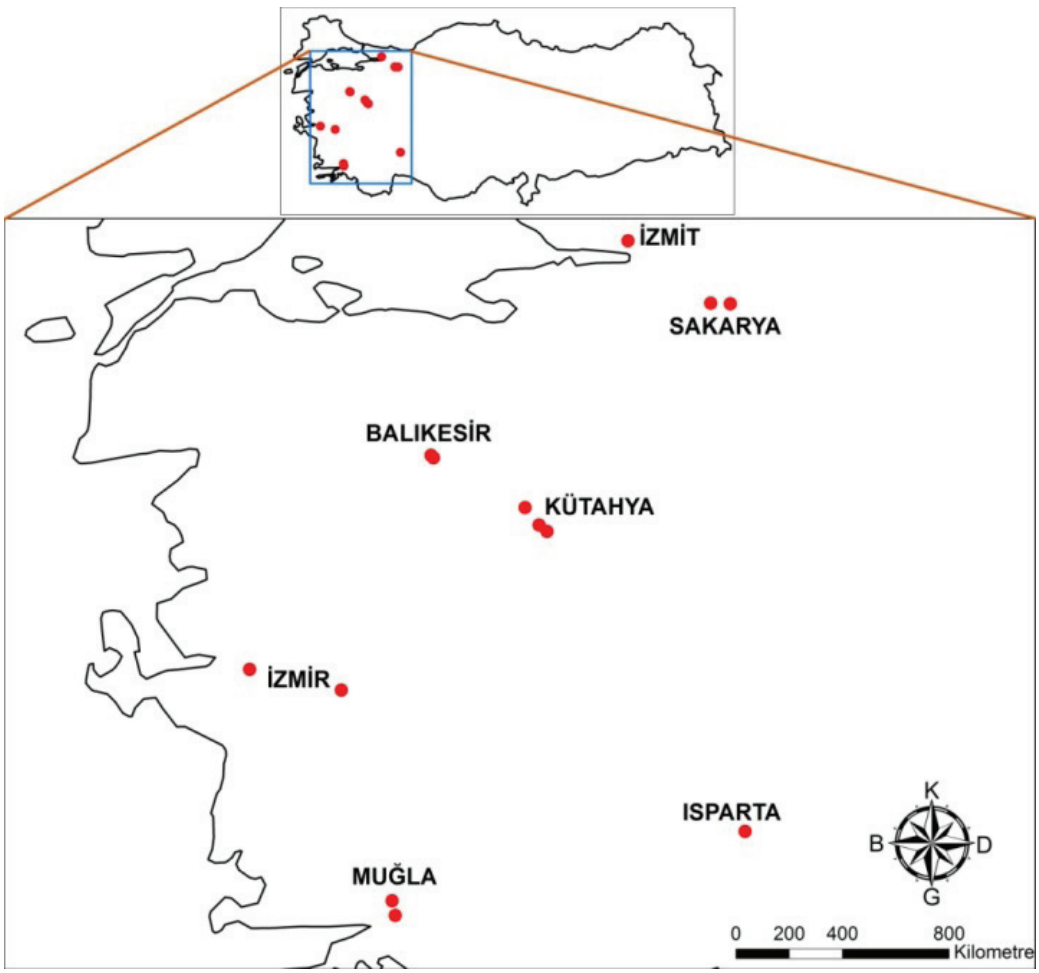

Figure 1. Study Area
Slika 1. Istraživano područje

et al., 1998), antithrombotic (Arslan et al., 2011), antifungal (Orhan et al., 2007), antinociceptive (Bor et al., 2012) effects and that they are effective in early periods of congestive heart failure (Rietbrock, 2001).

Hawthorn refers to deciduous trees or shrubs belong to genus *Crataegus* L. of family *Rosaceae* which generally has thorns (Christensen, 1992; Dönmez, 2004). Genus hawthorn has around 200 species around the world. Although more than 1000 names have been reported for this plant around the world, it has 100-200 species. Some characteristics of the genus such as leaf and seed morphology, number of seed and fruit color are polymorphous. Polymorphism and hybridization are the reason for high number of synonyms. There are 26 hawthorn taxa growing in Turkey (Dönmez, 2007).

This study aims to determine chemical contents of different hawthorn species which are a wild species distributed in Western Anatolia.

MATERIAL AND METHOD
MATERIJAL I METODA

Material of the study consisted of *Crataegus* samples collected from A1-A2, A3,B1-B2, B3, C2 and C3 squares according to squaring system in Flora of Turkey (Davis et. al., 1988) in 2010-2014 period (Figure 1, Table 1). Field study was conducted in the study area in blooming (May-June), fruit ripening (September-October) periods of *Crataegus* species. Samples were collected and registered and plant samples were maintained at Forest Botanic Laboratory of Süleyman Demirel University, Faculty of Forestry for drying and storage according to herbarium techniques. Plants were identified and kept at Süleyman Demirel University, Faculty of Forestry herbarium.

Determination of volatile components – Određivanje hlapljivih komponenti

Volatile components of hawthorn leaves and flowers were determined according to solid phase microextarction method (Vichy et. al., 2003). Collected plant materials were dried at room temperature. 2 gr of each sample were weighted and placed in glass bottles and were heated at 60 C^0 for 15 minutes. Then they were soaked in injector bottle with a suitable fiber tip and absorbed for 30 min. The compounds that were exposed to fiber tip were injected to injection block of GC unit and were kept for 5 min for absorption.

GC-MS device (Shimadzu QP 5050, Japan) was used to determine volatile components**.** HP-5 MS (30 m x 0.25 mm long and 0.25 um film thickness) column and Helium (10 psi flow rate) was used as carrier gas in the device. Injection block temperature was 240 °C and detector temperature was 250 °C.

Determination of fruit seed fixed oil composition – Određivanje sastava nehlapljivih ulja u sjemenkama voća

GC-MS (with FID Detector, Shimadzu QP 5050, and Japan) in Suleyman Demirel University Experimental and Observational Student Research and Application Center was used

Table 1. Locations of study material
Tablica 1. Lokacije od promatrani materijal

Taxa ***Takson***	**Locations and elevations** ***Lokacije i uzvisine***
C. pentagyna Waldst. & Kit. ex Willd. subsp. *Pentagyna*	İzmit province locality around TaşKöprü warehouse 456 m.
C. orientalis Pall. ex M. Bieb. subsp. *Orientalis*	Sakarya province Taraklı county; Karagöl Uğurlu plateau locality 1385 m. Balıkesir province Dursunbeyli county Aktuzla locality 1510 m. İzmir province Kemal Paşa county Ayrancı locality 820 m. İzmir province Ödemiş county Gölcük locality1120 m. Kütahya province Emet county Tahtalı locality 1120 m.
C. orientalis Pall. ex M. Bieb. subsp. *szovitsii* (Pojark.) K. I. Chr	Kütahya province Emet county Alıç locality 1450 m
Crataegus tanacetifolia (Lam.) Pers.	Kütahya province Emet county Çomar locality 1450 m. Sakarya province Taraklı county, Esenyurt plateau 1227 m,
Crataegus azarolus L. var. *aronia*	Muğla province Yaraş village Akyaka locality 812 m. Isparta Kovada Lake locality 933 m.
Crataegus monogyna Jacq. var. *lasiocarpa* (Lange) K. I. Christ	Balıkesir province Dursunbeyli county Aktuzla locality 1510 m.
Crataegus monogyna Jacq. var. *monogyna*	Muğla province Ula county Çiçekli locality 250 m.

Table 2. Leaf and flower volatile oil components of hawthorn taxa (%)
Tablica 2. Hlapljive komponente ulja iz lista i cvijeta taksona gloga (%)

		Volatile oil component (%)												
LRI *LRI*	**Components** *Komponente*	1	2	3	4	5	6	7	8	9	10	11	12	13
650	Isopropyl acetate				1,54	0,70			1,88					
662	Butyraldehyde	5,54	17,27	9,83	9,03	0,55	15,7	30,93	8,81	16,21	15,21	4,49	36,40	38,27
680	Ethylvinyl carbinol	1,62	7,13	4,35	0,52		3,22	6,26		2,87	4,01		1,62	0,90
682	Propyl methyl ketone					6,24								
696	Valeraldehyde		4,23	1,54	0,64		1,28	3,04	2,75	3,86	3,95	0,40	0,59	0,93
697	Diethyl ketone					0,79								
703	Furan	2,48			1,06	0,50	3,6			0,14	0,21	0,29	2,96	1,94
729	Isoamyl alcohol	4,74	5,41	7,45		1,20	1,8	3,8		2,51	3,45	1,43	1,83	3,52
732	Formate	1,09	2,97	3,64		0,80	0,96	3,92		1,46	1,97		0,57	1,62
751	2-Pentenal	0,61	0,63	0,91			0,87	1,16		0,76	1,62	0,05	0,40	0,51
761	1-pentanol	0,59	0,71	0,54			0,74	0,72		1,35	0,45	0,06	0,41	
767	2-Pentenol	0,76	1,17	0,91			1,16	0,58		1,33	0,75	0,10	0,78	0,84
801	Capronaldehyde	16,55	5,10	6,05	2,60	2,60	18,13	12,55		12,26	4,28	1,94	10,16	11,14
845	Furfural													0,06
850	2-Hexenal	18,70	7,05	12,96	12,68	12,15	13,11	13,28	4,95	13,73	21,67	2,57	17,01	8,29
853	3-Hexenol	12,47	4,94	5,53	1,84	2,03	4,53	4,85		7,00	9,12	0,40	6,37	2,82
866	2-Hexenol				0,69	1,03								
867	Hexanol	21,10	11,88	4,18	2,99	11,85	9,74	4,76	2,57	20,10	1,92	2,52	4,09	0,95
878	2,6-Lutidine				1,05	0,69			0,83					
891	Styrene				3,05	3,31			2,79					
898	2-Heptanone		0,34	0,15										
902	4-Heptenal	0,10									0,04		0,06	0,06
906	Enanthaldehyde	0,15			3,52	0,48	0,06		1,89	0,13			0,15	0,30
914	Sorbic aldehyde	0,16					0,18							
933	α-Pinene	0,19	0,88	18,68	2,27	1,55	0,56	0,72	3,34	0,32	0,60	0,04	0,35	0,17
934	3-Heptanone											1,23		
957	Camphene			0,09										
964	Benzaldehyde	8,34	17,68	11,46	4,97	8,06	6,30	6,31	4,55	10,83	23,86	82,54	10,31	17,09
970	n-Heptanol				1,87	1,30			2,22					
978	β-Pinene			1,53							0,07			
982	Vinyl amyl carbinol		0,26	0,12				1,45		0,10				0,08
986	Hept-5-en-2-one	0,51	0,60	0,50	1,56	2,98	1,71	0,72	1,04	0,71	0,58	0,17	0,43	0,58
989	Hexyl menthyl ketone		1,04											
991	Myrcene			2,75	3,91	4.32			5.46					
997	Trans-2-(2 pentenyl)furan	0,19		0,20			0,13			0,12	0,20	0,22	0,27	0,66
1006	Caprylaldehyde					1.87	0,10		1.81				0,16	
1009	3-delta-carene	0,14	0,15	0,16	1,30	0,67	0,18		1,47	0,09	0,17	0,21	0,22	0,14
1013	Heptandienal	1,19	0,22	0,19		0,47	0,08			0,25	0,14	0,08	0,93	0,18
1012	Hexanoic acid, 2-propenyl ester	0,22											0,20	
1018	α-Terpinene				0,67				0,98					
1025	Cymene	0,24	0,20	0,34	6,48	4,95	0,28		7,19		0,21	0,14	0,26	0,30
1030	Limonene	0,15	0,22	1,39	4,39	3,95	0,20		5.31	0,12	0,19	0,21	0,36	0,64
1032	Eucalyptol	0,08	0,31		3,52	1,90	0,12	0,32	5,22	0,15	0,27	0,05	0,26	0,18
1040	Benzyl alcohol	0,23	0,26			0,69					0,19		0,24	0,16
1045	Phenylacetaldehyde	0,30	0,13	0,33		0,94	0,12	0,25	0,64	0,16	0,26			1,37
1046	β-ocimene					1,47								
1050	Nonylol											0,11		
1058	γ-Terpinene				2,25	1,19			3,58					
1084	Benzyl mercaptan				1,40									
1059	2-Octenal													0,12
1068	Acetophenone													0,36
1098	Terpinolene	0,07	0,14	0,09	1,13	0,65		0,28	1,26			0,05	0,08	0,33
1101	Undecane			0,05										0,08
1107	Pelargonaldehyde	0,20	0,18	0,09		0,59	0,15			0,27	0,27	0,05	0,67	1,58

1113	Phenethyl alcohol	0,32	0,21	0,19			0,12			0,25		0,07	1,12	0,59
1153	2,6-Nonadienal											0,05		0,09
1170	2-Nonenol											0,27		0,21
1192	Methyl salicylate	0,21	1,84				0,40					0,07	0,13	0,15
1198	α-Terpineol		0,50						0,59					0,10
1243	Hexyl3methylbutanoate						0,22			0,25				0,10
1257	p-Anisaldehyde		0,57							0,41		0,08	0,40	1,84
1294	menthyl Nonyl ketone, undecan		3,66						3,05	0,22		0,09		0,21
1300	Tridecane				0,53	1,16								
1307	octyl propanoate.				0,57									
1357	Eugenol								0,61					
1375	α-Copaene		0,21				1,29			0,39	0,24			
1382	β-Bourbonene	0,09	0,64				2,85		0,68		0,42			
1400	Tetradecane				1,37	2,96			1,44					0,12
1418	β-Caryophyllene	0,44	0,79	0,61	1,38		8,11	3,29	1,48	0,87	3,29	0,02	0,15	0,06
1423	β-Cedrene		0,16				0,99							
1432	trans-α-Bergamotene							0,20						
1454	α-Humulene	0,07					0,37	0,15			0,17			
1480	1,6,Cadinadiene						0,16							
1495	Menthyl undecyl ketone, tridecan								1,26					
1504	α-farnesene		0,18		5,68	5,90	0,44	0,46	4,58		0,22			
1581	Hexyl benzoate	0,06					0,14			0,44				
1582	Hexadecane				1,44	1,12			0,64					
1900	Nonadecane				2,64	0,52			1,08					
1215	β-cyclocidral	0,10												
2100	Heneicosane				0,67									

***LRI: Retention index

Leaf and flower volatile components Sample 1. *C. pentagyna* subsp. *pentagyna*, sample 2. *C. orientalis* subsp. *orientalis*, sample 3. *C. orientalis* subsp. *orientalis*, sample 4.*C. orientalis* subsp. *orientalis,* sample 5. *C. orientalis* subsp. *orientalis,* sample 6. *C. orientalis* subsp. *orientalis,* sample 7. *C. orientalis* subsp. *szovitsii,* sample 8. *C. tanacetifolia*, sample 9. *C. tanacetifolia*, sample 10. *C. azarolus* var. *aronia*, sample 11. *C. azarolus* var. *aronia,* sample 12. *C. monogyna* var. *lasiocarpa*, sample 13. *C. monogyna* var. *monogynyna.*

Table 3. FID results of seed fatty acid components of hawthorn taxa

Tablica 3. Rezultati plameno-ionizacijskog detektora za komponente masnih kiselina u sjemenkama taksona gloga

Fatty Acids / *Masne kiseline*		Fatty Acid Components / *Komponente masnih kiselina %*												
General Name *Opći naziv*	Short Formula / *Kratka formula*	1	2	3	4	5	6	7	8	9	10	11	12	13
Palmitic	16:0	4,96	7,37	7,62	7,37	7,43	7,18	7,36	7,40	8,16	7,4	9,40	5,61	6,76
Palmitoleic	16:1	0,07	0,17	0,19	0,18	0,07	0,15	0,19	0,19	0,18	0,07	0,12	0,07	0,13
Stearic	18:0	2,25	2,41	1,70	1,7	2,27	2,41	2,36	2,41	2,45	1,93	1,81	1,43	1,91
Oleic	18:1	25,36	30,82	32,46	34,93	36,18	31,00	29,32	30,11	31,28	31,57	24,36	39,36	33,48
Linoleic	18:2	64,23	56,81	53,09	52,15	52,00	56,11	56,99	57,11	54,51	55,26	61,78	50,53	52,51
γ linolenic	18:3	1,54	1,17	1,59	1,52	1,06	1,07	1,18	1,12	1,47	1,49	1,30	1,26	1,47
Eicosenoic	20:1	0,44	0,43	1,44	0,53	0,32	0,43	0,46	0,38	0,31	1,01	0,37	0,40	0,45
Tricosanoic	23:0	0,56	0,44	0,20	0,85	0,05	0,42	0,39	0,39	0,15	0,25	0,39	0,89	0,64
docosadienoic	22:2	0,35	0,14	0,27	0,36	0,09	0,25	0,14	0,28	0,15	0,11	0,26	0,25	0,29
nervonic	24:1	0,18	0,06	0,53	0,20	0,11	0,17	0,52	0,19	0,06	0,09	0,14	0,15	0,17
Total		99,59	99,82	99,09	99,79	98,61	99,19	98,91	99,58	98,72	99,09	99,93	99,95	97,81

Seed fatty acids results Sample 1. *C. pentagyna* subsp. *pentagyna*, sample 2. *C. orientalis* subsp. *orientalis*, sample 3. *C. orientalis* subsp. *orientalis*, sample 4. *C. orientalis* subsp. *orientalis,* sample 5. *C. orientalis* subsp. *orientalis,* sample 6. *C. orientalis* subsp. *orientalis,* sample 7. *C. orientalis* subsp. *szovitsii,* sample 8.*C. tanacetifolia*, sample 9.*C. tanacetifolia*, sample 10. *C. azarolus* var. *aronia*, sample 11. *C. azarolus* var. *aronia,* sample 12. *C. monogyna* var. *lasiocarpa*, sample 13.*C. monogyna* var. *monogyna* species

to determine seed fatty acid amount and composition by injecting the samples to the device. Hexane was used to obtain fixed oil by cold extraction (Nimal Ratnayake et. al., 2006). After 24 hours, pure oil was separated from hexane using rotary evaporator and fixed oil was extracted. Pure cellulose from the extracted fixed oil was exposed to cold extraction in hexane by mixing approximately 15 g sample placed in cartridge at certain intervals for 24 hours. Then, hexane was removed from rotary evaporator, thus leaving oil extracts. 100 µL of the extract was kept in derivatizing agent containing 0.5% sodium methoxide (80:20 (methanol: isooctane) at room temperature for 24 hours (25c). 1 mL isooctane was added and mixed at vortex device (AOCS, 2005). The supernatant was let to separate. 1 µL of supernatant was injected to GC- FID. Chromatogram evaluation was determined according to supelco 37-fame mixture (fatty acid mixture) standard retention time.

RESULTS
REZULTATI

Volatile components and contents of *C. pentagyna* Waldst. & Kit. ex Willd. subsp. *pentagyna, C. orientalis* Pall. ex M. Bieb. subsp. *orientalis, C. orientalis* Pall. ex M.Bieb. subsp. *szovitsii* (Pojark.) K.I.Chr, *Crataegus tanacetifolia* (Lam.) Pers., *Crataegus azarolus* L. var. *aronia, Crataegus monogyna* Jacq. var. *lasiocarpa* (Lange) K.I.Christ, *Crataegus monogyna* Jacq. var. *monogyna* taxa

that are naturally distributed in Western Anatolia were determined by SPME (Solid-Phase Microextraction method). Results of volatile components are presented in Table 2

Seed fatty acid components of hawthorn taxa were determined in GC-FID analyses. The results for these samples are presented in Table 3.

DISCUSSION AND CONCLUSION
RASPRAVA I ZAKLJUČAK

A total of 81 components were determined in volatile oils of leaves and flowers of 7 *Crataegus* taxa collected from different localities. Major components are Benzaldehyde, butyraldehyde, 2-hexenal (82.54%, 38.27% and 21.67% respectively). The high content of Benzaldehyde, butyraldehyde, 2-hexenal and hexanol were determined in volatile oils of *C. orientalis* subsp. *orientalis* samples collected from different localities.

Kovaleva et al., (2009) analyzed chemical composition of volatile oils extracted from the flowers of *C. jackii*, *C. robesoniana*ve *C. flabellata*. Researchers determined main components of *C. robesoniana* as phthalate (15.62%), squalene (13.08%), tricosane (11.11%), main components of *C. flabellata* as tricosane (19.21%), heneicosane (12.59%), nonacosane (11.22%) and main volatile components of *C. jackii* as tricosane (17.88%), and phthalate (13.38%) heneicosene-1 (12.53%). This indicates that different components can be determined in different taxa.

Fruit seed samples of 7 *Crataegus* taxa were analyzed and 10 fatty acid components belonging to each taxon were determined. Linoleic (18.2%), oleic (18.1%) and palmitic (16.0%) acid components were the main acids present. Linoleic acid, which was found at the highest ratio (64.23%) was determined from *C. pentagyna* subsp. *pentagyna* sample collected from Taşköprü locality.

Barros et al., (2010) analyzed fatty acid composition of flower and fruits of *C. monogyna* Jacq. and determined the highest content of linoleic acid in unripe fruits (58.5%); ripe fruits (17.53%), flower buds (15.64%), flowers (14.17%) over ripened fruits (13.12%). The researchers reported that the fatty acid component with the second highest content was tricosanoic acid, which was determined in flower buds (36.95%), flowers (33.67%), unripe fruits (8.18%), ripened fruits (32.77%) and over unripened fruits (30.40%). γ linoiec acid was reported to be the 3rd fatty acid with the highest content, which was determined in flower buds (26.79%), flowers (29.51%), unripe fruits (5.98%), ripened fruits (7.41%), and over ripened fruits (15.65%). The high content of palmitic acid respectively in over ripened fruits (15.52%), ripened fruits (13.73%), flowers (11.23%), flower buds (11.02%), and unripe fruits (10.61%).

Hawthorn fruits have a wide field of use in its distribution areas and thus around the world. Hawthorn, which has a significant role in food industry, is directly consumed as fruit. Furthermore, due to chemicals such as fatty acid, sterols etc. in its fruit, a review of the literature has shown that hawthorn has antioxidant, antiviral, antifungal and anti-inflammatory effects (Bahorun et al.,1994; Shahat et al., 1998; Orhan et al., 2007; Ahumada et al., 1997). This study directly concentrated on seeds of hawthorn, which is consumed as food, after removal of flesh section. Thus, fatty acid compositions of fruit seeds, which are considered as waste after consumption of fruits, were identified and amounts of fatty acids were determined in terms of chemical use. The fatty acid with the highest procentage in all samples was found to be linoleic acid. Furthermore, other fatty acids were determined at significant amounts.

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Sažetak

Cilj ovoga rada je određivanje kemijskih svojstava svojti *Crataegus pentagyna* podvrste *pentagyna*, *C. orientalis* podvrste *orientalis*, *C. orientalis* podvrste *szovitsii*, *C. tanacetifolia*, *C. azarolus* var. *aronia*, *C. monogyna* var. *lasiocarpa*, *C. monogyna* var. *monogyna* prirodno rasprostranjenih u Zapadnoj Anatoliji. Uzorci lista i cvijeta prikupljenih 2010. – 2014. u provincijama Zapadne Anatolije Izmit, Sakarya, Balıkesir, Izmir, Kütahya, Muğla i Isparta, kako bi se odredile hlapljive komponente, osušeni su na sobnoj temperaturi. Hlapljive komponente, dobivene metodom mikroekstrakcije u krutoj fazi (SPME) u središnjem laboratoriju Sveučilišta Süleyman Demirel, određeni su uređajem puni naziv. Ukupno je utvrđena 81 hlapljiva komponenta iz 7 taksona gloga. Od hlapljivih komponenta ulja, koje su otkrivene u najvećim omjerima, pronađene su komponente benzaldehida (82,54%), butiraldehida (38,27%) i (E)2-heksenala (21,67%).

Određena je i vlažnost sjemenki uzoraka gloga, sakupljenih u uzorkovanim područjima tijekom perioda sazrijevanja. Određen je i sastav masnih kiselina pomoću uređaja GC-FID, koristeći se standardnom mješavinom masnih kiselina. Vlažnost sjemenki gloga varirala je između 14,49% – 36,33%. Identificirano je 10 sastava masnih kiselina iz 7 taksona gloga, od čega je najviše linoleinske kiseline (64,23%), oleinske kiseline (39,36%) i palmitinske kiseline (8,16%).

KLJUČNE RIJEČI: *Crataegus*, hlapljive komponente, benzaldehid, linoleinska kiselina, Zapadna Anatolija, Turska