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Original article

Leaf fatty acid composition of some Lamiaceae taxa from Turkey

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Summary. Fatty acids composition leaves of *Satureja hortensis* L., *Satureja boissieri* Hausskn ex Boiss., *Thymus kotschyanus* Boiss.& Hohen. var. *glabrescens* Boiss., *Thymus kotschyanus* Boiss. & Hohen. var. *kotschyanus, Thymus hausknechtii* Velen., *Thymus pubescens* Boiss. & Kotschy ex Čelak var. *pubescens*, *Thymus fallax* Fisch & Mey, *Origanum vulgare* L. subsp. *gracile* and *Origanum acutidens* L., were analyzed by gas chromatography. The fatty acid composition of plants used to this study showed different saturated and unsaturated fatty acid concentrations. The main fatty acids found were Palmitic acid methyl ester (13.49-27.71%), Linoleic acid methyl ester (10.85-19.47%), and Linolenic acid methyl ester (40.68-56.53%); while other fatty acids were found in minor proportions. As a result, all taxa had the highest total unsaturated fatty acid amounts (39.05-73.19%) and the lowest total saturated fatty acid amounts (19.43-51.12%). The highest unsaturated fatty acid determined in *Satureja hortensis* (73.19%), the lowest to *Thymus hausknechtii* (39.05%). In this study, palmitic acid methyl ester was found the major saturated fatty acids in all studied taxa.

Key words: fatty acid, *Satureja, Origanum, Thymus*

Introduction

Turkey is regarded as an important gene-center for the family Lamiaceae; most aromatic and medicinal plants belonging to the family Lamiaceae, are used as herbal tea and ethnobotany in Turkey (1). Many plant taxa of Lamiaceae are aromatic and often used as herbs, spices, folk medicines and a source of fragrance and most of the species have great importance due to their economic values; this family is represented about 258 genera and 3500 species in the world (2); and it is represented by 46 genera and 571 species of which 44.2% are endemic, and with subspecies, varieties and hybrids altogether 763 taxa exists in Flora of Turkey (3-5). Medicinal and aromatic plants are believed to be an important source of new chemical substances with potential therapeutic activities (6).

Aerial parts of *Satureja* L. (Lamiaceae) species have distinctive tastes; can be added to stuffing, meat, pies and sausages as a seasoning and also used as a condiment and herbal tea, owing to its stimulating, tonic and carminative effect (7). Most aromatic plants like *Satureja*, *Origanum*, *Thymus*, etc., taxa are used as herbal tea in Turkey (1). Many *Satureja* species are used as flavoring agents or for medicinal purposes and various biological activities such as antibacterial and antifungal (8), antioxidant (9), analgesic and anti-inflammatory (10), antispasmodic and antidiarrhoea (11), antidiabetic and reproduction-stimulatory activities (12), treatments of cardiovascular diseases and thrombosis, muscle pain, intestinal and stomach disorders (13). Also in Turkey folk medicine, some *Satureja* species are used to treat various diseases such as antispasmodic, cold and flu (14), menstural, abdominal pains (15) and have rich essential oil contents (14). The genus *Thymus* L. belonging to the Lamiaceae family includes about 350 species, existing mainly in Europe, Western Asia and the Mediterranean regions (16). *Thymus* is represented in Turkey by 39 species and 59 taxa, and the ratio of endemism in the genus is 53%

(17). The oils of *Thymus* taxa are widely used as an antiseptic agent in many pharmaceutical preparations and as a flavouring agent for many kinds of food products and rich essential oil content (18, 19). *Origanum vulgare* L., (Lamiaceae), is an erect, perennial, aromatic plant of 20-80 cm height. It is distributed and cultivated mainly in the Mediterranean region and also in many areas of mild temperate climates of Europe, Asia, North Africa, and America (20). Despite its economic significance, *Origanum* taxa are often referred to as an under-utilized, in the sense genetic resources and variability, and potential usage that need to be, fully researched (21). Oregano essential oils have antibacterial, antioxidant, antifungal, carminative, diaphoretic, antispasmodic, antifungal, antimicrobial analgesic effects and rich essential oil contents (22, 23).

There are some researches seed oil of Lamiaceae and Fabaceae taxa in the literature (24-27); but information on the leaf fatty acid composition of *Satureja, Thymus* and *Origanum* are scanty in the literature. In this study saturated and unsaturated leaf fatty acid composition of studied taxa were detected. Unsaturated fatty acids (UFA) function as major nutrients, constituents of cell membranes and precursors of various signal molecules; and they are important in both the medical and, as they are involved in the human inflammatory response, blood-pressure regulation, cholesterol metabolism and brain development (28, 29). Epidemiologic prospective cohort studies have suggested that replacing saturated fatty acids with carbohydrates is modestly associated with a higher risk of ischemic heart disease, whereas replacing SFAs with polyunsaturated fatty acids is associated with a lower risk of ischemic heart disease (30).

The objective of the present study is to determine leaf fatty acid contents of *Satureja hortensis*, *Satureja boissieri*, *Thymus kotschyanus* var. *glabrescens*, *Thymus kotschyanus* var. *kotschyanus, Thymus hausknechtii*, *Thymus pubescens* var. *pubescens*, *Thymus fallax, Origanum vulgare* subsp. *gracile* and *Origanum acutidens.*

Material and Methods

Plant samples

S. hortensis was collected vicinity of Bingol airport, on June 2016. *S. boissieri* was collected from North of Haserek mountain slopes (Bingol) on July 2016. *O. acutidens* was collected from Topalan village road, right edges (Bingol) on May 2016. *T. kotschyanus* var. *glabrescens* was collected from east of Dikme village, steppe, (Bingol) on May 2016. *T. kotschyanus* var. *kotschyanus* was collected from vicinity of Haserek ski center (Bingol), stony areas, on July 2016. *T. hausknechtii* was collected from vicinity of Aslankasi village (Keban-Elazig), stony areas, on June 2015. *T. pectinatus* was collected from vicinity of Levent valley (Malatya), steppe areas, on June 2015. *T. fallax* was collected from Erzincan, Kemaliye Kadik district, steppe, stony areas, on July 2016. *O. vulgare* subsp. *gracile* was collected from 5 km to Asagikoy village, moistly areas, on June 2016. Plant materials were identified with Flora of Turkey with volume 7 (3). The voucher specimens were deposited in Faculty of Agriculture, University of Bingol.

Oil extraction and preparation of fatty acid methyl esters (FAME)

Impurities were removed from the seeds and the cleaned seeds were ground. Lipids were extracted with hexane/isopropanol (2 v/v) (31). The lipid extracts were centrifuged at 10.0 g for 5 min and filtered. The solvent was a rotary evaporator at 40°C.

Capillary GLC

Fatty acids in the lipid extracts were converted into methyl esters by means of 2% sulphuric acid (v/v) in methanol (32). The fatty acid methyl esters were extracted with *n*-hexane. Then the methyl esters were separated and quantified by gas chromatography and flame ionization detection (Schmiadzu GC, 17 Ver.3) coupled to a glass GC 10 software computing recorder. Chromatography was performed a capillary column (25 m in length and 0.25 mm in diameter, Permabound 25, Machery-Nagel, Germany) using nitrogen as carrier gas (flow rate 0.8 mL/min) the temperatures of the column, detector and injector valve were 130-220, 240-280 °C, respectively. Identification of the individual method was performed by frequent comparison with authentic standards mixtures that were analyzed under the same conditions.

Results and Discussion

The leaf fatty acid composition of studied aromatic and medicinal plants showed different saturated and unsaturated fatty acid concentrations. The main components in the leaf oils of studied taxa are seen in Table 1. All studied taxa were rich by palmitic acid methyl ester; linoleic acid methyl ester and linolenic acid methyl ester, except for no content linoleic acid methyl ester in *Origanum acutidens*. It is noteworthy that, *Thymus hausknechtii* and *Thymus pubescens* var. *pubescens* were rich in view of behenic acid methyl ester (18.55%, 12.39%, respectively), but not other species (Table 1). Palmitic acid methyl ester was found as main saturated fatty acid components in all studied samples; linoleic acid methyl ester and linolenic acid methyl ester was found as main unsaturated fatty acid components (Table 1). The aerial parts of *Thymus capitatus* were analyzed for their fatty acids concentrations and fifteen fatty acids were identified, accounting for 95.0% of the lipid content; two major fatty acids, α-linolenic (29.6%) and linoleic (15.1%), were found in abundance (27). In our research, linoleic acid and linolenic acid also were found in abundance (Table 1). There are literature reports of insecticidal activity of linoleic acid and oleic acid against *Aedesae gyptii* larvae (33). Additional health benefits of studied *Satureja, Thymus* and *Origanum* taxa may be achieved from due to the presence of flavonoids and polyterpenoids,

Table 1. Leaf fatty acid composition of Some Lamiaceae Taxa From Turkey (%)

Studied Taxa	12:0	14:0	15:0	15:1	16:0	16:1	17:0	18:0	18:1	18:2	18:3	20:0	22:0	TSFA	TUSFA	Total Identified
Satureja hortensis	--	0.51	--	--	17.95	1.69	--	--	--	14.97	56.53	0.97	--	19.43	73.19	92.62
Satureja boissieri	--	--	--	--	22.94	--	--	--	2.50	10.85	52.89	--	--	22.94	66.24	89.18
Thymus kotschyanus var. *glabrescens*	--	--	--	--	21.47	--	--	1.80	2.53	13.53	53.46	--	--	21.47	71.32	92.79
Thymus kotschyanus var. *kotschyanus*	--	0.47	0.59	--	21.50	0.41	0.47	2.30	2.68	16.98	44.59	1.33	--	26.66	64.66	91.32
Thymus hausknechtii	--	0.23	0.17	--	27.71	0.37	--	1.26	3.71	12.50	46.77	3.20	18.55	51.12	39.05	90.17
Thymus pubescens var. *pubescens*	--	0.36	0.27	--	13.49	0.36	--	1.67	7.51	10.88	40.68	2.79	12.39	30.97	59.43	90.40
Thymus fallax	0.05	0.42	0.15	--	21.88	0.30	0.26	3.91	--	19.47	42.91	1.18	--	27.85	62.68	90.53
Origanum vulgare subsp. *gracile*	--	0.52	0.21	0.10	15.17	1.70	0.27	3.39	--	15.73	52.94	0.66	--	20.22	70.47	90.69
Origanum acutidens	0.14	1.46	0.26	0.18	21.00	0.32	0.39	3.99	8.29	--	55.41	1.61	--	28.85	63.20	92.05

Lauric acid methyl ester (C12:0); Myristic acid methyl ester (C14:0); Pentadecanoic acid methyl ester (C15:0); Cis-10- Pentadecanoic acid methyl ester (C15:1); Palmitic acid methyl ester (C16:0); Palmitoleic acid methyl ester (C16:1); Heptadecanoic acid methyl ester (C17:0); Stearic acid methyl ester (C18:0); Oleic acid methyl ester (C18:1); Linoleic acid methyl ester (C18:2); Linolenic acid methyl ester (C18:3); Arachidic acid methyl ester (C20:0); Behenic acid methyl ester (C22:0).

Table 2. Other chemical components in studied taxa

Studied Taxa	Caryophyllene	Naphthalene	Phenol	Azulene
Satureja hortensis	2.26	1.95	2.99	--
Satureja boissieri	4.12	2.60	--	4.17
Thymus kotschyanus var. *glabrescens*	1.91	0.95	--	--
Thymus kotschyanus var. *kotschyanus*	3.84	1.06	--	--
Thymus hausknechtii	3.35	0.60	--	--
Thymus pubescens var. *pubescens*	2.01	1.63	--	--
Thymus fallax	4.75	--	2.54	--
Origanum vulgare subsp. *gracile*	3.61	1.24	--	--
Origanum acutidens	2.53	--	1.44	--

which demonstrated anti-inflammatory, antifungal, and antioxidant properties (34), and the essential fatty acids linolenic and linoleic acids implicated in human health promotion (35).

It is noteworthy that, behenic acid methyl ester was found to be only in *Thymus hausknechtii* and *Thymus pubescens* var. *pubescens.* In addition, also it is noteworthy that linoleic acid methyl ester was not determined only in *Origanum acutidens* (Table 1).Total saturated fatty acid of studied species were between 19.43% and 51.12%. *Satureja hortensis* has the lowest level of total saturated acid and *Thymus hausknechtii* the highest amount of total saturated fatty acid concentrations. Total unsaturated fatty acids of studied species were between 39.05% and 73.19%. *Thymus hausknechtii* has the lowest level of total unsaturated acid and *Satureja hortensis* the highest amount of total unsaturated fatty acid concentrations. Other seconder metabolites of studied taxa are seen in Table 2. Secondary metabolites, especially fatty acids and essential oils have chemotaxonomic importance in the some genus patterns in Lamiaceae and apparently act as defense against herbivores, microbes, viruses or competing plants and as signal compounds to attract pollinating and etc.; in addition many species of Lamiaceae family are aromatic and often used as herb species, folk medicines and fragrances (36). Studied taxa manufactured many similar constituents in their fatty acid composition that could be verified by the same ecological conditions of their habitat; but also differences were detected that could ecological needs and conditions to evaluate if the pedoclimatic circumstances could affect the fatty acid composition cause chemical convergence and approve their taxonomic separation.

In conclusion, the oil contents of studied Lamiaceae taxa belonging to the *Satureja, Thymus* and *Origanum* genuses, showed quantitative differences. The results revealed that the leaf oils of studied taxa studied with a substantial amount of very long chain fatty acids might have attracted attention because of their value of nutritional, industrial and renewable resources. In this study, studied taxa synthesized many similar compounds in their fatty acids that could be justified by the similar ecological conditions of their habitat. However, taking into account the differences referred to some constituents, also the taxonomic distance of these species could be confirmed by our chemical data. The comparison between studied taxa evidenced a similarity, at least with reference to the presence of the main fatty acid constituents. Work described in this paper showed that genetic and environmental factors both play a role in determining the composition of fatty acids of the studied taxa. Furthermore findings showed that the genus *Satureja, Origanum* and *Thymus* had some minor variations in fatty acid composition and this study demonstrates the occurrence of the palmitic acid, linoleic acid and linolenic acid chemotypes of studied taxa.

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