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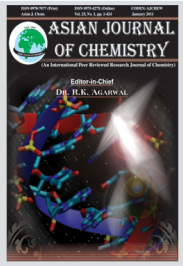

Herbal Tea Fatty Acid Contents of Some Medicinal Plants Grown in Konya, Turkey

ERAY TULUKCU

Technical Vocational School of Higher Education, Program of Medical Aromatic Plants, Selcuk University, 42500 Konya, Turkey

Corresponding author: Fax: +90 332 4473425; Tel: +90 332 4475621; E-mail: eraytulukcu@selcuk.edu.tr

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In this study, 6 medicinal plants were generally used as herbal tea in Turkey. The medicinal plants are *Hyssopus officinalis*, *Lavandula officinalis*, *Mentha piperita*, *Salvia sclareae* L., *Foeniculum vulgare* Mill and *Thymus vulgaris*, respectively. The fatty acid compositions of medicinal plants were determined using gas chromatography (GC). 30 different fatty acids were determinated in the compositions of medicinal plants. At the end of experiment, the lowest total poly unsaturated fatty acid (PUFA) level was found in *Hyssopus officinalis*, the highest level was found in *Lavandula officinalis*. Oleic acid was identified as the major mono unsaturated fatty acid MUFA (4.8-35.61 % of total MUFAs). It was shown that the C 18:1 fatty acid played an important role on (MUFA) of *Foeniculum vulgare* Mill. Generally, linoleic acid and linolenic acid were the most abundant PUFA.

Key Words: Medicinal plants, Cultivation, Fatty acid composition, ω-3 Fatty acid.

INTRODUCTION

People have to drink water to sustain their lives. Water can be taken natural sources, fruits and vegetables and those juices and from a variety of herbal tea. Especially in our society tea and coffee cultures are developed. There is 9000 species plant in Turkey and thus it has an important position in the world. The interests in herbal teas are increasing[1].

There are many types of herb consumed as traditional tea in Turkey. Some beneficial effects of these herbal teas such as antimicrobial, antioxidant, antiviral, anticonvulsant, antiulcer, antithrombin, anticancer/antitumor, antidepressant, cholesterol lowering and wound healing had been determined in various studies[2]. Some medicinal plants are using generally herbal tea in Turkey.

Salvia sclarea (Clary sage) is commonly known as 'misk ada cayi' in Turkey. It is widely cultivated for extractive purposes in France, Bulgaria, USA and former USSR. The oil of flowering spikes and leaves are used as a sedative and for treatment of stomach ache, constipation and to reduce sweating. Antifungal activity of Clary sage has also been reported. Among the major components of the oil, linalool is known for its antibacterial activity[3].

Foeniculum vulgare Mill. plant is known as fennel, belonging to Family *Apiaceae* or *Umbelliferae*. Fennel is a strong aromatic perennial shrublet up to 200 cm high, with feathery leaves and golden yellow flowers. It is native to North Africa, Mediterranean region, southern Europe and Asia. Volatile oil is obtained by steam distillation of the crushed ripe fruits, reported that the used essential oil from fennel seed and plant has flavoring, cosmetic and pharmaceutical uses astomachic, tonic, carminative, antispasmodic, diuretic[4].

Hyssopus officinalis L. plant is known as Hyssop, belonging to Family *Lamiaceae*. Hyssop is a strong aromatic perennial shrublet up to 100 cm high, bright leaves and generaly blue sometimes pink flowers. It is native to small Asia, Mediterranean region and southern Europe Volatile oil is obtained by steam distillation of the crushed leaves, reported that the used essential oil from Hyssop flowers and flowering branches has flavouring, cosmetic and pharmaceutical uses alcoholic and non-alcoholic beverage industry[5].

Lavandula officinalis plant is known as lavender, belonging to Family *Lamiaceae*. lavender is a strong aromatic perennial plant up to 100 cm high, with feathery leaves and gray blue, blue coloured flowers. It is native to southern Europe and Mediterranean region. Volatile oil is obtained by steam distillation of the crushed leaves, reported that the used essential oil from lavender flowers and flowering branches has flavouring, cosmetic, perfumery and pharmaceutical uses soap, chewing gum, candy and tea making[6].

Mentha piperita plant is known as mint, belonging to Family *Lamiaceae*. Mint is a strong aromatic perennial plant up to 40-70 cm high, with feathery leaves and lilac coloured flowers. It is native to center of Europe, south Europe and Asia. Volatile oil is obtained by steam distillation of the crushed leaves, reported that the used essential oil from Mint leaves and flowering branches has flavoring, cosmetic and pharmaceutical uses soap, toothpaste, food industry[7].

Thymus vulgaris plant is known as thyme, belonging to Family *Lamiaceae*. In Turkey, "thyme" is defined as belonging to the *Lamiaceae* family, although many aromatic plant species especially the essential oil containing thymol carvacrol and is regarded as a"species"of thyme. Among these species *Thymus*, *Origanum*, *Thymbra*, *Satureja* and *Coridothymus* genus are distribution as well as large and economically important. Thyme is a strong aromatic generally perennial plant up to 30-50 cm high, with feathery leaves and small white coloured flowers. It is native to small Asia, Mediterranean region southern Eurpea and America. Volatile oil is obtained by steam distillation of the crushed leaves, reported that the used essential oil from thyme leaves and flowering branches has flavoring, thyme oil and thyme juice uses spices and antimicrobial activity[8]. The fatty acid composition of medicinal plants are listed in Table-1.

There are a large number of chemicals in the plant structure. Fatty acids are the main components of plants. The synthesis of DHA from linolenic acid (LNA) is even more restricted than that of EPA. It is generally assumed that linoleic acid (LA) reduces EPA synthesis because of the competition between LNA and LA for the common desaturation and elongation enzymes[9]. The conversion of dietary LNA into EPA is limited because the efficacy of the synthesis of ω-3 PUFAs decreases down the LNA conversion cascade[10]. DHAs and EPAs are essential for the development of foetal brain[11] and play very important roles in physiology, especially during foetal and infant growth, in particular in the formation of the central nervous system and retina[12].

Due to the imbalanced ω-6/ω-3 PUFA ratio of the western diet today, dietary saturated FA and ω-6 PUFA are promoters of chronic diseases, such as arteriosclerosis, essential hypertension, obesity, diabetes and possibly some forms of cancers[13]. Johansen *et al.*[14] reported that supplementation with ω-3 fatty acids significantly decreased hemostatic markers of atherosclerosis. Several scientific studies have shown that ω-3 fatty acids have benefits for lowering CHD risk. It has been also suggested that ω-3/ω-6 ratio of 10 or less results in reduction in fatal CHD risk[15]. Thus, PUFAs, especially the longer chain ω-3 and ω-6 PUFAs, have been considered essential fatty acids and have been shown to have curative, fat glycemic control[16]. Similarly, Citil *et al.*[17], found that the fatty acid composition of some feed raw materials were at around.

TABLE-1
FATTY ACID COMPOSITIONS OF MEDICINE PLANTS

Fatty acids	*Hyssopus officinalis*	*Lavandula officinalis* L.	*Mentha piperita*	*Salvia sclareae*	*Foeniculum vulgare* Mill	*Thymus vulgaris*
C 8:0	0.02	0.00	0.00	0.14	0.01	0.00
C 9:0	0.00	0.00	0.00	0.62	0.11	0.00
C 10:0	0.12	0.00	1.20	0.00	0.00	0.00
C 12:0	0.05	0.01	0.30	0.12	0.13	0.00
C 13:0	0.02	0.01	1.70	0.16	0.00	0.00
C 14:0	1.92	0.90	3.60	4.32	0.75	0.10
C 15:0	1.15	0.24	1.00	0.84	0.29	0.02
C 16:0	27.99	4.80	24.50	13.99	5.26	23.30
C 17:0	1.12	0.81	0.80	0.95	0.22	0.70
C 18:0	12.48	1.50	20.01	8.69	2.47	4.10
C 20:0	0.22	0.10	1.00	0.00	0.22	2.20
C 21:0	0.34	0.02	0.02	0.10	1.19	0.02
C 22:0	0.01	0.00	0.01	0.04	0.03	0.60
Σ SFA	**45.44**	**8.39**	**54.14**	**29.97**	**10.68**	**31.05**
C 14:1	0.04	0.12	0.32	0.44	0.02	0.01
C 15:1	0.03	0.00	0.03	0.00	0.01	0.01
C 16:1	3.73	0.10	3.90	1.81	0.89	2.80
C 17:1	0.11	0.04	0.00	0.00	0.01	0.00
C 18:1	35.61	13.60	4.80	12.19	72.12	8.20
C 20:1	0.00	0.40	0.00	0.00	0.00	0.00
C 22:1	0.02	0.00	0.00	0.01	0.03	0.00
Σ MUFA	**39.54**	**14.26**	**9.05**	**14.45**	**73.08**	**11.02**
C 18:2	11.20	12.09	7.30	8.64	13.99	13.50
C 18:3	0.21	65.22	29.50	42.07	0.49	44.42
C 20:2	3.55	0.04	0.01	0.00	0.00	0.00
C 20:3	0.03	0.00	0.00	0.00	0.00	0.01
C 20:5	0.00	0.00	0.00	0.96	0.77	0.00
C 22:2	0.03	0.00	0.00	1.07	0.99	0.00
C 22:3	0.00	0.00	0.00	1.18	0.00	0.00
C 22:4	0.00	0.00	0.01	1.11	0.00	0.00
C 22:5	0.00	0.00	0.00	0.11	0.00	0.00
C 22:6	0.00	0.00	0.00	0.44	0.00	0.00
Σ PUFA	**15.02**	**77.35**	**36.82**	**55.58**	**16.24**	**57.93**
ω3	0.24	65.22	29.50	44.76	1.26	44.43
ω6	14.78	12.13	7.32	10.82	14.98	13.50
ω3/ω6	0.02	5.38	4.03	4.14	0.08	3.29
SFA/PUFA	3.03	0.11	1.47	0.54	0.66	0.54

**SFA: Saturated fatty acid. MUFA: Mono unsaturated fatty acid. PUFA: Poly unsaturated fatty acid. UFA: Unsaturated fatty acid.

Nettleton[18] reported positive effects from the intake of MUFA, such as oleic acid and of ω-3 fatty acid on health, with reduced triglyceride concentration in blood. In recent years, the lipid composition of chicken egg has been an area of primary consumer concern, due to the connection between specific dietary lipids and the development of coronary heart disease and some forms of cancer[19]. The objective of the present study was to compare the nutritionally important fatty acid compositions between medicinal plants. The levels of ω-3/ω-6 ratios and poly unsaturated fatty acid, mono unsaturated fatty acid were compared among the fatty acid composition of medicinal plants which some drinking obtained from harvested.

EXPERIMENTAL

The tested medicinal plants were cultivated in Cumra county of Konya province located in central Anatolia, Turkey with a 300 mm rainfall about 80 % of which is received from November to July and 1040 m altitude. The town of Cumra is located at between 33-34 north altitude and 37-38 east longitude with a surface area of 2320 km^2. Cumra is where the first irrigation projects (Konya Plain Project) were applied. The study area is about 47 km from the center of Konya. The Toros Mountains start 20 km away from the South of Cumra[20].

A representative soil sample (0-30 cm) was taken before planting to determine some properties. Levels of particle size distribution were 10.27 kg/da P_2O_5, 2.58 % organic matter and 14.64 % $CaCO_3$. The experimental region soil is clay loam and pH was 7.5 and EC was 0.12 %.

The perennial plants (*Salvia sclarea*, *Hyssopus officinalis* L, *Mentha piperita*, *Lavandula officinalis*) which are 4 years old leaf samples were cut in June. The other annual samples (*Foeniculum vulgare*, *Thymus vulgaris*) were taken by cutting at a height of 10 cm above the soil level, cleaned with water, dried in a shaded area and powdered. All the reagents were analytical grade and used without further purification.

Sample collection: For the determination of fatty acid composition, six medicinal plants were selected and analyzed after harvested experimental plot. The medicinal plants from each sample were separeted and held in packing (in N_2 atmosphere) at -18 ºC. At the beginning of each analysis, the samples were allowed to achieve at room temperature and homogenized.

Fatty acid analysis: Total lipid was extracted from the plants samples by the method[21]. 4 g samples of plants were homogenized with 80 mL of a 2:1 (v/v) mixture of chloroform-methanol, after which 4 mL 0.88 % NaCl was added; the liquid was mixed and left to stand for 2 h to allow phase separation. The chloroform-methanol extract was evaporated to dryness in a water bath at 50 ºC under N_2 flow. The lipid extracts were then converted to fatty acid methyl esters by using boron-trifluoride-methylation solution (catalogue No. 3-3021). The fatty acid methyl esters (FAMEs) were separated and analyzed by gas chromatograph (GC), equipped with dual flame ionisation detector and a 1.8 m × 3 mm internal diameter packed glass column containing 100/120 Chromosorb WAW coated with 10 % SP 2330. The injector and detector temperatures were 225 and 245 ºC, respectively. Column temperature program was 190 ºC for 35 min then increasing at 30 ºC/min up to 220 ºC where it was maintained for 5 min. Nitrogen at a flow rate of 20 mL/min was used as the carrier gas. Conditions were chosen to separate fatty acids of carbon chain length 8-22. The fatty acids were identified by comparison of retention times with known external standard mixtures, quantified by a Shimadzu Class-VP software and the results expressed as percentage distribution of fatty acid methyl esters. All the chemicals used for the gas chromatography analysis procedure were obtained from Supelco Inc. (Bellefonte, PA, USA).

RESULTS AND DISCUSSION

Medicinal plants contain around 5-9 % of lipids. The fatty acid profiles of the medicinal plants were different region types. The total lipid content determined in the medicinal plants throughout the different fatty acit sources. Similarly, Kara *et al*.[3] found that lipid content of *Salvia sclareae* was at a level (9.42 %).

Thirty fatty acids in leaves lipids of medicinal plants were identified and evaluated. The fatty acid composition of the various oil sources used in the experiment are given in Table-1. In this study, all fatty acids were identified. The results of this experiment showed medicinal plants fatty acid content were different. There were significantly different medicinal plants fatty acid contents.

The major effects of these fatty acid compositions of medicine plants were observed for C16:0, C18:0, C18:1 n9, C18:2 n6, C18:3 ω3, respectively. In general, the total contents of C16:0, C18:0, C18:1, C18:2, C18:3 fatty acids accounted for close to 90 % of the total fatty acids[22].

Oleic acid was identified MUFA in the medicine plants for all plants (4.8-72.12 %). Oleic acid was predominant fatty acid in *Foeniculum vulgare* Mill., of medicine plants. In the experiment of Cosge *et al*.[23], oleic acid was the major fatty acid of *Foeniculum vulgare* Mill. Stearic acid was the predominant fatty acid in *Mentha piperita* most abundant saturated fatty acid (54.14 %) in the present study.

Poly unsaturated fatty acid content in *Salvia sclareae* have been reported to be 53.41 %[3]. In this work, the PUFA contents were generally much higer than SFA in *Lavandula officinalis*, *Salvia sclareae*, *Thymus*, 77.35, 55.58, 16.24 and 57.93 %, respectively. Saturated fatty acid contents of medicine plants were higher than MUFA in *Hyssopus officinalis*, *Mentha piperita*, *Salvia sclareae* L., *Thymus*, 45.44, 54.14, 29.97 and 31.05 %, respectively. In, a high of C 18:3 (0.21 %) and C 20:3 (0.03 %) increased the ω-3 content and a low level of linoleic acid lowered the PUFA contents of *Hyssopus officinalis*.

In this research, the amount of stearic acid which can be determined in *Hyssopus officinalis*, *Lavandula officinalis*, *Mentha piperita*, *Salvia sclareae* L., *Foeniculum vulgare* Mill, *Thymus* is less than the amount of palmitic acid by these medicine plants. Linolenic acid is higher than the oleic acid in *Lavandula officinalis*, *Mentha piperita*, *Salvia sclareae* L. and *Thymus*. Similarly, Ghfir *et al*.[24] found that palmitic acid is higher than the oleic acid in *Hyssopus officinalis*.

The long chain ω-3 and ω-6 fatty acids commonly called PUFAs and their ratios are also (ω-3/ω-6) considered to be important[25]. In the present study, the ω-3/ω-6 ratios were 0.02,

5.38, 4.03, 4.14, 0.08 and 3.29 % in *Hyssopus officinalis*, *Lavandula officinalis*, *Mentha piperita*, *Salvia sclareae* L., *Foeniculum vulgare* Mill, *Thymus*, respectively. Dyerberg[26] noted that an increase in the ratio of ω-3/ω-6 PUFA increases the availability of ω-3 PUFAs, which are beneficial for human health. ω-6 content was higher than ω-3 content in all egg yolks. Unsaturated fatty acids constituted a significant component 64.59-68.23 % in all egg yolks. With a high ratio of UFAs, the crop is desirable for human nutrition[27].

In the report of HMSO[28], it was suggested that the minimum ratio of PUFA/SFA was 0.45. Kara *et al*.[3] reported that this ratio of *Salvia sclareae* was 1.88. In this study, this ratio in *Hyssopus officinalis* was found to be around 0.33.

The results of this experiment showed that medicinal plants are important role on fatty acid composition. The amounts of all fatty acids were affected by different growth conditions. In this experiment, the fatty acid composition of the medicinal plants is different. That is, it is possible to say that changing of fatty acid composition of medicinal plants. For example, while the lowest total saturated fatty acid level was found in *Lavandula officinali*s, the highest level was found in *Mentha piperita*.

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