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Fatty Acid Composition, Vitamin A, and Vitamin E Content of *Sphaerophysa kotschyana*

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ABSTRACT
Sphaerophysa kotschyana, which is endemic to Central Anatolia, is included in the list of plants that must be absolute protected by the Bern Convention. *S. kotschyana* is important in terms of functional compounds because of being resistant to salty soil conditions. In this study, fatty acid components, vitamin A and vitamin E content were analysed in leaf and fruit of *S. kotschyana*. Vitamin A content was found to be 16.8 mg/kg DW herba and 15.85 mg/kg DW fruit. Vitamin E content in the herba was observed to be 84.1 mg/kg DW and in the fruit 70.6 mg/kg DW. The main component fatty acids were determined as linoleic acid (72.41%) and palmitic acid (18.20%) in fruit and; oleic acid (59.12%) and stearic acid (13.42%) in the herba.

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ÖZET
İç Anadolu'ya özgü olan *Sphaerophysa kotschyana*, Bern Sözleşmesi ile mutlak korunması gereken bitkiler listesine dahil edilmiştir. *S. kotschyana* tuzlu toprak şartlarına dayanıklı olmasından dolayı fonksiyonel bileşikler açısından önem arz etmektedir. Bu çalışmada, *S. kotschyana* bitkisinden elde edilen ekstrelerden yağ asidi bileşenleri, A vitamini ve E vitamini içeriği değerlendirildi. A vitamini içeriği yaprak-gövde de 16.8 mg / kg kuru bitki ve meyvede 15.85 mg / kg kuru bitki olarak bulunmuştur. Yaprak-gövdede ki E vitamini içeriğinin 84.1 mg / kg kuru bitki ve meyvede 70.6 mg / kg kuru bitki olduğu gözlendi. Ana bileşen yağ asitleri meyvede linoleik asit (% 72.41) ve palmitik asit (% 18.20); yaprak-gövdede ise oleik asit (% 59.12) ve stearik asit (% 13.42) olarak belirlenmiştir.

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INTRODUCTION

The genus *Sphaerophysa* DC. from Fabaceae represents two species in the world. These are *Sphaerophysa kotschyana* Boiss. and *Sphaerophysa salsula* DC.(Polhill, 1981) *S. kotschyana* is endemic to Central Anatolia, while *S. salsula* grows in China, Russia, Azerbaijan, Iran and Syria. *S. kotschyana* species is included in the list of plants in the absolute protection of the Bern Convention (Trouwborst, 2014. Hamza and Aksoy, 2009; Yildiztugay et al., 2013). *S. salsula*, which is used in herbal medicine in Chinese traditional medicine, is used in the treatment of some diseases such as nephritis, hypertension, chronic hepatitis and angioneurotic oedema (Lin et al., 2009; Ma et al., 2004). However, ethnobotanical use of *Sphaerophysa kotschyana* species has not been reported in the literature and there is no public use. These plants are endemic to Central Anatolia, Turkey. In this context, chemical content analysis of this plant is important.

In a properly functioning metabolism, the mitochondrial cytochrome system protects the organelles in the cytosol from the harmful effects of oxidants. In cases where this system is inadequate, natural enzymes are activated. Oxidants, which cannot be neutralized by enzymes, initiate lipid peroxidation by affecting lipids in the first cell membrane. Lipid peroxidation is the metabolize of the polyunsaturated fatty acids (PUFA) found in membranes by the free oxygen radicals to various products such as peroxides, alcohols and aldehydes. The resulting bioactive aldehydes cause cell damage (Benzer and Temizer, 2003; Gökpınar et al., 2006). The essential fatty acids are not synthesised by mammalian cells. These fatty acids are defined as ω6 and ω3 fatty acids. The ω6 and ω3 fatty acids that

should be in the human diet are linoleic (18: 2 n 6) and linolenic (18:3 n 3) acids. Prostaglandins, thromboxane and leukotrienes that are involved in the regulation of vital functions are derived from linoleic acid in the cell (Innis, 1991).

α-tocopherol, the most effective form of vitamin E, suppresses fatty acid oxidation by donating the hydrogen atom in the phenolic hydroxyl group to the lipid-derived peroxy group. This effect is achieved by protecting the unsaturated fatty acids of membrane lipids from the peroxy group and preventing lipid peroxidation. Consequently, α-tocopherol reacts with the lipid peroxy group to form the α-tocopherol group.

The high resistance of this group results in the chain reaction stopping the oxygen. The alpha-tocopheroxyl group is then reacted with glucuronic acid and excreted with bile (Burton, 1990; Yarsan, 2014).

Carotenoids, the precursor of vitamin A, antioxidant activities by participating in free radical reactions reduce the rate of formation of harmful hydrogen peroxides. Therefore, they show anticarcinogenic properties (Van et al., 2000; Di Mascio et al., 1991).

According to our literature research, we did not find any studies on fatty acid composition and fat soluble vitamins of *S. kotschyana* plant. Therefore, in this work, we aim to study the fatty acid components and vitamin A-vitamin E content. The subject of this study will be the first record on this plant and new information will be provided to the literature.

MATERIALS and METHODS

Plant Material

The plant materials were collected in Konya region during the fruit period in July 2012. *S. kotschyana* was collected C4 Konya, Cihanbeyli, Yavşan Tuzlası, 4290336N, 36511649E, July 2012, 950 m, identified by Prof. Dr. Murad Aydın Şanda. (Collect Number: Şanda 2350).

Extraction for fatty acid, vitamin A and vitamin E

Dried and powdered herba and fruit were taken one gram measured into 5 g capped glass tubes then extracted with 10 mL hexane-methylene chloride mixture (6:4). It was vortexed and left in the ultrasonic bath for 2 hours and then the solvent was evaporated. After removal of solvent, approximately 500 mg of oil was obtained. This extracted oil was used for the analysis of both fatty acids and vitamins.

Experimental procedures for vitamin analysis

Vitamin A and Vitamin E were analysed by high performance liquid chromatography (HPLC) with direct injection of 20 µL of filtrated (0.22 µm) ethanol extracted samples. Analysis of Vitamin A and Vitamin E was executed using Shimadzu HPLC, LC 20AT pump, CTO-20AC Column Oven and SPD-M20A detector. 100% methanol was used as the mobile phase and the flow rate was determined as 1 mL / min and the column temperature was set at 50 °C. Detector wavelength; 295 nm for vitamin E and 450 nm for vitamin A, respectively.

General experimental procedures

Fatty acid analyses were determined by a gas chromatography equipped with a flame ionization detector (FID) (Perkin-Elmer Clarus 500). The fatty acid methyl esters were obtained by transmethylation. BPX-5 was used as a capillary column (30 m × 0.25 mm, 0.25 um i.d.). The temperature of injection was steady and FID was performed at 250 ºC. Helium was used as the carrier gas at a rate of 1.0 ml/min. The oven temperature was 50 ºC at the beginning then was raised to 220 ºC with a rate of 8 ºC/min. Each peak area was calculated based on the FID data used the authentic standards (Supelco Company, Fatty acid Mix).

RESULTS and DISCUSSION

Vitamin A and vitamin E content of herba and fruit part of *S. kotschyana* were determined by HPLC. Vitamin A values were found close to each other (Table 1). Vitamin E values were higher in the herba than in the fruit.

Table 1. Amount of vitamin A and E of *S. kotschyana*
Çizelge 1. S. kotschyana'nın A ve E vitamini miktarı

	Vitamin A (mg/kg DW)	Vitamin E(mg/kg DW)
Herba (*Yaprak-Gövde*)	16.8	84.1
Fruit *(Meyve)*	15.85	70.6

When the fatty acids in the fruit of *S. kotschyana* were examined, the highest percentage of linoleic acid (72.41), palmitic acid (18.20), stearic acid (4.74) and oleic acid (1.39) were observed (Table 2). While the results obtained for herba are examined, it is seen that linoleic acid (59.12%), stearic acid (13.42%), myristic acid (8.35%) and lauric acid (7.32%) were determined. *S. kotschyana* plant compared to some of the fatty acids in olive oil, palmitic and linoleic acid were found to be higher in the fruit of *S. kotschyana*. When the palmitic acid was 18.20% in *S. kotschyana*, in the olive oil was found to be 14.69%. Furthermore linoleic acid was found to be 72.41% in the fruit of *S. kotschyana* plant, while linoleic acid was 12.82% in olive oil.

While the saturated fatty acid in the fruit was 25.08%, the total of unsaturated fatty acids was 74.93% were determined (Table 3). The ratio of unsaturated fatty acids/saturated fatty acids (UFAs / SFAs) ratios was obtained as high as 3 and polyunsaturated fatty acids (PUFA) were calculated as 73.32.

Table 2. Fatty acid composition of *S. kotschyana*
Çizelge 2. S. kotschyana'nın yağ asidi bileşenleri

Number of Carbon *Karbon Sayısı*	Fatty Acids *Yağ Asitleri*	Amount of Fatty Acids (%) (*Yağ asidi Miktarı(%)*)	
		Fruit (*Meyve*)	Herba (*Yaprak-Gövde*)
C12:0	Lauric Acid	0.18	7.32
C14:0	Myristic Acid	0.75	8.35
C16:0	Palmitic Acid	18.20	ND
C16:1	Palmitoleic Acid	0.22	0.61
C17:0	Heptadecanoic Acid	0.25	2.73
C18:0	Stearic acid	4.74	13.42
C18:1n9c	Oleic Acid	1.39	1.59
C18:2n6c	Linoleic Acid	72.41	59.12
C18:3n3	α-Linolenic Acid	0.88	0.44
C21:0	Hexanoic Acid	0.38	2.29
C24:0	Lignoceric Acid	0.58	3.34
C22:6n3	Docosahexaenoic Acid	0.03	0.79

When the fatty acid components of the herba were examined, the ratio of saturated fatty acids was 37.45, unsaturated fatty acids were 62.55 and the ratio of unsaturated fatty acids/saturated fatty acids (UFAs / SFAs) ratios was 1.7.

Table 3. Saturated and unsaturated fatty acid ratios of *S. kotschyana*
Çizelge 3. S. kotschyana'nın doymuş ve doymamış yağ asidi oranları

Parameters	*Sphaerophysa kotschyana*	
	Fruit (*Meyve*)	Herba (*Yaprak-Gövde*)
SFAs (%)	25.08	37.45
UFAs (%)	74.93	62.55
MUFAs (%)	1.61	2.2
PUFA (%)	73.32	60.35
PUFAs / MUFAs	45.54	27.43
UFAs / SFAs	3	1.7

CONCLUSION

Our results demonstrated that fruit and leave of *S. kotschyana* sustained the highest amount of USFA especially PUFA. Thus, it seems to be the most appropriate candidate to be used as industrial area especially cosmetics and phytotherapy. *S. kotschyana* is considerable to be a material usable for the cosmetic industry of the plant both in terms of its fat-soluble vitamins and fatty acid profiles. However, further research is needed on the effects of this plant for human health.

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Statement of Conflict of Interest

Authors have declared no conflict of interest.

Author's Contributions

The contribution of the authors is equal.

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