

## FATTY ACID COMPOSITION OF THE SEEDS OF SOME *Vicia* SPECIES

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The Fabaceae (Leguminosae) is a family of flowering plants comprising about 269 genera and 5100 species and is one of the largest plant families in the world and also in Turkey. It comprises 68 genera and more than 900 species in the Flora of Turkey [1]. The *Vicia* genera include around 190 species located mainly in the Mediterranean region. *Vicia* genera, as other legumes, may grow under drought stress conditions and on poor soils due to their capacity to fix atmospheric nitrogen [2]. Legume plants include many economically important crop plants that are utilized in human foodstuffs, herbal medicines, oil materials, and as animal forages [3]. The use of the *Vicia* species as grain legumes requires an understanding of their nutritive value and the potential toxicity of the grain of the different species to the various types of livestock (fish, poultry, pigeons, pigs, horses, cattle, sheep, goats) and humans [4].

Studies on the oil contents and fatty acid compositions of *Vicia* species are very scant in Turkey [5–7]. The fatty acid composition of plants showed different saturated and unsaturated fatty acid concentrations. Linolenic, oleic, palmitic, and linoleic acids were found as the abundant compounds. The seeds are rich in unusual fatty acids and protein [8].

The objective of the present study was to determine the fatty acid contents of the seeds of seven *Vicia* species growing wild in Turkey and to characterize the seed fatty acids used by animals in the field, to establish their nutritional value, and to study their contribution to renewable resources of fatty acid and other chemical patterns in these crops.

The seed oils of *Vicia* species contain palmitic (13.49–20.64%) and stearic (3.08–5.23%) acids as the major component fatty acids, among the saturated acids, with small amounts of myristic (0.15–0.42%), pentadecanoic (0.10–0.26%), margaric (0.13–0.23%), arachidic (0.23–0.87%), and behenic (0.14–0.25%) acids. The major unsaturated fatty acids found in the seed oils were oleic (8.98–26.06%), linoleic (52.17–76.58%), and linolenic (4.05–12.01%) acids. Palmitoleic and eicosenoic acids were shown to be lower than 1%. In this study, the total saturated fatty acids of *Vicia* species were between 17.39 and 25.12%, while the amounts of total unsaturated fatty acids were between 74.88 and 82.61%.

Saturated acid components of the seed oils revealed that low molecular weight acids (myristic, pentadecanoic, and margaric acids) commonly occur in all the investigated species. Palmitic and stearic acids were the major saturated fatty acids in the seed oils. The amounts of unsaturated fatty acids were higher than those of saturated fatty acids, but the amounts of palmitoleic and eicosenoic acids were shown to be lower than 1%.

Myristic acid and pentadecanoic acid were detected in all species but found at the highest level in *V. hybrida* L. (0.29 and 0.26%, respectively). Palmitic acid was detected in all species, and margaric acid was detected in six species but found at the highest level in *V. sativa* subsp. *nigra* (20.64 and 0.23%, respectively). The amounts of stearic acid and arachidic acid were higher in *V. sativa* subsp. *sativa* (5.23, 0.87%, respectively) than in other species. Behenic acid was detected in three species: 0.25% in *V. grandiflora*, 0.14% in *V. pannocia*, and 0.14% in *V. sativa* subsp. *sativa* (Table 1).

The major unsaturated acids in the seed oils of all species were oleic, linoleic, and linolenic acids. The oleic acid content was highest level in *V. narbonensis* (26.06%) but lowest in *V. peregrina* (8.98%) and *V. sativa* subsp. *sativa* (11.51%). The seed oils of all the species were richer in linoleic than linolenic acid. Linoleic acid was found in the greatest proportion in the seed oil. The linoleic acid content was highest in *V. hybrida* (76.58%), *V. pannonica* (75.06%), and *V. peregrina* (63.06%) but lowest in *V. narbonensis* (52.17%). Linolenic acid was also detected at low level in *V. narbonensis* (4.05%).

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TABLE 1. Fatty-acid Composition of Some *Vicia* Species from Turkey, %

Species	14:0	15:0	16:0	16:1	17:0	18:0	18:1	18:2	18:3	20:0	20:1	22:0	TSFA	TUSFA
<i>V. narbonensis</i>	0.15	0.10	13.63	–	–	3.08	26.06	52.17	4.05	0.43	0.32	–	17.39	82.61
<i>V. hybrida</i>	0.29	0.26	13.49	0.14	0.19	4.43	–	76.58	4.38	0.23	–	–	18.90	81.10
<i>V. sativa</i> subsp. <i>nigra</i>	0.19	0.22	20.64	–	0.23	3.41	–	62.87	12.01	0.42	–	–	25.12	74.88
<i>V. sativa</i> subsp. <i>sativa</i>	0.18	0.12	17.09	–	0.13	5.23	11.51	54.20	10.33	0.87	0.19	0.14	23.77	76.23
<i>V. pannonica</i>	0.27	0.12	13.91	0.15	0.15	3.09	–	75.06	6.40	0.41	0.29	0.14	18.10	81.90
<i>V. peregrina</i>	0.18	0.20	13.99	–	0.19	5.22	8.98	63.06	7.80	0.37	–	–	20.16	79.84
<i>V. grandiflora</i>	0.42	0.13	15.65	–	0.15	3.08	19.09	54.90	5.64	0.43	0.27	0.25	20.10	79.90

TSFA: total saturated fatty acids, TUSFA: total unsaturated fatty acids.

The linolenic acid content was highest in *V. sativa* subsp. *nigra* (12.01%) and *V. sativa* subsp. *sativa* (10.33%). Palmitoleic acid was also detected in two species: 0.14% in *V. hybrida* and 0.15% in *V. pannonica*. Eicosenoic acid was detected in four species: 0.32% in *V. narbonensis*, 0.29% in *V. pannonica*, 0.27% in *V. grandiflora*, and 0.19% in *V. sativa* subsp. *sativa* (Table 1).

The total saturated fatty acids (TSFA) of the *Vicia* species were between 17.39 and 25.12%. *Vicia narbonensis* had the lowest level of saturated acid, and *V. sativa* subsp. *nigra* had the highest saturated fatty acid (SFA) concentration. The total unsaturated fatty acids (TUSFA) of the *Vicia* species were between 74.88 and 82.61%. *V. narbonensis* had the highest level of unsaturated fatty acid (82.61%), along with *V. pannonica* (81.90%), *V. hybrida* (81.10%), *V. grandiflora* (79.90%), *V. peregrina* (79.84%), *V. sativa* subsp. *sativa* (76.23%), and *V. sativa* subsp. *nigra* (74.88%) (Table 1).

The results revealed that the seed oils of the *Vicia* species studied with a substantial amount of very long chain fatty acids might have attracted attention because of their nutritional and industrial value, and as a renewable resource. Such a favorable composition of unsaturated fatty acids of *Vicia narbonensis*, *Vicia pannonica*, and *Vicia hybrida* suggests that these species might have potential as a new seed oil crop for the food industry if growth and yield can be improved. We found that these species, besides producing oil with the lowest saturated fatty acid contents, produce the highest concentration of unsaturated fatty acids.

**Seed Samples.** The *Vicia* species used in this study were *Vicia narbonensis* L., *Vicia hybrida* L., *Vicia sativa* L. subsp. *nigra* (L.) Ehrh., *Vicia sativa* L. subsp. *sativa* L., *Vicia pannonica* Crantz, *Vicia peregrina* L., and *Vicia grandiflora* Scop. Mature seeds of these species were collected from various locations in the Bingol Province of Turkey between June and August 2013.

**Oil Extraction and Preparation of Fatty Acid Methyl Esters (FAME).** Impurities were removed from the seeds, and the clean seeds were ground into powder using a ball mill. Lipids were extracted with hexane–isopropanol (2 v/v) [9]. The lipid extracts were centrifuged at 10.0 g for 5 min and filtered; then the solvent was removed on a rotary evaporator at 40°C.

**Capillary GLC.** Fatty acids in the lipid extracts were converted into methyl esters by means of 2% sulfuric acid (v/v) in methanol [10]. The fatty acid methyl esters were extracted with hexane. Then the methyl esters were separated and quantified by gas chromatography and flame ionization detection (Schimadzu GC, 17 Ver.3) coupled to a glass GC 10 software computing recorder. Chromatography was performed with 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 and 240–280°C, respectively. Identification of the individual method was performed by frequent comparison with authentic standard mixtures that were analyzed under the same conditions.

**Statistical Analysis.** The experimental design was a completely randomized design with three replications. Data were analyzed using the SAS packet program.

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