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FATTY ACID AND METAL COMPOSITION OF THE SEEDS OF *Vicia ervilia* VARIETIES FROM TURKEY

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Bitter vetch (*Vicia ervilia* L.) of the Fabaceae family is grown in Asiatic Turkey, central and northern Spain, and other countries of the Mediterranean region and western United States; the seed is exported to the United Kingdom and other countries for feed, especially for sheep. The antinutritional factors of the species of the genus *Vicia*, in addition to affecting the nutritional value of the grain, can cause pathological changes of varying extent in animals that consume them, especially birds. The seed is the part mainly used in this group of legumes, although they are also grown as green fodder or hay and play an important role as a green manure, which is dug in at the end of the winter to improve soil fertility. The straw of these legumes is of high nutritional value for livestock [1].

The objective of the present study was to determine the fatty acid (FA) and trace elements of the seeds of *Vicia ervilia* L. varieties. In addition, during the course of this study, our aim was to characterize seed fatty acids used by animals in the field, to establish the nutritional value, and to contribute to the renewable resources of FA and other chemical patterns in these crops.

The results of the fatty acid analysis are shown in Table 1, and of the trace elements, in Table 2. The fatty acid composition of some bitter vetch varieties used as feed crops showed different saturated and unsaturated fatty acid concentrations. The main components in the seed oils of the feed crops were linolenic, oleic, palmitic, myristic, stearic, and linoleic acids. Linoleic acid, undoubtedly, is one of the most important polyunsaturated fatty acids in human food because of its ability to prevent heart and vascular diseases [2]. The saturated acid components of the seed oils relieved that low-molecular weight acids (caproic, caprylic, capric, and lauric acids) commonly found in all the investigated varieties. The total saturated fatty acid (TSFA) concentrations of the feed crop oils studied were between 22.34 and 37.25%. On the other hand, the total unsaturated FA contents (TUSFA) of the seed oils were higher than the TSFA, between 62.75 and 75.22%. Linoleic, oleic, and linolenic acid components were reported as the main USFA components in *Vicia* [3], *Colutea*, *Gonocytisus*, *Lupinus*, *Vicia*, *Hedysarum*, *Onobrychis*, *Trigonella* [4], and *Astragalus* [5, 6] genera patterns and also in some other family patterns like Euphorbiaceae [7]. The high USFA contents in these seed crops have nutritional significance. As far as unsaturated fatty acid content is concerned, the present study is supported by previous reports [4, 6, 8–11] that suggest that the unsaturated FA contents of legume seed oils closely resemble each other and the abundant components are the linoleic–palmitic and/or oleic acids type FA [12].

The concentrations of the elements in the seeds are presented in Table 2. All data are averages of three measurements on each sample. The levels of metals were calculated on $\mu g \cdot g^{-1}$ dry weight. Eight elements (Cu, Mn, Mo, Na, Zn, Fe, Mg, and B) were detected in the crop seeds in different amounts. The contents of elements in the crop seeds were Cu 6.91–9.11, Mn 10.55–12.94, Zn 107.3–154.9, Fe 57.84–81.79, Mg 1014–1119, B 2.70–6.24, Mo 0.35–1.44, and Na 10.14–17.63 $\mu g \cdot g^{-1}$ (Table 2). The role of trace elements in human nutrition and disease cannot be overemphasized. Even though the mineral elements form a small proportion of the total composition of most plant materials and total body weight and do not contribute to the energy value of the food, they are of great physiological importance particularly in body metabolism [13]. It is of interest that the prevalent mineral element in the seeds is Mg, which is present in amounts of 1014–1119 $\mu g \cdot g^{-1}$ dry weight in all varieties (Table 2). The high quantity of potassium, magnesium, and calcium together with the quantity of sodium plus the content of the essential elements iron, manganese, zinc, and copper make excellent sources of bioelements [14]. It is recommended that these seeds be used in the preparation of diets of individuals with low levels of these mineral elements.

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TABLE 1. Fatty Acid Composition of *Vicia ervilia* Varieties, %

Fatty acid	IFVE-2801 Sel	IFVE-248 (103)	IFVE-2804 Sel	IFVE-2698 (105)	B4-5	B4-6	IFVE-2797 (107)	IFVE 2852 Sel	IFVE 2943 Sel	IFVE-2981 (110)
4:0	–	–	–	–	0.45	–	–	–	–	–
6:0	0.55	0.46	0.31	0.46	0.31	0.64	0.41	0.25	0.19	0.31
8:0	0.33	0.27	0.19	0.28	0.19	0.38	0.25	0.15	0.10	0.18
10:0	0.67	0.55	0.38	0.56	0.38	0.78	0.50	0.31	0.21	0.38
12:0	0.81	0.67	0.47	0.76	0.46	0.94	0.62	0.37	0.26	0.45
13:0	0.63	–	–	–	–	0.97	–	–	–	–
14:0	3.85	3.35	2.51	3.37	2.52	4.51	3.16	2.13	1.74	2.47
16:0	21.86	21.00	18.33	20.16	18.85	23.27	20.83	17.39	16.99	18.57
16:1	–	–	–	–	–	–	–	0.40	0.35	–
18:0	5.35	4.84	3.99	4.97	3.72	5.77	4.41	3.55	2.85	3.83
18:1	30.26	29.64	27.79	31.47	26.69	29.19	31.62	29.23	27.49	31.50
18:2	29.42	32.01	34.84	32.58	35.53	27.93	32.37	36.50	39.39	34.57
18:3	6.29	6.90	7.24	5.08	6.54	5.63	5.83	6.89	7.28	6.63
20:0	–	–	1.51	–	1.35	–	–	1.65	–	1.11
20:1	–	–	–	–	–	–	–	–	0.71	–
TSFA	34.05	31.14	27.69	30.56	28.23	37.25	30.18	25.80	22.34	27.30
TUSFA	65.95	68.55	69.87	69.13	68.76	62.75	69.82	73.02	75.22	72.70

TABLE 2. Trace Elements of *Vicia ervilia* Varieties (μg·g^{-1} dry weight)

Trace element	IFVE-2801 Sel	IFVE-248 (103)	IFVE-2804 Sel	IFVE-2698 (105)	B4-5	B4-6	IFVE-2797 (107)	IFVE-2852 Sel	IFVE-2943 Sel	IFVE-2981 (110)
B	5.11	4.51	5.21	4.93	4.22	3.86	2.70	6.24	3.39	3.29
Cu	8.26	7.75	8.10	8.27	6.91	8.16	9.11	8.17	8.02	8.08
Fe	75.5	62.3	72.92	66.02	57.84	73.98	81.79	64.11	63.07	67.25
Mg	1056	1119	1079	1028	1014	1118	1059	1072	1014	1038
Mn	11.43	11.61	12.22	12.01	10.55	12.53	11.53	12.74	12.94	11.90
Mo	0.73	1.44	0.35	0.79	0.73	0.49	0.82	0.65	0.73	0.61
Na	10.35	10.78	14.42	17.63	10.49	14.02	17.12	17.48	10.14	10.24
Zn	154.9	123.9	146.7	146.6	107.3	133.3	137.0	134.7	145.2	147.0

Metals are unique nutrients because of their important role in metabolism. They are an essential part of many important enzymes and also play roles of catalysts and antioxidants. Iron and copper, for example, are essential in blood formation, and copper is also involved in normal carbohydrate and lipid metabolism [15].

As a result, the seeds of *Vicia ervilia* L. varieties are rich in unsaturated fatty acids and some elements. The results were discussed in terms of nutrition, agricultural values, and phytochemicals. Legumes occupy an important place in human and animal nutrition. Legumes are rich in proteins and complex carbohydrates and are an important source of minerals and vitamins [16]. Grain legumes are potential sources of energy and micronutrients, but their use is still limited because of uncertainty with respect to the amount and effect of antinutritional factors they may contain [17].

Seed Samples. The *Vicia ervilia* L. varieties used in this study were IFVE 2801 Sel, IFVE-248 (103), IFVE 2804 Sel, IFVE-2698 (105), B4-5, B4-6, IFVE-2797 (107), IFVE 2852 Sel, IFVE 2943 Sel, and IFVE-2981 (110). The seeds used in this study were supplied by Cukurova Agricultural Research Institute and sown over experiemental fields of Erciyes University Agricultural Faculty. Harvested seeds were ground and sieved through 1 mm sieve, and analyses were performed on ground seeds.

Determination of Fatty Acid Composition of Oils. A 100-mg sample of the oil was saponified with 100 μL of 2 mol/L KOH, and 3 mL *n*-hexane was added to the mixture. The mixture was vigorously shaken with a vortex (Nuve NM 110, Turkey) for 1 min and then centrifuged at 2516 × g for 5 min at 25°C (Nuve, Ankara, Turkey). A 1-mL sample of the solution was put into GC vials, and injection was started immediately. A gas chromatography system (Agilent 6890, Arizona, USA) equipped with a flame ionization detector and an HP-88 column (100 m × 0.25 mm ID) was used. Injection block temperature was set at 250°C. The oven temperature was kept at 103°C for 1 min, then ramped up from 103°C to 170°C at 6.5°C/min, from 170°C to 215°C for 12 min at 2.75°C/min, and finally held at 230°C for 5 min. Helium was used as carrier gas with flow rate

2 mL/min and split ratio 1/50. Two replications were conducted for determining the fatty acid composition of the oil samples. Fatty acid compositions were expressed as % of total triglyceride.

Mineral Content Analysis. Plant samples went through a wet-ashing process with hydrogen peroxide (2:3) in three different steps (1st step at 145°C and 75% microwave power for 5 min, 2nd step at 80°C and 90% microwave power for 10 min, and 3rd step at 100°C and 40% microwave power for 10 min) in a wet-ashing unit (speedwave MWS-2 Berghof products + Instruments Harresstr.1. 72800 Enien Germany) resistant to 40 bar pressure [18a]. Then the P, K, Ca, Mg, Na, Fe, Mn, Zn and Cu, B, Si contents of the plant samples were determined using an ICP OES spectrometer (inductively couple plasma spectrophotometer, PerkinElmer, Optima 2100 DV, ICP/OES, Shelton, CT 06484-4794, USA) [18b].

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

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