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FATTY ACID AND METAL COMPOSITION OF THE SEEDS OF *Lathyrus sativus* VARIETIES

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Among the grain legumes from the Old World, we may single out two species of the genus *Lathyrus* (*L. sativus* L. and *L. cicera* L.), one species of the genus *Trigonella* (*T. foenum-graecum* L.), and three species of the genus *Vicia* (*V. ervilia* (L). Willd., *V. monanthos* (L). Desf. and *V. narbonensis* L.) on account of their current state of marginalization [1]. *Lathyrus* genus, which is in Leguminosea, is large, with 187 species and subspecies [2]. The main centers of diversity in the genus are around the Mediterranean region, Asia Minor, North America, and temperate region of South America [3, 4]. The widespread use of legumes makes this food group an important source of lipid and fatty acids in animal and human nutrition. Some publications dealing with the total lipid and fatty acid composition are reviewed by a few researchers [5–7]. Metal ions, metal complexes, and vitamins are materials that play an important role in vital functions of organisms [8].

The objective of the present study was to determine the fatty acid and trace elements of the seeds of *Lathyrus sativus* L. varieties. In addition, during the course of this study, we aimed to characterize the seed fatty acids used by animals in the field, to establish the nutritional value, and to make contributions as 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 the trace elements ara shown in Table 2. The fatty acid composition of some *Lathyrus* varieties used as feed crops from the Fabaceae family showed different saturated and unsaturated fatty acid concentrations. The total unsaturated fatty acids (TUSFA) of the studied *Lathyrus* varieties were found to be between 63.54 and 72.45%. Oleic acid (18:1) of these varieties ranged from 17.91 to 22.46%. Linoleic acid of these varieties ranged from 39.61 to 43.18%. A number of studies suggest that the unsaturated fatty acid component of Fabaceae seed oils resembles each other, and oleic and linoleic acid (18:3) were the main components in seed oil [9]. Oleic and linoleic acid are the principal component acids (about 65% of the total fatty acids). The percentages of these two acids are inversely correlated – some of the legume oils are rich in linoleic acid, whereas in others oleic acid is present in larger amounts [10]. Linolenic acid was also detected in the seed oil of *Lathyrus* varieties, but at very low levels in all of the patterns when compared with linoleic and oleic acid. For edible purposes, oil should have a minimal amount of linolenic acid since it is commonly thought to be the prime constituent responsible for reversion to undesirable flavors in stored oils and in food products containing vegetable oils [10]. Total saturated fatty acids (TSFA) of the studied *Lathyrus* varieties were found between 27.54 and 36.18%. In terms of the saturated acid components of the seed oils, palmitic acid was found abundant. These results were supported by other studies [11]. Saturated acid components of the seed oils revealed that the low-molecular-weight acids caproic (6:0), caprylic (8:0), and capric (10:0) acids commonly occur in all the investigated varieties. There is some evidence that the rarer fatty acids, like nonprotein amino acids, may be harmful to animals eating the seeds [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 μg/g dry weight. Eight elements (Cu, Mn, Mo, Na, Zn, Fe, Mg, and B) were detected in the crop seeds in different amounts. Magnesium is a critical structural component of the chlorophyll molecule and is necessary for the function of plant enzymes to produce carbohydrates, sugars, and fats. 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 allow the seeds to be considered as excellent sources of bioelements [12].

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TABLE 1. Fatty Acid Composition of *Lathyrus sativus* Varieties from Turkey

Fatty acid	IFLS 232 Sel 474	IFLS 417 Sel 515	IFLS 522 (103)	M1-18	IFLS 298 (109)	Gurbuz 2001	Komur	IFLS 274 (106)	Sel 678	M3-13
4:0	–	–	–	–	–	2.12	–	1.39	–	–
6:0	1.89	2.13	2.08	2.17	2.01	1.57	1.63	1.61	0.81	0.78
8:0	1.09	1.23	1.24	1.26	1.16	0.94	0.98	0.94	0.48	0.46
10:0	2.31	2.54	2.51	2.60	2.41	1.97	2.04	2.03	0.96	0.94
12:0	2.64	2.98	2.92	3.04	2.90	2.38	2.46	2.50	1.16	1.13
13:0	–	–	–	–	–	–	–	–	1.57	0.90
14:0	5.16	6.43	6.36	6.54	6.31	4.98	5.32	5.09	5.10	5.08
14:1	–	–	–	–	–	–	–	1.80	–	–
15:0	–	–	–	–	–	–	–	1.59	–	–
16:0	12.45	12.31	12.66	12.88	12.77	10.35	10.68	10.34	11.11	10.63
16:1	–	–	–	–	–	–	–	1.04	–	–
18:0	7.34	7.57	7.79	7.69	7.99	6.58	7.19	8.60	7.59	7.62
18:1	20.35	21.82	21.41	20.82	20.45	20.86	20.65	17.91	22.35	22.46
18:2	39.65	42.18	42.13	42.93	43.18	41.13	41.30	39.61	41.45	42.75
18:3	6.56	–	–	–	–	6.31	7.03	5.16	7.03	7.24
TSFA	32.88	35.19	35.56	36.18	35.55	30.89	30.30	34.09	28.78	27.54
TUSFA	66.56	64.00	63.54	63.75	63.63	68.30	68.98	65.52	70.83	72.45

TSFA: total saturated fatty acid; TUSFA: total unsaturated fatty acid.

TABLE 2. Trace Elements of *Lathyrus sativus* Varieties from Turkey (μg/g dry weight)

Trace element	IFLS 232 Sel 474	IFLS 417 Sel 515	IFLS 522 (103)	M1-18	IFLS 298 (109)	Gurbuz 2001	Komur	IFLS 274 (106)	Sel 678	M3-13
B	10.47	9.30	7.42	6.70	7.18	6.10	7.01	8.50	7.45	6.14
Cu	10.38	10.20	9.09	9.81	10.13	10.39	9.00	9.47	8.42	9.13
Fe	51.62	48.50	41.81	48.05	52.69	51.55	48.26	41.18	64.63	47.50
Mg	1352	1256	1244	1384	1258	1367	1361	1398	1207	1323
Mn	19.11	13.82	14.90	15.95	16.41	16.98	14.40	18.02	20.82	14.78
Mo	4.29	2.99	3.35	4.29	3.15	5.11	2.85	2.64	4.09	3.52
Na	136.6	146.7	134.4	132.9	136.5	137.8	114.6	89.5	94.5	129.7
Zn	134.1	148.1	124.9	148.2	136.3	149.7	145.9	138.6	121.1	133.4

Iron is necessary for many enzyme functions and as a catalyst for the synthesis of chlorophyll. Manganese is involved in enzyme activity for photosynthesis, respiration, and nitrogen metabolism [13]. Zinc is a component of enzymes or a functional cofactor of a large number of enzymes, including auxins (plant growth hormones). It is essential in carbohydrate metabolism, protein synthesis, and internodal elongation [14]. Copper is also concentrated in roots of plants and plays a part in nitrogen metabolism [15]. Legumes occupy an important place in human nutrition and also animal nutrition. Legumes are rich in proteins and complex carbohydrates and are an important source of minerals and vitamins [16].

Values obtained in this study may be useful in future diet formulations. It is evident that most of the grain legumes contain high levels of fiber, which may limit high inclusion levels of these sources, especially in diets for broilers. Anti-nutritional factors may also be a detrimental factor in the utilization of legume grains [17]. Oils rich in oleic and linoleic acids, according to Bailey [18], are the most adaptable of all oils and are excellent edible oils. These species might have potential as a new oilseed crop for the food industry if growth and yield can be improved.

Seed Samples. The *Lathyrus sativus* L. varieties used in this study were IFLS 232 Sel 474, IFLS 417 Sel 515, IFLS 522 (103), M1-18, IFLS 298 (109), Gurbuz 2001, Komur, IFLS 274 (106), Sel 678, and M3-13. The seeds used in this study were supplied by the Cukurova Agricultural Research Institute and sown over experimental fields of the Erciyes University Agricultural Faculty. Harvested seeds were ground and sieved through 1 mm sieves, and analyses were performed on ground seeds.

Determination of Fatty Acid Composition of Oils. The oil sample (100 mg) was saponified with 100 μL KOH (2 mol/L), 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). One milliliter 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 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 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 a flow rate of 2 mL/min and split ratio of 1:50. Two replications were conducted for determination of the fatty acid composition of the oil samples. Fatty acid compositions were expressed as % 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 [19]. Then the B, Cu, Fe, Mg, Mn, Mo, Na, and Zn contents of the plant samples were determined using an ICP OES spectrometer (PerkinElmer, Optima 2100 DV, ICP/OES, Shelton, CT 06484-4794, USA) [20].

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

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