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BRIEF COMMUNICATIONS

FATTY ACID COMPOSITION OF THE SEEDS OF *Vicia faba* var. *major* GENOTYPES FROM TURKEY

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Vicia faba var. *major* (broad bean) is an important member of edible pulses, and broad bean seeds are rich in proteins, fiber, and starch and sufficient in vitamins and minerals; thus, they are commonly used for nutritional purposes [1, 2]. They also contain a source of other health-improving smaller components and are thus used for health purposes [3]. Broad bean has been farmed in Iraq, Iran, Syria, Northwest India, Pakistan, South China, and Mediterranean Countries for thousands of years [4]. Broad bean-supplemented diets remarkably reduce plasma LDL-cholesterol levels [5].

Unsaturated fatty acids, especially ω3 and ω6 fatty acids, reduce the negative impact of saturated fatty acids and have positive effects on human health [6]. Fatty acids taken through daily diets may facilitate the risk of cancer, cardiovascular diseases, diabetes, and degenerative disorders [7]. Despite several studies conducted on the positive impacts of fatty acids of various plant species, such studies have not been conducted for some plant species yet [8]. Fatty acid quantities and compositions are largely influenced by plant genetics and environmental conditions [9]. Therefore, fatty acids should be assessed based on these factors. Some reports on fatty acid compositions of different *Vicia* species have been published by several researchers in Turkey [10–14].

The aim of this study was to compare the fatty acid composition of the seeds of 15 broad bean (*Vicia faba* var. *major* L.) genotypes grown in Turkey. The results are given in Table 1. Gas chromatographic analysis of the oil of broad beans revealed that the fatty acid content was composed of 10 different fatty acids. The carbon numbers of these fatty acids range from 14 to 23. The major fatty acids were linoleic, oleic, palmitic, and linolenic acids. Arachidonic acid was found to be at lower levels. The other fatty acids were also quantified below 1%.

While myristic acid (14:0) detected in the seeds of the broad bean genotypes varied between 0.36% and 0.59%, it was detected at a high rate (2.29%) only in the Luz De Otonoto variety. The myristic acid in seeds of broad bean genotypes was determined by [15] as 1.45% and by [16] as 0.31%. On the other hand, myristic acid was found by [17] as 0.2%, [18] as 2.6%, [19] as 2.53%, and [20] as 0.28% in *Vicia faba* var. *major*. The values found by researchers were different from our values. This is due to the different genotypes used in the research.

It was evident from our results that in the seed oil of the studied *V. faba* var. *major* genotypes, palmitic acid was the major saturated fatty acid. Palmitic acid was at the highest level in the Reina Mora (19.46%) variety and lowest level in the Eresen 87 (14.05%) variety. The findings we obtained on palmitic acid were similar to the values obtained by [15, 17], while it was higher than the values obtained by [16, 19] and lower than the values obtained by [18, 20].

Oleic acid ranged from 20.64% to 38.95%. The highest oleic acid was found in the Eresen 87 variety, while the lowest percentages of oleic acid were found in the Luz De Otonoto variety. While the lowest linoleic and linolenic acids were obtained in the Eresen 87 variety with 44.66% and 2.34%, respectively, the highest linoleic acid was obtained in the Seher genotype with 55.63%, and the highest linolenic acids was obtained in the Canakkale genotype with 5.94%.

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TABLE 1. Fatty Acid Composition of the Seeds of Some Broad Bean Genotypes

Genotype	14:0	15:0	16:0	18:1 (9)	18:2 (9,12)	18:3 (9,12,15)	20:0	20:2	22:0	23:0	ΣSFA	ΣUSFA
Emiralem	0.53	0.34	18.37	27.84	46.65	4.39	1.85	–	0.03	–	21.12	78.88
Histal	0.42	0.26	15.11	25.23	51.73	5.24	1.67	0.15	0.19	–	17.65	82.35
Sorgun	0.56	0.23	16.95	24.89	50.63	5.02	1.60	–	0.12	–	19.46	80.54
Kitik 2003	0.59	0.29	17.79	27.50	47.50	4.34	1.90	–	0.09	–	20.66	79.34
Sakiz	0.54	0.27	17.38	26.38	48.32	5.06	1.77	–	0.28	–	20.24	79.76
Eresen 87	–	–	14.05	38.95	44.66	2.34	–	–	–	–	14.05	85.95
Sevil	0.51	0.24	16.97	24.21	52.29	5.71	–	–	0.07	–	17.79	82.21
Reina Mora	–	–	19.46	28.25	48.12	4.17	–	–	–	–	19.46	80.54
Filiz 99	0.45	–	16.18	32.62	46.68	4.07	–	–	–	–	16.63	83.37
Salkim	0.53	0.33	17.42	27.14	49.12	5.46	–	–	–	–	18.28	81.72
Luz De Otonoto	2.29	–	18.45	20.64	52.71	5.91	–	–	–	–	20.74	79.26
Seher	0.36	0.28	15.71	22.40	55.63	5.50	–	–	–	0.12	16.47	83.53
EU4446	–	0.30	16.81	23.60	53.66	5.63	–	–	–	–	17.11	82.89
Canakkale	–	–	16.06	23.19	54.81	5.94	–	–	–	–	16.06	83.94
Antalya	0.44	0.31	16.69	24.99	52.24	5.33	–	–	–	–	17.44	82.56

14:0 – myristic acid, 15:0 – pentadecanoic acid, 16:0 – palmitic acid, 18:1 – oleic acid, 18:2 – linoleic acid, 18:3 – linolenic acid, 20:0 – arachidonic acid, 20:2 – eicosadienoic acid, 22:0 – behenic acid, 23:0 – tricosanoic acid. SFA: saturated fatty acids, USFA: unsaturated fatty acids.

These results show that the oleic, linoleic, and linolenic acids mean of the 15 genotypes in our study overlaps with the values determined by [15, 16, 19].

The total unsaturated fatty acid (TUSFA) of the studied broad bean genotypes was between 78.88 and 85.95% (Table 1). The highest TUSFA was found in the Eresen 87 variety, while the lowest percentage was found in the Emiralem variety. The total saturated fatty acid (TSFA) of the studied Eastern beech populations was between 14.05 and 21.12%. The Emiralem variety has the highest level of TSFA, and the lowest percentages of TSFA were found in the Eresen 87 variety. The total saturated and unsaturated fatty acid values we obtained from the seeds of broad bean genotypes were found to be similar to those in many previous studies [15, 18, 19].

Fatty acids consist of two categories, saturated and unsaturated fatty acids. The fatty acids palmitic acid (16:0), arachidonic acid (20:0), myristic acid (14:0), and pentadecanoic acid (15:0) in broad bean seeds are classified as saturated fatty acids. The most important of the unsaturated fatty acids in seeds are oleic acid (18:1), lineloic acid (18:2), and linolenic acid (18:3) fatty acids. Polyunsaturated fatty acids are known to reduce the amount of fatty acids in the blood, prevent thrombosis and vascular occlusion, and protect heart health [21]. Polyunsaturated fatty acids are one of the most important omega 9 fatty acids, and oleic acid is an essential fatty acid. Since it cannot be synthesized by the body, it must be taken from outside [22]. Oleic acid is known to lower HDL cholesterol and triglyceride levels [23]. It is known to have an effect on lowering high blood pressure [24]. It protects the lipoproteins and cell membrane in the cell against oxidative stress and ensures the durability of the cell [25]. It is known to reduce the risk of many cancers and reduce insulin levels [26]. It is known that there are 26.52% omega 9 and 50.32% omega 6 fatty acids in broad bean seeds. The seeds are beneficial for human health.

Collection of Seeds and Sample Preparation. Some of the broad bean seeds were obtained from seed companies and some from local farmers in Turkey. These seed samples were mixed well and then 5 g samples were weighed. Dried samples were then ground using a stainless steel mill to 1 mm particle size (Cole-Parmer Analytical Mill, USA) and made ready for chemical analyses.

Oil Extraction and Preparation of Fatty Acid Methyl Esters (FAME). One gram of seed material of broad bean genotypes was homogenized in 5 mL of hexane–isopropanol (3:2) with a magnetic stirrer for 1 h and kept in the refrigerator for one night. The upper part was removed and placed in a 50 mL glass cylinder by filtration. Non-fat impurities such as protein, carbohydrate, and amino sugars were removed by washing with 2.5 mL 5% NaCl. The lower layer was collected, and the total oil-containing chloroform phase was removed in a glass ball and evaporated under vacuum at 45°C on a rotary evaporator [27]. Fatty acid methyl esters were obtained according to the recommendation of Agilent Technologies with a minor modification of the method described by [28]. For this, the total oil contained in the glass ball of the rotary evaporator was dissolved by shaking with 10 mL of hexane for 1 or 2 min. After transferring the mixture to a 100 µL capped plastic bottle,

100 µL 2 N KOH in methanol was added and the whole vortexed for 30 s and centrifuged for 10 min at 4500 rpm. The resulting supernatant was transferred to a 1.5 mL vial and made ready for GC-MS analysis.

Capillary GLC. Analysis of individual fatty acid methyl esters was carried out on a gas chromatograph (Agilent Technologies 7890A GC/5975C MS) with a BPX90 SGE 054596 column (260°C, 100 m × 250 µm × 0.25 µm ID). The device began to read the fatty acids at 40°C, with a ramp rate of 4°C/min, until the temperature reached 150°C; the hold time at this temperature was 5 min. Then a ramp rate of 3°C/min was applied until the temperature 255°C; after a wait time of 10.5 min at this temperature, the reading process was terminated. The device was run in the splitless mode, and the injection volume was 1 µL. Nitrogen gas was used as carrier gas.

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