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Short Communication

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Fatty acid compositions of seeds of some proprietary safflower (*Carthamus tinctorius* L.) cultivars

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Abstract

Safflower, an important oil plant, has been cultivated for about 3000 years. Due to the fact that it is used as a raw material in many sectors, safflower has been examined in various studies. This study was carried out in the laboratories of the Department of Biosystem Engineering and the Central Laboratory Application and Research Center, Faculty of Agriculture, Bingol University between 2020 and 2021. In the study, the saturated fat contents of the seeds of four different registered safflower varieties (Balçı, Dinçer, Yektay, and Yenice) were determined. It was found that there were 19 different components in all safflower varieties. Oleic acid (20.03% to 34.41%) and Linoleic acid (39.79% to 53.70%) were found to be in the highest rates, and some fatty acids were detected in trace levels.

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Introduction

Safflower (*Carthamus tinctorius* L.), an annual herbaceous oil plant from the Asteraceae family, has an economic value (Koç and Günes, 2021; Culpan and Arslan, 2018; Baydar and Erbaş, 2020; Kammili and Yadav, 2022). It has many positive features such as the resistance to extreme climatic conditions (drought, low temperature, etc.) and the ability to benefit from plant nutrients in the soil thanks to its good root structure (Baydar and Erbaş, 2020; Wasson *et al.*, 2012; Geçit *et al.*, 2018; Ebrahimian *et al.*, 2019; Köse *et al.*, 2021). While it was first grown for its flowers, over time it began to be grown as an oil plant (Dajue and Mündel, 1996; Johnston *et al.*, 2002; Koutrobas *et al.*, 2021). Safflower seeds are reported to contain about 32-40% oil, 32-34% carbohydrates, 14-15% protein, 5-8% moisture, and 2-7% ash (Weiss, 2000; Çoşge *et al.*, 2007; Kalafat *et al.*, 2009). However, these values vary depending on the region and climate where the plant is grown (Kurt *et al.*, 2017).

Safflower is used as a raw material (food, medicine, animal feed, textile, paint, biodiesel) in many sectors due to its value as an oil plant (Yılmaz and Tunçtürk, 2018; Koç and Güneş, 2021). For this reason, many researches are carried out on safflower. In pharmacological studies, safflower is reported to have antioxidant, anti-coagulant, anti-hypertension, anti-tumor and immunosuppressant effects (Fan *et al.*, 2009; Yeloojeh *et al.*, 2020).

In this study, the unsaturated oil contents of the seeds of four different registered safflower cultivars were determined. The purpose of this study is to contribute to the future breeding studies and the efforts to increase the production possibilities for safflower in wider areas and to determine the appropriate tools, machines, and systems.

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Materials and methods

This study was carried out in the Department of Biosystem Engineering, Faculty of Agriculture, Bingol University between 2020 and 2021. Four registered safflower cultivars (Balçı, Dinçer, Yektay, Yenice) examined in the study were obtained from the Transitional Zone Agricultural Research

Institute, Ministry of Agriculture and Forestry, Republic of Turkey. Fatty acid analyzes of the plant materials were carried out at the Central Laboratory Application and Research Center, Bingol University.

For the analysis of safflower cultivars, 5-10 g samples of each cultivar were ground to 1 mm using a laboratory grind-

Table I. Saturated fatty acid compositions of the safflower cultivars (%)

No	Saturated Fat Content	Balçı	Dinçer	Yektay	Yenice
1	Lauric acid	0.00	0.00	0.01	0.00
2	Miristic acid	0.26	11.96	0.22	0.21
3	Pentadecanoic acid	0.00	0.02	0.04	0.02
4	Palmitic acid	12.46	9.89	11.18	9.33
5	Heptadecanoic acid	0.00	0.00	0.02	0.00
6	Stearic acid	0.76	1.29	0.35	0.88
7	Oleic acid	20.03	20.84	34.41	21.59
8	Linoleic acid	53.70	46.55	39.79	47.58
9	Linolenic acid	0.21	0.20	0.17	0.22
10	Arachidic acid	0.70	0.71	0.66	0.66
11	Gadoleic acid	0.42	0.29	0.58	0.36
12	Dihomo-linoleic acid	5.78	6.34	0.06	6.17
13	Heneicosanoic acid	0.02	0.01	0.01	0.00
14	Behenic acid	0.06	0.55	0.56	0.40
15	Erucic acid	0.00	0.96	0.80	0.00
16	Docosadienoic acid	0.00	0.02	0.01	0.00
17	Tricosylic acid	0.07	0.07	0.06	0.05
18	Lignoceric acid	0.21	0.31	0.34	0.28
19	Nervonic acid	0.35	0.00	0.51	0.23

er. The prepared samples were analyzed using the method reported by Hara and Radin (1978) after revising the oil extractions and fatty acid derivative. 5 ml of hexane/isopropanol (3:2) was added to 1 g samples taken from each safflower variety, and they were centrifuged at 4500 rpm for 10 minutes by vortexing. Then, the upper parts of the samples were taken and 2.5 ml of 2% methanolic sulfuric acid was added and vortexed. Then, the mixture was left for methylation at 50 °C for 15 hours. At the end of this period, the prepared tubes were cooled at room temperature and vortexed by adding 2.5 ml of 5% NaCl. Fatty acid methyl esters formed in the tubes were extracted with 2.5 ml of hexane. The hexane phase was removed from the upper part with a Pastor pipette, treated with 2.5 ml of 2% Na₂CO₃, and left for 1 hour to separate the phases. Then, the supernatant was taken and put into test tubes, and the mixture containing methyl esters was evaporated under nitrogen at 45°C. After this process, the fatty acids in the test tubes were dissolved with 1 ml of hexane, taken into vials, and analyzed in the GC-MS device. In the analysis of the volatile components of the proprietary safflower varieties, the GC-MS device [Agilent brand 7890A model GC, 5975C model MS together with FID detector (Column J&W 122-7061, 60m x 250µm x 0.15 µm)] was set to the following parameters: temperature, 250 °C; injection volume, 1µ L; and split 50:1 mode.

Column flow rate 1 mL (carrier gas helium) was used simultaneously. Chromatographic conditions during the analyses were as follows: Waiting for 2 minutes starting from 50 °C until reaching 200 °C at a speed of 20 °C/min and reaching 230 °C at a speed of 5 °C/min, and waiting here for 30 minutes. The total analysis time was 55.5 min. The MS results were determined by comparing with the Wiley and NIST libraries of the device (Kılıç and Kökten, 2020).

Results and discussion

As a result of the oil analysis of the seeds of four different safflower cultivars, it was found that each seed contained 19 different components. As seen in Table I; Oleic acid and Linoleic acid were found to be the most abundant components in all safflower varieties. The seeds of the variety Yektay were rich in oleic acid (34.41%) and those of the variety Balcı were rich in linoleic acid (53.70%). In addition, the seeds of the safflower varieties were found to have higher contents of Miristic acid, Palmitic acid, and Dihomo-linoleic acid compared to other oil contents. Kurt et al. (2017) identi-

fied the crude oil contents and fatty acid compositions of 36 safflower lines in order to contribute to the adaptation and selection researches on safflower lines.

Among the four safflower cultivars examined in the study, the cultivar Dinçer was found to have a significantly higher content of Miristic acid (11.96%) than the other cultivars. Palmitic acid contents of the safflower varieties were close to each other (9.33-12.46%); however, the variety Dinçer was found to have a lower content of Linolenic acid (0.02%) than the others. Similarly, the variety Yektay was found to have a lower content of Dihomo-linoleic acid (0.06%) than the others. All safflower cultivars were found to have similar contents of Lignoseric acid (0.21%-0.34%) (Table I).

In addition to oleic acid, linoleic acid, palmitic acid, 16 different components were identified in the safflower varieties. These contents may change depending on the factors such as irrigation, temperature, and the environmental conditions (climate, region). Therefore, the regional climatic factors have an effect on the oil compositions of the seeds. The data obtained on the seeds of the safflower cultivars examined in this study will contribute to increasing the study opportunities for this product, especially breeding and mechanization, and will help to increase the production opportunities in wider areas.

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Declaration of Competing Interest

The author declared no conflict of interests.

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