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BRIEF COMMUNICATIONS

DETERMINATION OF THE FATTY ACID COMPOSITION OF *Amygdalus scoparia* KERNELS FROM IRAN USING GAS CHROMATOGRAPHY-MASS SPECTROMETRY

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Amygdalus scoparia Spach is a medicinal plant from the Rosacea Juss. family [1], which mainly grows in mountain provinces in Iran such as Lorestan, Ilam, Kohgiluyeh and Boyer-Ahmad, and Khuzestan. Because of its medicinal properties, *A. scoparia* is used in these regions for gastric ulcer treatment and to prevent hair loss. The fruit of *A. scoparia* contains amygdalin, and it is used in many traditional medicines [2, 3].

In this study, we used gas chromatography coupled with mass spectrometry (GC-MS) to determine the fatty acid composition of oil from kernels of *A. scoparia* from three provinces in Iran. Several studies have used GC-MS to study the fatty acid compositions of medicinal plants [4–8].

For *A. scoparia* from Lorestan (Province I), Kohgiluyeh and Boyer-Ahmad (Province II), and Khuzestan (Province III), the quantities of extracted oil were 30.14, 31.25, and 29.36% w/w, respectively. Eight fatty acids were identified in the *A. scoparia* oils from the three samples. The oleic acid contents in the oil samples from the three provinces increased in the following order: Province III, 38.72%; Province I, 68.55; and Province II, 84.40%.

The sample from Province III had a high content of linoleic acid (Table 1). Balancing omega-3 and omega-6 fatty acids in the diet is important for health. The highest content of linoleic acid was found in the Province III sample (45.38%). The linoleic acid contents in the Province I and II samples were 7.50 and 0.20%, respectively. The omega-6 fatty acid linolelaidic acid was also found in the Province III sample (2.56%).

(*Z*)-11-Hexadecenoic acid is an omega-5 fatty acid, and was found in the Province I (6.57%) and II (0.83%) samples.

Three saturated fatty acids (SFAs), myristic acid, palmitic acid, and stearic acid, were found in the samples. It is recommended that dietary intake of SFAs be kept low because of their ability to increase serum cholesterol levels in humans [9]. However, the effect of stearic acid on cholesterol levels is thought to be neutral. The stearic acid content of the Province I sample was 1.89%, and it was not detected in the other two samples. Myristic acid was also only found in the Province III sample. The palmitic acid contents in the Province I and II samples were 6.16 and 10.0%, respectively.

The total contents of SFAs and unsaturated fatty acids (USFAs) are shown in Table 1. The lowest and highest contents of SFAs were found in the Province III and II samples, respectively. The USFAs contents did not vary much among the three samples. All samples had a high content of USFAs, which indicates that *A. scoparia* could be used as a source of good fats in the diet and in medicinal applications.

Essential USFAs, including omega-3 and omega-6 fatty acids, cannot be made in the body and must be consumed in the diet. The total contents of different omega fatty acids in *A. scoparia* are shown in Table 1. The highest content of omega-5 fatty acids was found in the Province I sample. The contents of omega-6 fatty acids in the Province I, II, and III samples were 7.50, 0.20, and 47.94%, respectively. The Province II sample had the highest content of omega-9 fatty acids. These results show that *A. scoparia* is a good source of essential fatty acids, including omega-5, omega-6, and omega-9.

Methanol, hexane, hydrochloric acid, and potassium hydroxide were purchased from Merck KGaA (Darmstadt, Germany).

Samples of *A. scoparia* fruit were collected from the mountainous regions of Provinces I, II, and III in the west of Iran.

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TABLE 1. Fatty Acid Contents (Mass Fraction, %) for Samples of *A. scoparia* from Three Provinces in Iran (n = 3)

Fatty acid	I	II	III
Myristic (14:0 ω6)	–	–	0.99 ± 0.2
Linolelaidic	–	–	2.56 ± 0.4
Oleic (18:1 ω9)	68.55 ± 0.7	84.40 ± 0.7	38.72 ± 0.8
Linoleic (18:2 ω6)	7.50 ± 0.4	0.20 ± 0.1	45.38 ± 0.8
Stearic (18:0)	1.89 ± 0.4	–	–
Z-11-Hexadecenoic (16:1 ω5)	6.57 ± 0.6	0.83 ± 0.1	–
Palmitic (16:0)	6.16 ± 0.3	10.00 ± 0.2	–
Z-7-Hexadecenoic (16:1 ω9)	–	0.19 ± 0.1	–
SFA	8.05 ± 0.2	10.00 ± 0.2	0.99 ± 0.2
USFA	82.62 ± 0.8	85.62 ± 0.5	86.66 ± 0.5
Omega-5	6.57 ± 0.6	0.83 ± 0.1	–
Omega-6	7.50 ± 0.4	0.20 ± 0.1	46.37 ± 0.6
Omega-9	68.55 ± 0.7	84.59 ± 0.7	38.72 ± 0.8

SFA: saturated fatty acid, USFA: unsaturated fatty acid.

The stones from the fruits were removed, and then dried in an oven at 37°C for 4 h. After drying, the stones were broken open to obtain the kernels. The kernels were kept dry overnight in an airtight container and stored at room temperature until required for extraction.

Oil Extraction and Methylation. Samples of the dried kernels (10 g) were ground to a powder using a mortar and pestle, transferred into a cellulose cartridge, and extracted in a 250 mL Schott Duran Soxhlet extractor (Germany) with 200 mL of hexane for 12 h. The solvent was evaporated on a rotatory evaporator at 40°C, and the residue was dissolved in 15 mL of hexane. Then, 2 mL of 2 mol/L potassium hydroxide in methanol was added to the extracted oil, and the mixture was shaken vigorously for 30 s and then centrifuged for 2 min at 3000 rpm. The supernatant containing the methyl esters was removed. Finally, 1 μL of this solution was injected into the GC-MS instrument for analysis.

The injection was performed using a 1 μL Hamilton GC syringe. The GC-MS system (6890N, Agilent Technologies, Santa Clara, CA) was equipped with an inert mass selective detector (5975C with triple-axis detector, Agilent Technologies). An HP-5 capillary column (30 m × 0.32 mm i.d., 0.25 μm film thickness, Agilent Technologies) was used for separation of the fatty acids. Helium was used as the carrier gas at a constant flow rate of 1.0 mL/min. The split ratio was 1:50. The oven temperature was initially set at 60°C for 2 min, then increased to 240°C at a rate of 5°C/min, and held at 240°C for 10 min. The injector temperature was kept at 250°C, and the transfer line temperature was set at 300°C. The quadrupole mass spectrometer was scanned over the 40–500 *m/z* range.

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REFERENCES

1. G. Fadavi, M. A. Mohammadifar, A. Zargarran, A. M. Mortazavian, and R. Komeili, *Carbohydr. Polym.*, **101**, 1074 (2014).
2. R. Tanaka, A. Nitta, and A. Nagatsu, *J. Nat. Med.*, **68**, 225 (2014).
3. M. Hosseini, R. Heydari, and M. Alimoradi, *J. Sep. Sci.*, **38**, 663 (2015).
4. S. Khodadoust, A. Mohammadzadeh, J. Mohammadi, C. Irajie, and M. Ramezani, *Nat. Prod. Res.*, **28**, 573 (2014).
5. S. K. Padhan, P. M. Mishra, S. Baliarsingh, A. Sree, and M. Panigrahi, *Chem. Nat. Compd.,* **51**, 323 (2015).
6. Sh. K. Khidoyatova, N. T. Ulchenko, and S. D. Gusakova, *Chem. Nat. Compd.*, **51**, 224 (2015).
7. M. Sajid, O. Ilkay, A. Zaheer, A. Sinem, and G. Muhammad, *Food Chem.*, **109**, 855 (2008).
8. L. V. Dudareva, V. V. Nokhsorov, E. G. Rudikovskaya, and K. A. Petrov, *Chem. Nat. Compd.,* **51**, 220 (2015).
9. C. K. Chow, *Fatty Acids in Foods and Their Health Implications*, 1st Edition, Marcel Dekker, New York, 1992, pp. 735–753.