Herbal Medicines Journal **2022; 7(3):119-22**
DOI: 10.22087/hmj.v7i3.923 **ISSN:** 2538-2144

Letter to Editor

Fatty acids in *Aristolochia* L. Seeds from Iran

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Received: 25.11.2021; Accepted: 21.07.2022

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Please cite this article as: Khajeh M, Keshavarzi M, Fazeli F, Ghanavati M. Fatty acids in *Aristolochia* L. Seeds from Iran. Herb. Med. J. 2022;7(3):119-22.

Dear Editor

There are about 500 species in the genus *Aristolochia* L. (Aristolochiaceae) along tropical and subtropical regions of the world (1). The *Aristolochia* species are known for their medicinal significance, particularly due to the existence of fatty acids (2, 3). The beneficial roles of some kinds of fatty acids such as ω-3 polyunsaturated fatty acids (PUFAs) and monounsaturated fatty acids (MUFAs) have been well documented in inflammation-related disorders such as hypertension, coronary heart diseases, cognitive disorders, rheumatoid arthritis, etc. (4, 5, 6, 7). As observed in previous reports, the major natural products in *Aristolochia* species are represented by aristolochic acids, aristolactams, mono-, sesqui-, di-, and tri-terpenes, alkaloids, and flavonoids. These components have mutagenic and carcinogenic effects (8).

To date, the composition of fatty acids has been successfully characterized in a number of *Aristolochia* species. For instance, Teresa *et al*. (1984) for the first time evaluated the lipid components of *Aristolochia longa* and revealed the fatty acid composition of vegetative extracts of roots and shoots. Totally 15 compounds were identified, which stood for more than 90% of the total achieved oil. They detected trans-pinocarveol (24.2%), α-pinene (16.4%), and pinocarvone (14.2%) as major constituents of oil (9). Despite the medicinal use of *Aristolochia* species as a drug for women in childbirth, the extract exhibited apoptotic effects. Moreover, cytotoxic effects have been extensively shown (7).

Studying the composition of fatty acids and antibacterial activity of wild *A. longa* in Tunisia showed that the extracted oil was full of polyunsaturated fatty acids, and the linolenic as well as linoleic acids were the most significant ones, while the saturated fatty acids were mainly palmitic and stearic acids (10).

The *Aristolochia* has only three species in Iran, two of which are endemic, *Aristolochia hyrcana* P.H. Davis & M.S. Khan and *A. olivieri* Colleg. ex Boiss (11). Despite the ethnobotanical importance of this genus in Iran, there is no record of chemical components of native species. The seed fatty acid content of *A. bottae* and *A. hyrcana* can assist to illustrate the medicinal value of these plants. Thus, this study aimed at determining the profile of fatty acids in these two species in Iran.

Table 1: Fatty acids composition of *A. bottae* and *A. hyrcana* seed oil. ΣSFA: Saturated fatty acids; ΣMUFA: Monounsaturated fatty acids; ΣPUFA[3]: Polyunsaturated fatty acids; ΣUSFA: Unsaturated fatty acids; U/S: unsaturated/saturated.

Fatty acids	*A. bottae* [%]	*A. hyrcana* [%]
Lauric acid(C12:0)	0.02	0.06
Myristic acid(C14:0)	0.05	0.03
Pentadecylic acid(C15:0)	4.90	
Palmitic acid(C16:0)	4.90	6.02
Palmitoleic acid(C16:1)	0.35	0.24
Margaric acid(C17:0)	0.06	0.05
Heptadecanoic acid(C17:1)	0.16	0.06
Stearic acid(C18:0)	1.47	2.48
Elaidic acid(C18:1t)	0.03	—
Oleic acid (C18: 1c)	84.97	80.09
Linoleaidic acid(C18:2t)	0.11	0.14
Linoleicacid(C18:2c)	5.06	5.08
Trans-Linolenic acid(C18:3t)	—	0.06
Linolenic acid(C18:3c)	0.79	0.95
Arachidic acid(C20:0)	0.67	1.22
Behenic acid(C22:0)	0.41	1.43
Erucic acid(C22:1)	0.01	0.04
Lignoceric acid(C24:0)	0.18	0.63
Nervonic acid(C24:1)	0.03	0.06
Docosahexaenoic(DHA)(C22:6)	0.02	0.14
ΣSFA	12.66	11.92
ΣMUFA	85.55	80.49
ΣPUFA[3]	5.98	6.37
ΣUSFA	91.53	86.86
U/S	7.22	7.28
Trans-unsaturated fatty acids	0.15	0.2

Seeds of *A. bottae* and *A. hyrcana* were collected from natural habitats in Iran. *A. bottae* samples were gathered from Tehran, Darband, PasQaleh at the altitude of 1982 m. *A. hyrcana* samples were collected from Guilan, Rudbar, Lakeh village at 1214 m altitude. Vouchers are deposited in the herbarium of Alzahra University (ALUH) Tehran, Iran. The ground seeds (200g) were exposed to hydro-distillation in a Clevenger apparatus for 3h. The oil yield was 0.4–0.5% of dry weight. The oil was dried over anhydrous sodium sulfate and then maintained in a sealed vial under refrigeration before gas chromatography. The lipids were extracted using N-Hexane -MeOH (2:1) at 25°C for 24 h. The triglycerides were trans-esterified to methyl esters by potassium hydroxide in methanol according to ISO method 5509. The methyl esters of fatty acids were analyzed on 6100 gas chromatography made in South Korea. SGE-BPX70 capillary column (60 m length. 0.5 mm i.d., 0.25 µm film thickness) was utilized for the GC system. The temperature program was set up from 150-190 ºC at 5 ºC/min with injector temperature of 280ºC, detector temperature of 300ºC, and H_2 as carrier gas (1 mL/min.). Authentic compounds and retention times identified the compounds.

Up to 20 fatty acids, including saturated (SFAs), monounsaturated (MUFAs), and polyunsaturated fatty acids (PUFAs) were identified in the seed extract of *A. hyrcana and A. bottae*. In the *A. bottae*, SFAs made up 12.7% of fatty acids in the seeds, while in *A. hyrcana* it was 11.9%. Pentadecylic acid and palmitic acid were the major saturated fatty acids in *A. bottae*, while palmitic acid was the major saturated one in *A. hyrcana*. The latter species lacks pentadecylic acid. Other SFAs such as lauric acid, myristic acid, palmitoleic acid, and margaric acid were detected in a percentage of less than 3% (Table 1). Moreover, polyunsaturated fatty acids (PUFAs) contained essential fatty acids in the two species studied (Table 1). PUFA/SFA is an index normally used to assess the impact of diet on cardiovascular health (CVH). The PUFAs/SFAs ratio is an important index that enables a comparison of the

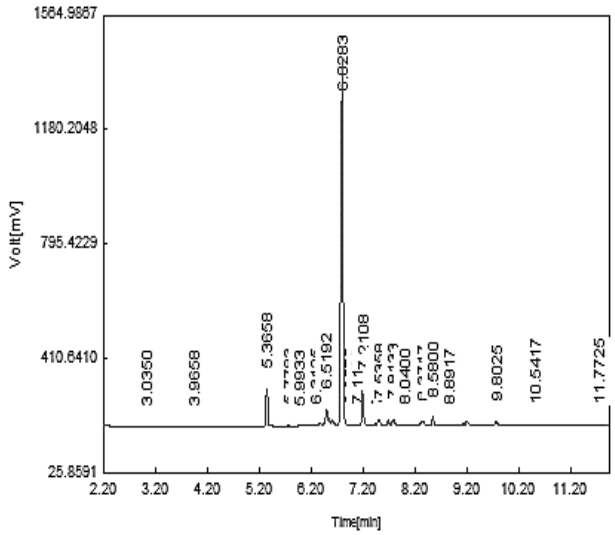

Figure 1. Gs chromatogram of fatty acids methyl esters in *Aristolochia hyrcana*.

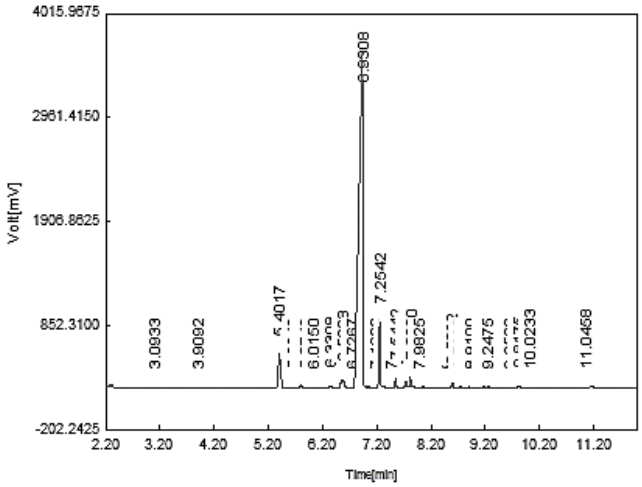

Figure 2. Gs chromatogram of fatty acids methyl esters in *Aristolochia bottae*.

relative nutritive values of lipids (12). In the present study, the PUFAs/SFAs ratio ranged from 0.47 to 0.53 in the seeds of *A. bottae* and *A. hyrcana* respectively. Seeds of *A. hyrcana* and *A. bottae* showed a high amount of oleic acid (Table 1) (Fig. 1 & 2). The dominant fatty acids from *A. bottae* were oleic acid, linoleic acid, pentadecylic acid, and palmitic acid; while the main fatty acids were oleic acid, palmitic acid, and linoleic acid in *A. hyrcana*. Oleic acid and linoleic acid were found as the major monounsaturated fatty acid and the major polyunsaturated fatty acids in these two plant species respectively. Trans-elaidic acid was observed in *A. bottae* but absent in *A. hyrcana*. Moreover, trans-linolenic acid was only present in *A. hyrcana* species.

Conclusion

The fatty acid contents of three *Aristolochia* species in Iran have recently been studied for the first time. The Trans forms of fatty acids are found at a very small level in the seed oil of *A. bottae* and *A. hyrcana*. *A. bottae* had more mono and polyunsaturated fatty acids than *A. hyrcana*. Besides, the extent of saturated fatty acids was much less in the species studied. Similarly, the saturated fatty acids in the aerial parts and roots were at a low level in *A. longa* (13).

Oleic acid belongs to the family of Omega-9 fatty acids

whose accumulation in the liver and nerve cells is low (14). Oleic acid decreases LDL (bad cholesterol) in the blood and increases the oxidative stability of oils (13). The content of this fatty acid from the *Aristolochia* species was highly favorable in this respect. Similarly, monounsaturated fatty acids are mainly represented by oleic acid in *A. longa* (13). Linoleic acid is an essential fatty acid for the human body (15). The frequency rates of this fatty acid in *A. hyrcana* and *A. bottae* were consistent with other species of the same genus (2).

Despite being rich in beneficial compounds such as polyunsaturated fatty acids, the use of *Aristolochia* species is very limited due to its toxicity (16, 5). Our findings revealed that *A. bottae* and *A. hyrcana* could be considered as potential sources for oleic acid with a very small level of trans fatty acids in seed oil. However, prior to the commercial applicability of the species studied, the toxicological analysis should be carried out. In the future, processing may develop it as a useful industrial and pharmaceutical supply.

Acknowledgments

The present research was not based on any specific grant from public funding agencies, commercial, or not-for-profit sectors.

Conflict of Interest

The authors declare that they have no conflict of interest.

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