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RESEARCH NOTES

Oil Composition of Iranian Major Nuts

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ABSTRACT

Iran annually exports considerable quantities of nuts such as almonds, hazelnuts, pistachios and walnuts. The fatty acid profile of these nut oils as an index of their quality was determined using gas chromatography. Results indicated that oleic acid (C18:1) was the major fatty acid in almonds (75.37%), hazelnuts (76.21%) and pistachios (60.49%) followed by linoleic acid (C18:2), whereas in walnuts, the main fatty acid was linoleic acid (49.84%) followed by oleic acid. However, in all cases palmitic acid (C16:0) was detected at a much lower level than those of oleic and linoleic acid (7.26, 5.29, 7.20, 9.23%, respectively).

Keywords: Almond, Fatty acids, Hazelnut, Pistachio, Triacylglycerols, Walnut.

INTRODUCTION

It is well known that cultivar and environmental factors have impact on the composition and thus price of foodstuffs obtained from plants. In terms of nuts, oil is a major component and therefore its quality and fatty acid profile is very important. Nuts such as almond, hazelnut, pistachio and walnut, contain high levels of unsaturated fatty acids like oleic, linoleic, and linolenic acids and are essentially free of cholesterol, so that nowadays are considered as healthy (functional) foods. These advantages along with their favorable flavors have caused them to be subjected of several studies.

Holland *et al*. (1992) determined fat content of different nuts. Fourie and Basson, (1990) applied a transesterification method to determine fatty acid composition of oil extracted from different nuts. Many attempts were also made to identify fatty acid composition of nuts oil grown in different parts of the world. Dugo *et al*. (1797) investigated fatty composition of sweet almond grown in Italy. Habib and Ashoush (1990) reported fatty acid and sterol content of Egyptian almond oil. Carlos *et al*. (1996) also determined fatty acid profile of 19 varieties of almonds.

Other nuts were also studied individually. Yildiz (1998) reported oil composition of pistachio. Bonveli and Coll (1993) reported oil content, oil stability and fatty acid composition of Spanish hazelnuts. Parcerisa *et al*. (1995) also employed a chromatographic method for determination of hazelnut lipid composition originated from Spain. Savage *et al*. (1997) analyzed oil composition and oxidative stability of oil extracted from hazelnut grown in New Zealand. Seventeen native and imported varieties of hazelnut cultivated in Oregon, USA, were examined for fatty acid composition and sterol and tocopherol content.

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Walnut oil and fatty acid composition have been also investigated, and reports about American (Anonymous, 1991) and Turkish varieties (Beyhan *et al*., 1995) of walnuts and those grown in New Zealand (Savage *et al*., 1999) are now available.

The main objective of this study is to evaluate the major fatty acid composition of four Iranian nuts that are mostly exported to other countries.

MATERIALS AND METHODS

The nuts (almond, hazelnut, pistachio and walnut) were gifts from the Iranian Centre for Developing Exports (ICDE). Fatty standards were purchased from Merck (Darmstadt, Germany). Other chemicals were all reagent grades.

The nuts were ground and then 100 g from each was taken to extract oil by Soxhlet (Pomeranz and Clifton, 1987). Gas chromatography was employed to performed analyses of fatty acids. Preparation of fatty acid methyl esters was carried out as described by Badings and De Jong (1983). The methyl esters were injected into a gas chromatograph model Shimadzu, 14A, Kyoto, Japan that was equipped with a split injection port and a flame ionization detector (FID) and CBP20 capillary column (25m × 0.22mm. I.D. and 0.33 mm O.D.). The temperature of injector was 240°C. The column temperature gradient was programmed as follow: after an isothermal period of one minute at 155°C, the column temperature was raised to 210°C at a rate of 17°C/min. After further minute, the temperature was raised again to 220°C at a rate of 2°C/min and held for five minutes at 220°C.

RESULTS AND DISCUSSION

Table 1 shows the retention time and concentration of different fatty acid standards. Figure 1 shows the chromatogram obtained from fatty acids of fatty standards (A), and almond oil (B). The response factor (Rf) values and the percentage of three major fatty acids found in different nuts' oil were calculated and are shown in Table 2. The results indicated that 75.37% of total fatty acids in the almond oil sample was oleic acid, showing the major fatty acid content of the sample. The least fatty acid found in almond oil was palmitic acid, 5.29%. It was also demonstrated that linoleic acid comprised 19.38% of total fatty acids. These results are in agreement with those reported by Garcia and Marcos (1971) where the concentration of palmitic, oleic and linoleic acids in their samples were 7.51, 66.38 and 23.5%, respectively. Moreover, Colombini *et al*. (1979) who investigated the main fatty acids in almonds reported that oleic acid is in the range of 72.0 to 75.8%. Dugo *et al*. (1979) also reported that the concentration of oleic acid was 70.8 to 75.3%, and of linoleic acid was 16.9 to 19.2%. Habib and Ashoush (1990) also demonstrated that unsaturated fatty acids contribute 87% of the total fatty acids present in sweet almond oils.

The results indicated that the amount of

Table 1. Final concentration of fatty acid standard prepared for fatty acid determination of Iranian nut oil.

Fatty acid[a]	Rt[b] (min)	Fatty acid standard[c] (%)	Concentration[d] (mg/100µl)
C16:0	6.89	4.99	4.26
C18:1	9.80	71.28	60.90
C18:2	10.57	23.73	20.27

[a] Major fatty acids found in Iranian nut oil.
[b] Retention time of fatty acid standards.
[c] Percentage of fatty acid standards in final solution.
[d] Fatty acid concentration prepared for on column injection.

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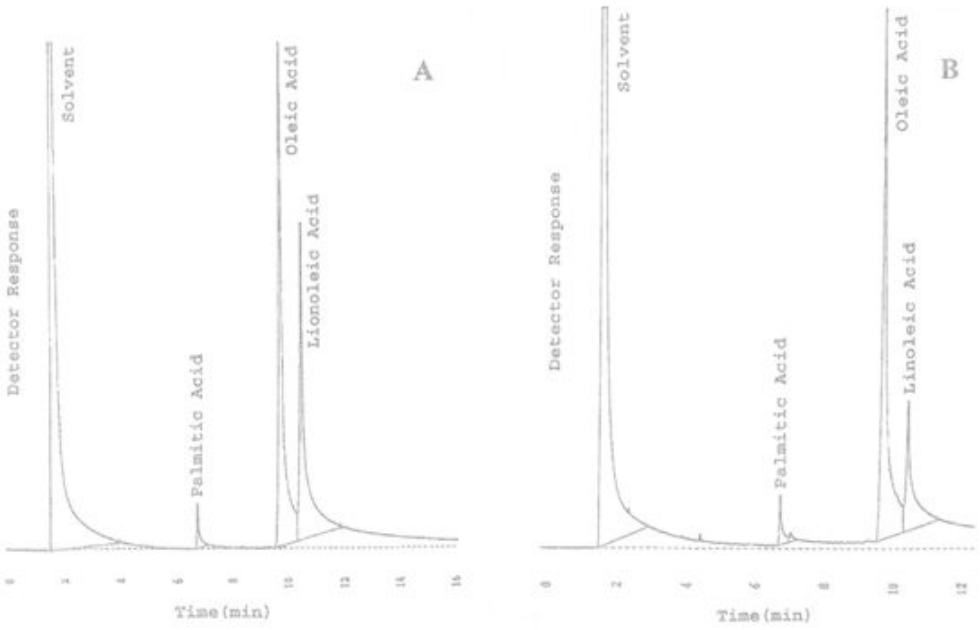

Figure 1. Chromatogram of fatty acid standards obtained by GC (Shimadzu, Japan, capillary 25m, O.D. 0.33mm, I. D. 0.22mm) for fatty acid composition of standard (A) and almond oil (B).

oleic acid was 76.21% of total fatty acids in the hazelnut oil sample, showing the major fatty acid content, and again the amount of saturated fatty acid, as palmitic acid, was the lowest of other fatty acids in the hazelnut oil and accounted for 7.26%. Parcerisa *et al*. (1998) showed that the monounsaturated fatty acids comprised the major group of fatty acids in hazelnut oil, accounting for 74.5-83.2% whereas saturated fatty acids represented minor components of the oil. In another study Savage *et al*. (1999) demonstrated that 73.8-80.1% of total fatty acids of hazelnut oil obtained from New Zealand, were monounsaturated oleic acid.

The results also showed that the amount of linoleic acid was 16.51% in hazelnut oil. Bonvehi and Coll (1993) indicated that the Negret variety of hazelnut had the greatest variation in linoleic acid content, ranging from 11.70 to 20.10%. Comparing it to other Spanish hazelnut varieties, Parcerisa (1998) reported that polyunsaturated fatty acids of hazelnut oil accounted for 8.3-17.9% of total fatty acids.

According to the results, the major fatty acid content of Iranian pistachios was of oleic acid which accounted for 60.49% of total fatty acids, whereas, palmitic acid comprised the lowest level of fatty acids in the oil (7.20%). The results also showed that the amount of linoleic acid was 32.30%. Danechrad (1974) reported that pistachios contained 67.9% oleic acid, 17.0% linoleic acid and 11.7% palmitic acid. Moreover, Yildiz *et al*. (1998) reported that fatty acids identified in the oil samples of pistachios grown in Turkey were palmitic, palmitoleic, stearic, oleic and linoleic acids with oleic acid being the dominant fatty acid (68.78%).

For walnuts the results showed that, in contrast to other nuts, linoleic acid was the major fatty acid content in the sample (49.84%) followed by oleic acid (40.92%). Savage *et al*. (1999) reported that oleic acid content of the oils in walnut ranged from 12.7 to 20.4%, whereas, linoleic acid content

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Table 2. The Rf value and the percentage of main fatty acids found in oil of exported Iranian nuts.

Nut deviation oil	Fatty acid	Rf[a]	Concentration (mg/100µ l)	Fatty acid (%)	Standard (sd)[b]
Hazelnut	Cl6:0	8.70×10^{-5}	0.073	7.26	± 0.02
	C18:1	6.40×10^{-5}	0.766	76.21	± 0.01
	Cl8:2	4.20×10^{-5}	0.166	16.51	± 0.05
Almond	Cl6:0	9.59×10^{-5}	0.066	5.29	± 0.09
	C18:1	7.47×10^{-5}	0.918	75.37	± 0.03
	Cl8:2	4.31×10^{-5}	0.236	19.38	± 0.04
Pistachio	Cl6:0	9.59×10^{-5}	0.070	7.20	± 0.06
	C18:1	7.47×10^{-5}	0.588	60.49	± 0.03
	Cl8:2	4.31×10^{-5}	0.314	032.30	± 0.05
Walnut	Cl6:0	9.59×10^{-5}	0.079	9.23	± 0.03
	C18:1	7.47×10^{-5}	0.350	40.92	± 0.01
	Cl8:2	4.31×10^{-5}	0.427	49.84	± 0.08

[a] Calculated response factor value.
[b] Standard deviation obtained from 3 replications.

ranged from 57.0 to 62.5%. In another study extracted from walnuts grown in New Zealand, Zwarts *et al*. (1999) showed that the oleic acid content of the oils ranged from 14.3-26.1% and the linoleic acid content ranged from 49.3-62.3%. According to a report in California, walnut oil contains 71% polyunsaturated fatty acids, 18% monounsaturated fatty acids and 11% saturated fatty acids (Anon, 1991). However, like other nuts tested, palmitic acid was found at a lower concentration.

CONCLUSION

It is suggested that frequent consumption of nuts may be associated with a reduced risk heart disease. This study showed that almonds, hazelnuts, pistachios and walnuts grown in Iran were rich in unsaturated fatty acids.

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REFERENCES

1. Anon.1991. California Walnuts- the Versatile Nut. *Euro-Food-Drink-Rev*., **121**: 123-125.
2. Badings, H. T. and De Jong, C. 1983. Capillary Gas Chromatography of Fatty Acid Methyl Esters. A Study of Conditions for the Quantitative Analysis of Short- and Long-Chain Fatty Acids in Lipids. *J. Chromatogr.*, **270**: 493-506.
3. Beyhan, O., Kaya, I., Sen, S. M. and Dogan, M. 1995. Fatty Acids Composition of Walnut (*Juglans regia L*.) Types Selected in Darende. *Turkish J. Agric. Forest*., **19 (4)**: 299-302.
4. Bonvehi, J. S. and Coll, F. V., 1993. Oil Content, Stability and Fatty Acid Composition of the Main Varieties of Catalonian Hazelnuts (*Corylus avellana L*.). *Food Chem*., **48 (3)**: 237-241.
5. Carlos, G. L., Nuria, G. T., Vicente, B-N, J. Efigenio, G-G, and Luisa, M-C. 1996. Major Fatty Acid Composition of 19 Almond Cultivars of Different Origins. A chemometric Approach. *J. Agric. Food Chem*., **44**: 1751-1755.

[DOR: 20.1001.1.16807073.2007.9.3.4.3]

6. Colombini, M., Vanoni, M. C. and Amelotti-G., 1979. The Sterol Composition of Walnut, Hazelnut, Almond and Avocado Oils. *Rivista-Italiana-delle-Sostanze-Grasse*, **56 (10)**: 391-392.
7. Danechrad, A., 1974. Study of Pistachio oil (*Pistacia vera L.*). *Oleagineux*, **29 (3)**: 153-154.
8. Dugo, G., Stago-d'Alcontres, I., Controneo, A. and Salvo, F. 1979. Composition of Almond oil. I. Fatty Acids, Hydrocarbons and Sterols of Some Sicilian Sweet Almond varieties. *Rivista- Italiana- delle- Sostanze-Grasse*, **56 (5)**: 201-203
9. Fourie, P. C. and Basson, D. S. 1990. Application of a Rapid Transesterification Method for Identification of Individual Fatty Acids by Gas Chromatography on Three Different Nuts Oils. *J. Am. Oil Chem. Soc.*, **67**: 18-20.
10. Garcia, O. R. and Marcos, G. M. A. 1971. Study of Oils from Spanish Dry Fruits. Fatty Acid Composition. *Anales-de-Bromatologia,* **23 (3)**: 233-257.
11. Habib, M. A. and Ashoush, Y. A. 1990. The Fatty Acid and Sterol Composition of Almond Oils [Egypt]. *Minufiya J. Agric. Res. (Egypt),* **10 (1)**: 551-565.
12. Holland, B., Unwin, I. D. and Buss, D. H. 1992. The Composition of Foods. In: "*Fruits and Nuts*", 5th Ed. First Supplement to McCance and Widdowsons, Royal Society of Chemistry, Cambridge, U. K., 106 pp.
13. Parcerisa, J., Boatella, J., Codony, R., Rafecas, M., Castellote, AI, Garcia, J., Lopez, A. and Romero, A. 1995. Comparison of Fatty Acid and Triacylglycerol Compositions of Different Hazelnut Varieties (*Corylus avellana L.*) Cultivated in Catalonia (Spain). *J. Agric. Food Chem.*, **43 (1)**: 13-16.
14. Parcerisa, J., Richardson, D. G., Rafecas, M., Codony, R. and Boatella, J. 1998. Fatty Acid, Tocopherol and Sterol Content of Some Hazelnut Varieties (*Corylus avellana L.*) Harvested in Oregon (USA). *J. Chromat.* –A, **805 (1/2)**: 259-268.
15. Savage, G. P., McNeil, D. L. and Dutta, P. C. 1997. Lipid Composition and Oxidative Stability of Oils in Hazelnuts (*Corylus avellana L.*). Grown in New Zealand. *J. Am. Oil Chem. Soc.*, **74 (6)**: 755-759.
16. Savage, G. P., Dutta, P. C., and McNeil, D. L. 1999. Fatty Acid and Tocopherol Contents and Oxidative Stability of Walnut Oils. *J. Am. Oil Chem. Soc.*, **76 (9)**: 1059-1063.
17. Pomeranz, Y. and Meloan, C. E. 1987. Extraction of Lipids in Selected Foods. In: "*Food Analysis, Theory and Practice*". *Avi, Van Nostrand Reinhold*, USA, 704 pp.
18. Yildiz, M., Gurcan, S. T., and Ozdemir, M. 1998. Oil Composition of Pistachio Nuts (*Pistacia vera L.*) from Turkey. *Fett-Lipid*, **100 (3)**: 84-86.
19. Zwarts, L., Savage, G. P., and McNeil, D. L. 1999. Fatty Acid Content of New Zealand-Grown Walnuts (*Juglans regia L.*). *Int. J. Food Sci. Nut.*, **50 (3)**: 189-194.

ترکیب چربی مهمترین دانه های خوراکی ایرانی

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چکیده

نمونه‌هائی از دانه‌های آجیلی و صادراتی کشور شامل فندق، پسته، بادام و گردو از مرکز توسعهء صادرات ایران تهیه گردید که پس از آسیاب کردن، روغن دانه‌ها استخراج و در مجاورت ازت و در ۲۰- درجه سانتی‌گراد نگهداری گردید. ترکیب اسیدهای چرب دانه‌ها توسط دستگاه گاز کروماتوگراف (GC) شیمادزو ژاپن و با استفاده از ستون موئین و آشکارگر FID تعیین گردید. نتایج

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بدست آمده از تجزیهء فندق نشان داد که به ترتیب اسید اولئیک، اسید لینولئیک و اسید پالمیتیک ۷۶/۲۱، ۱۶/۵۱و ۷/۲۶ درصد تمام اسیدهای چرب موجود در فندق را تشکیل میدهد. در مورد بادام ۷۵/۳۷ درصد کل اسیدهای چرب دانه را اسید اولئیک تشکیل میدهد، مقدار اسید لینولئیک به میزان ۱۹/۳۸ درصد و اسید چرب اشباع شدهٔ پالمیتیک به میزان ۵/۲۹ درصد بدست آمد. نتایج حاصل از تجزیهٔ اسیدهای چرب روغن پسته نشان داد که ۶۰/۴۹ درصد کل اسیدهای چرب آنرا اسید اولئیک تشکیل می دهد. اسید لینولئیک ۲۳/۳۰ درصد اسیدهای چرب موجود در پسته را می سازد. اسیدهای چرب اشباع شده نیز در مولکول تری اسیل گلیسرولهای پسته به مقدار ۷/۲۰ درصد دیده شد. نتایج بدست آمده از اندازه‌گیری درصد اسیدهای چرب گردو نشان داد که این بار اسید لینولئیک فراوان ترین اسید چرب در روغن گردو می باشد و مقدار آن به ۴۹/۸۴ درصد می رسد. بعد از آن اسید اولئیک ۴۰/۹۲ و اسید پالمیتیک ۹/۲۳ درصد از کل اسیدهای چرب گردو را تشکیل می دهند.

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