RESEARCH NOTES

Oil Composition of Iranian Major Nuts

M. Safari\textsuperscript{1*} and H. Alizadeh\textsuperscript{2}

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 \textit{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 \textit{et al.} (1977) investigated fatty composition of sweet almond grown in Italy. Habib and Ashoush (1990) reported fatty acid and sterol content of Egyptian almond oil. Carlos \textit{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 \textit{et al.} (1995) also employed a chromatographic method for determination of hazelnut lipid composition originated from Spain. Savage \textit{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 perform 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 follows: 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>
<thead>
<tr>
<th>Table 1. Final concentration of fatty acid standard prepared for fatty acid determination of Iranian nut oil.</th>
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</thead>
<tbody>
<tr>
<td><strong>Fatty acid</strong>&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>C16:0</td>
</tr>
<tr>
<td>C18:1</td>
</tr>
<tr>
<td>C18:2</td>
</tr>
</tbody>
</table>

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

**ACKNOWLEDGEMENT**

This research was carried out with the help of a grant of financial support from the Research Council of Tehran University which is appreciated.

**REFERENCES**


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

<table>
<thead>
<tr>
<th>Nut deviation oil</th>
<th>Fatty Rf° acid</th>
<th>Concentration (mg/100μl)</th>
<th>Fatty acid (%)</th>
<th>Standard (sd)°</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hazelnut</td>
<td>Cl6:0 8.70 x10⁻⁵</td>
<td>0.073</td>
<td>7.26</td>
<td>± 0.02</td>
</tr>
<tr>
<td></td>
<td>Cl18:1 6.40 x10⁻⁵</td>
<td>0.766</td>
<td>76.21</td>
<td>± 0.01</td>
</tr>
<tr>
<td></td>
<td>Cl18:2 4.20 x10⁻⁵</td>
<td>0.166</td>
<td>16.51</td>
<td>± 0.05</td>
</tr>
<tr>
<td></td>
<td>Cl6:0 9.59 x10⁻⁵</td>
<td>0.066</td>
<td>5.29</td>
<td>± 0.09</td>
</tr>
<tr>
<td></td>
<td>Cl18:1 7.47 x10⁻⁵</td>
<td>0.918</td>
<td>75.37</td>
<td>± 0.03</td>
</tr>
<tr>
<td></td>
<td>Cl18:2 4.31 x10⁻⁵</td>
<td>0.236</td>
<td>19.38</td>
<td>± 0.04</td>
</tr>
<tr>
<td>Almond</td>
<td>Cl6:0 9.59 x10⁻⁵</td>
<td>0.070</td>
<td>7.20</td>
<td>± 0.06</td>
</tr>
<tr>
<td></td>
<td>Cl18:1 7.47 x10⁻⁵</td>
<td>0.588</td>
<td>60.49</td>
<td>± 0.03</td>
</tr>
<tr>
<td></td>
<td>Cl18:2 4.31 x10⁻⁵</td>
<td>0.314</td>
<td>032.30</td>
<td>± 0.05</td>
</tr>
<tr>
<td>Pistachio</td>
<td>Cl6:0 9.59 x10⁻⁵</td>
<td>0.079</td>
<td>9.23</td>
<td>± 0.03</td>
</tr>
<tr>
<td></td>
<td>Cl18:1 7.47 x10⁻⁵</td>
<td>0.350</td>
<td>40.92</td>
<td>± 0.01</td>
</tr>
<tr>
<td></td>
<td>Cl18:2 4.31 x10⁻⁵</td>
<td>0.427</td>
<td>49.84</td>
<td>± 0.08</td>
</tr>
</tbody>
</table>

° Calculated response factor value.

° Standard deviation obtained from 3 replications.
کته داد نشان فندق جزء از ترتيب اسید اولئیک، اسید لیتلیک و اسید پالیمتیک بوده.

درصد آمده از تجزیه فندق نشان داد که 16/78 و 26 درصد تمام اسیدهای چرب موجود در فندق را تشکیل می‌دهند. در مورد بادام 3/75 درصد کل اسیدهای چرب دانه را اسید اولئیک تشکیل می‌دهد، مقدار اسید لیتلیک به میزان 3/75 درصد و اسید چرب اشباع شده پالیمتیک به میزان 2/95 درصد بسته آمد. نتایج حاصل از تجزیه اسیدهای چرب روغن پسته نشان داد که 0/6 درصد کل اسیدهای چرب آن اسید اولئیک تشکیل می‌دهد. اسید لیتلیک 0/23 درصد اسیدهای چرب موجود در پسته را می‌سازد. اسیدهای چرب اشباع شده نیز در مولکول تری اسید گلیسرولیهای پسته به مقدار 0/72 درصد دیده شد. نتایج پدست آمده از اندازه‌گیری درصد اسیدهای چرب گردو نشان داد که این یار اسید لیتلیک فراوان ترین اسید چرب در روغن گردو می‌باشد و مقدار آن به 84/6 درصد می‌رسد. بعد از آن اسید اولئیک 42/60 و اسید پالیمتیک 9/23 درصد از کل اسیدهای چرب گردو را تشکیل می‌دهند.