Comparative study of argan and olive fruits and oils

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Abstract

This study was conducted to compare argan and olive fruits and virgin oils. Dry argan fruits, traditional and semiautomatic extracted argan oils, from roasted and unroasted seeds, from Essaouira’s area, were studied. Morphological characteristics of argan fruit were determined and compared with the ‘Picual’ olive’s ones. The results showed certain similarities between the two fruits. The quality parameters analyzed were acidity and peroxide value, K270, K232 and ΔK, total phenols and oil stability, comparing them with those of ‘Picual’ virgin olive oil. Quality parameters corresponded to the Moroccan Standard for edible virgin argan oil. Traditional argan oil showed the lowest stability whereas semiautomatic edible oil presented the highest one. However, virgin olive oil showed higher phenol content and better oxidative stability than the virgin argan oils.

Keywords: Argan, Olive, Fruit, Quality Parameters, Phenols, Oil Stability.

Etude comparative des caractéristiques des fruits et des huiles d’argan et d’olive

Résumé


Introduction

The argan tree (*Argania spinosa* L. Skeels) belongs to the Sapotaceae family. It is perfectly adapted to his environment and plays essential local ecological and economical roles in south-western Morocco. His fruit is a drupe with an average weight from 5 to 20 g [1]. The mesocarp or pulp surrounds the epicarp or nut which contains between 1 and 3 seeds. This component is the most important for its oil wealth but it does not represent more than 10% of the dry fruit weight. Although the oil represents approximately half of the seed, it does not exceed 5% of the fruit weight [2].

The argan tree lives since centuries close to the olive tree, one of the main fruit-bearing species of the kingdom. In the same way, the argan oil was often compared with the olive one, for its physicochemical composition as well as for its nutritional and therapeutic properties.

The fatty acid composition of the argan oil is constituted mainly by: palmitic (16:0), stearic (18:0), oleic (18:1), and linoleic (18:2) acids. The difference with the olive oil, with respect to fatty acids, is essentially the oleic and linoleic contents. Due to his monounsaturated and polyunsaturated fatty acid wealth, the argan oil is considered as an oleic-linoleic type, which confers it a high dietetic value [3].

Oil extraction from argan seeds is made through a traditional process or a semiautomatic one. In the case of edible oils, seeds are roasted before extraction, but when the oil is used for cosmetics, no seed roasting is required. Several cooperatives and private enterprises are established in south-west Morocco producing and commercializing edible and cosmetic argan oil. In the laboratory the solvent extraction is made using the Soxhlet system.

In the present work, dry fruits, edible and cosmetic argan oils produced by semiautomatic and traditional extraction, from Essaouira’s area, were analyzed. At the same time, olives and virgin olive oils of the variety ‘Picual’, from the province of Jaén (Spain), were also characterized.

Materials and methods

All of the reagents and solvents used were of analytical grade. Folin-Ciocalteau phenol reagent was supplied by Panreac, Ref. 251567.1609 (Barcelone, Spain). Caffeic acid standard were purchased from Sigma, Ref. C0625-256 (USA).

2.1 Argan fruit and oil samples

The argan dry fruits were supplied by a private enterprise nearby the city of Essaouira (Morocco), as well as the edible and cosmetic oils obtained from the same fruits batch. All the oil samples were kept at -24ºC until analysis.

The semiautomatic extraction process includes cleaning the nut from pulp which is made by a machine, cracking and seed separation from de stone made by hand, roasting seeds in a toaster machine, pressing them mechanically, and finally filtered the oil obtained through a cellulosic plate filter. For the cosmetic oils, the extraction is carried out without roasting the seeds.

2.2 Morphological characteristics of the fruit

From 1 kg of dry fruits, each part of the fruit was weighed, the dry pulp and the nut after removing manually the pulp, the stone and the seed after cracking the nut. The percentage (% in weight) of each part of the fruit was calculated.

Some ratios have been determined, such as pulp/nut, stone/seed, and pulp/seed, comparing the results with those of the olive fruit.
2.3 Total fat content

Estimation of the argan seed total fat content was made by extraction solid-liquid, through Soxhlet method, using technical hexane as solvent. Grinding dry seeds were placed in a thimble and extracted continuously by solvent, during 24 h. After solvent’s recuperation, technical hexane remained was evaporated in a drying oven at 105±1°C. Fat yield was calculated according to the fresh and dry matter.

2.4 Free acidity, peroxide value and spectrophotometric characteristics

Acidity (%) and peroxide value (meq O₂/kg) were carried out following the analytical methods AOCS Cd 3d-63 and AOCS Cd 8b-90, respectively. Absorbance at 270 nm (K₂70) and 232 nm (K₂32) and ΔK was determined by spectrophotometry (spectrophotometer UV-VIS, Thermo, Mod. Helios Gamma), according to AOCS CH 5-91 method.

2.5 Determination of total phenols

The total phenolic content was colorimetrically tested by the Folin-Ciocalteau method [4]. The calibration curve was calculated using caffeic acid concentrations ranging from 50 to 250 mg/l, with a linear regression coefficient of 0.991. Extraction of phenols from argan oil samples was achieved by dissolving the oil in n-hexane, followed by liquid-liquid extraction using a methanol/water (60:40 vol/vol) mixture. An aliquot of the aqueous extract of the oil was reacted with the Folin-Ciocalteau reagent in sodium hydroxide solution and kept in the dark at room temperature for 45 min. Absorbance was measured at 725 nm against ultrapure water as blank. The total phenolic content was expressed as mg caffeic acid/kg oil sample.

2.6 Determination of oil stability

The oil stability or the oxidation induction time was determined according to the AOCS Official Method Cd 12b-92. An air flow (10 l/h) was bubbled through the oil heated at 98°C, using the Rancimat apparatus (Metrohm Ltd., Mod. 743 Rancimat, Herisau, Switzerland).

Results

3.1 Morphological characteristics of the fruit

The seed is the most important component for its oil wealth and represents less than 10% of the dry weight of the fruit (6.77%), Figure 1. On the contrary, the stone represents a quite high percentage of the dry fruit weight (53.75%).

![Figure 1](image-url)  
**Figure 1.** Percentages of dry argan fruit pulp, stone and seed.

Comparing with the olive fruit, it is observed that the pulp is very different; in the argan, it is practically exempts of fat matter, whereas in the olive the maximum percentage of fat matter is concentrated in the pulp.

The stone is similar in the two fruits, and the seeds also have certain similarity in their characteristics.
Table 1 shows some relations between the components of the argan fruit and its comparison with the olive ones.

The ratio stone/seed is similar in both fruits, whereas the relationships pulp/nut and pulp/seed are lower for the argan fruit, in the case of dry pulp as well as for the fresh one.

**Table 1.** Comparison between argan and olive fruits

<table>
<thead>
<tr>
<th>Ratio</th>
<th>Argan fruit</th>
<th>Olive fruit ('Picual')[5]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pulp/nut</td>
<td>0.65 (0.88)*</td>
<td>2.1-4.0</td>
</tr>
<tr>
<td>Stone/seed</td>
<td>7.94</td>
<td>7.0-9.5</td>
</tr>
<tr>
<td>Pulp/seed</td>
<td>5.83 (7.88)*</td>
<td>28.5-37.5</td>
</tr>
</tbody>
</table>

*Fresh pulp: moisture content=35% [6]*

**3.2 Total fat content**

Fat content is similar for the two fruits, when the yield is expressed according to the fresh matter (Yf%), but goes lower for argan seed, according to the dry matter (Yd%), Table 2.

**Table 2.** Fat yields according to the fresh (Yf%) and dry matter (Yd%)

<table>
<thead>
<tr>
<th>S/L</th>
<th>Yd (%)</th>
<th>Yf (%)</th>
<th>Yd (%)</th>
<th>Yf (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.091</td>
<td>21.28</td>
<td>20.25</td>
<td>35.8-41.6</td>
<td>17.3-24.0</td>
</tr>
<tr>
<td>0.18</td>
<td>41.82</td>
<td>39.23</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>0.26</td>
<td>48.41</td>
<td>46.22</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Table 2 also shows the importance of ratio between sample weight and solvent volume (S/L) in the fat yield resulted, which increases with the ratio S/L.

**3.3 Total acidity**

Acidity, for traditional and semiautomatic edible oils, allowed the classification of the edible virgin argan oils according to the Moroccan Standard NM 08.5.090 [8]. Concerning the cosmetic argan oil and that obtained by solvent extraction, they were compared to the olive pomace oil, according to the Codex standard [9] and showed lower values than the required one, Table 3.

**Table 3.** Quality parameters of argan oil samples (data expressed ± SD)

<table>
<thead>
<tr>
<th>Sample:</th>
<th>Acidity (%)</th>
<th>Peroxide value (meq O₂/kg)</th>
<th>K₂₇₀</th>
<th>K₂₃₂</th>
<th>ΔK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traditional</td>
<td>1.19±0.01</td>
<td>2.59±0.00</td>
<td>0.042±0.001</td>
<td>0.190±0.000</td>
<td>0.003±0.000</td>
</tr>
<tr>
<td>Semiautomatic (edible)</td>
<td>0.47±0.00</td>
<td>1.49±0.01</td>
<td>0.017±0.000</td>
<td>0.129±0.000</td>
<td>0.000±0.000</td>
</tr>
<tr>
<td>Extra virgin argan oil</td>
<td>≤0.8</td>
<td>≤15</td>
<td>≤0.35</td>
<td>-</td>
<td>≤0.01</td>
</tr>
<tr>
<td>Extra virgin olive oil</td>
<td>≤0.8</td>
<td>≤20</td>
<td>≤0.22</td>
<td>≤2.50</td>
<td>≤0.01</td>
</tr>
<tr>
<td>Semi automatic (cosmetic)</td>
<td>0.81±0.01</td>
<td>1.87±0.00</td>
<td>0.024±0.000</td>
<td>0.132±0.001</td>
<td>0.001±0.000</td>
</tr>
<tr>
<td>Soxhlet method extraction</td>
<td>0.26±0.01</td>
<td>1.95±0.00</td>
<td>0.027±0.000</td>
<td>0.146±0.001</td>
<td>0.001±0.000</td>
</tr>
<tr>
<td>Olive pomace oil [9]</td>
<td>≤1.0</td>
<td>≤15</td>
<td>≤1.70</td>
<td>-</td>
<td>≤0.18</td>
</tr>
</tbody>
</table>
3.4 Peroxide value

All the samples showed a lower peroxide value than the required one by the standard NM 08.5.090 [8] for the edible “extra virgin argan oil” category, including the cosmetic oil and the one obtained by solvent extraction [9], Table 3.

3.5 Spectrophotometric characteristics

$K_{270}$ and $\Delta K$ values corresponded to “extra virgin argan oil category” according to the Moroccan Standard [8] and the Codex [9]. $K_{232}$, which indicates the level of conjugated dienes, and therefore the oxidation status, is not mentioned in this standard, Table 3.

3.6 Total phenol

The total phenolic content, in all analyzed samples, was lower than 100 mg/kg whereas in the virgin olive oil, it exceeded 250 mg/kg, Table 4.

**Table 4.** Total polyphenol content of the oils

<table>
<thead>
<tr>
<th>Argan oils</th>
<th>Phenol content (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Edible oil</td>
<td>87.0</td>
</tr>
<tr>
<td>Cosmetic oil</td>
<td>72.4</td>
</tr>
<tr>
<td>Virgin olive oil</td>
<td>2885.0 - 855.0</td>
</tr>
</tbody>
</table>

3.7 Oil stability

The relative resistance of argan oil to oxidation in the Rancimat apparatus is reported in the literature, ranging from 12.2 [11] to 17.0 h [12], (values obtained at 110ºC).

**Table 5.** Oxidative stability of the oils

<table>
<thead>
<tr>
<th>Argan oils</th>
<th>Stability (h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soxhlet method extraction</td>
<td>26.85</td>
</tr>
<tr>
<td>Semiautomatic (edible)</td>
<td>25.51</td>
</tr>
<tr>
<td>Semiautomatic (cosmetic)</td>
<td>18.02</td>
</tr>
<tr>
<td>Traditional</td>
<td>16.40</td>
</tr>
<tr>
<td>Virgin olive oil [10]</td>
<td>87.5 – 198.4</td>
</tr>
</tbody>
</table>

Table 5 shows highly differences in the oxidative stability between the different categories of argan oils. The traditional oil presents the lowest stability. The oil extracted by solvent and the edible one obtained by semiautomatic process present a quite high stability, whereas the cosmetic oil has a low one.
Discussion

Ratio stone/seed is similar in the two fruits, whereas the relationships pulp/nut and pulp/seed are lower for the argan fruit, in the case of dry pulp as well as for the fresh one.

The fat content is similar for the argan and olive fruits, according to the fresh matter, but lower for argan seed, according to the dry matter.

Quality parameters values (acidity, peroxide value, K270 and ΔK) of edible oils are in the range of those mentioned for the edible virgin argan oils [8]. Nevertheless, the acidity value classifies the traditional argan oil in the category “lampante” and the one obtained by semiautomatic extraction process like “extra virgin oil”.

With respect to the traditional argan oil, a high acidity can be produced by combined action of the temperature and water added during the process and above all by a separation liquid/liquid made exclusively by decantation.

All the samples show a lower peroxide value which indicated a good oxidative resistance. However, edible oil obtained by semiautomatic extraction process presents a better oxidative stability than the cosmetic one obtained by the same method or the traditional one.

Finally, it is important to notice that the organoleptic characteristics (positive attributes and defects) do not enter in the commercial classification table of virgin argan oils as it goes for the virgin olive oil.

The traditional oil has the lowest stability, due probably to the difficulty to separate totally the water added during the extraction process. Moreover, adding water during the extraction impoverishes the oil in tocopherols and polyphenols (hydrosoluble components), enhancing the process of oxidation [2].

Oxidation stability of argan oil, due to his high unsaturated fatty acids content, could be justified by the presence of natural antioxidants such as polyphenols and tocopherols [2]. However, virgin olive oil (variety ‘Picual’) has a greater oxidative stability due to his higher polyphenol content.

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