Fatty Acids and Sterols of *Pistacia atlantica* Fruit Oil

Sir:

In Algeria the *Pistacia atlantica* (mastic tree) is the most characteristic plant species of the pre-Saharan regions of the country. The fruit, rich in oil, is used by the local inhabitants in many ways, as an antidiarrheal and also as a constituent of cattle feed. Some studies have been performed to determine the FA composition of the different pistachio species cultivated in large plantations (1–3). However, no investigation of the *P. atlantica* fruit oil of Algeria has been carried out. Thus, this study investigates the oil composition of *P. atlantica* with respect to sterols in order to classify it among the other known feed oils and to compare the oil compositon with the oils of other *Pistacia* species. Chemical characteristics of *P. atlantica* fruit oil are reported in Table 1 along with data already published for other *Pistacia* spp.

The oil content in the sample studied is 45%. This value is lower than that found in the *P. vera* L. from Turkey (57–62%) (3). Compared with other vegetable seeds oils (sunflower, peanut, cotton, corn) (4) the fruit of *P. atlantica* appears to be rich in oil. The iodine value of the oil (88) indicates that the oil contains a rather high amount of saturated FA. The saponification value (199 mg KOH/g) indicates that the oil contains FA with 16 to 18 carbon atoms. The oil shows a higher acid value than vegetable oils (4.8 mg KOH/g), which is perhaps due to poor conservation of the fruit.

The major FA are oleic (46%), linoleic (27.5%), and palmitic (24%). Clearly, the oil is rich in unsaturated FA (oleic + linoleic = 73%); the remaining FA are saturated (palmitic + stearic = 25.8%).

The identification of FAME is done by comparing the retention times on GC analysis with authentic samples as well as by the MS analysis of the individual peaks representing the FAME. The methyl esters of long-chain FA are easily identified by electron impact MS, and their spectra are characterized by a prominent molecular ion [M^+] and other significant ions equivalent to [M – 31] (loss of methanol), [M – 43] (loss of C_2, C_3, and C_4 as a result of rearrangement), together with a series of ions of the general formula $[CH_3COO(CH_2)_n]^+$; often, a molecular ion at *m/z* = 74 is formed by the MacLafferty rearrangement $[C_3H_6O_2]^+$. Methyl palmitate, methyl oleate, and methyl linoleate are characterized by the presence of peaks at *m/z* = 74, 55, and 67, respectively.

Sterols are identified in the oil by MS of the individual chromatographic peaks. The mass spectra of the silylated sterols presented evidence for molecular ions with values 458, 472, 484, and 486, and for molecular ions corresponding to the loss of a methyl group [M – 15], trimethylsilane hydroxy (TMSOH) group [M – 90] and [M – Me – TMSOH]. We observed the presence of two peaks at 213 and 255; the first corresponds to the cleavage of the D-ring with a transfer of one hydrogen atom; the second results from the cleavage of the side chain between C_{17} and C_{20}, which allowed us to determine the formula of the side chain by difference with the mass of molecular ion. The MS of the Δ^5 sterols shows the presence of the intense peak (usually peak 100%) at 129 accompanied with the ion [M – 129]. The presence of these two ions is characteristic of the sterol (TMS) with unsaturation at positions 5 and 6.

The major sterol of the *P. atlantica* fruit oil is β-sitosterol (87%), which is also found in some vegetable seeds oils (peanut, sunflower) (4) and in *P. vera* L. from Turkey (3).

If we compare the results for FA composition of *P. atlantica* with those of Ucciani (2), we see that the FA composition is very near to that of *P. lentiscus* oil from France and *P. terebinthus* from Turkey. Our results show that the oil has a higher content of unsaturated FA (oleic and linoleic 73.4%) and that the oil of *P. atlantica* fruit can be classified as an oleo-linoleic vegetable oil.

TABLE 1
Chemical Characteristics of Pistachio Oils

Parameter	Determined[d] (*Pistacia atlantica*)	Reported (*Pistacia* spp.)
Oil (%)	45	59.7[a]
Acid value (mg KOH/g)	4.8	—
Iodine value	88	94.2[a]
Saponification value (mg KOH/g)	199	188.2[a]
FA composition (%)		
16:0	24	9.6[a], 22.8[b], 24.5[c]
16:1	1.2	1.4[a], 1.2[c]
18:0	1.8	3.1[a], 1.8[c]
18:1	46	68.8[a], 55.3[b], 54.8[c]
18:2	27.4	17.1[a], 21[b], 13.9[c]
18:3	—	0.4[b], 2[c]
Sterol composition (%)		
Cholesterol	1.5	—
Campesterol	4.3	0.6[a]
Stigmasterol	—	6.3[a]
β-Sitosterol	87	85[a]
Δ^5-Avenasterol	4	1.7[a]
Δ^7-Avenasterol	3.2	—
Unidentified	—	6.4[a]

[a]From reference 3.
[b]From reference 2.
[c]From reference 1.
[d]Three samples were analyzed to determine data.

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REFERENCES

1. Daneshard, A., and Y. Aynechi, Chemical Studies of the Oil from *Pistacia* Nuts Growing Wild in Iran, *J. Am. Oil Chem. Soc. 57*:248–249 (1980).
2. Ucciani, E., *Nouveau Dictionnaire des Huiles Végétales, Composition en acides gras*, Lavoisier, Paris, 1995, pp. 442–443.
3. Mustafa, Y., S., Türcan Gürcan, and M. Özdemir, Oil Composition of Pistachio Nuts (*Pistacia vera* L.) from Turkey, *Fett/Lipid 3*:84–86 (1986).
4. Karlenskind, A., *Manuel des Corps Gras*, Lavoisier, Paris, 1992, pp. 116–228.
5. Willie, S.G., A. Berbard, A. Amos, and L. Tökés, Electron Impact Induced Fragmentation of Cholesterol and Related C-5 Unsaturated Steroids, *J. Org. Chem. 42*:725–732 (1977).

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