

**LEAF VOLATILE OIL CONSTITUANTS OF *SCHINUS*  
*TEREBINTHIFOLIUS* AND *SCHINUS MOLLE* FROM TUNISIA**

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**Abstract**

Members of the genus *Schinus* mainly *S. terebinthifolius* (Brazilian pepper tree) and *S. molle* (Peruvian pepper tree) have long been recognized as a consolidate sources of functional ingredients namely essential oils and phenols. Despite the substantial data on the volatile oil constituents of their fruits, the leaf volatile fraction has not received much interest. Consequently, the aim of the present study is to analyse the chemical composition of the essential oils of the aforementioned species.

The Results show that the hydrodistillation of air dried leaves yielded a pale yellowish oil with pungent and pepper like aroma in 0.75 and 1.06% (w/w dw) for *S. terebinthifolius* and *S. molle*, respectively. In both oil samples, monoterpenes hydrocarbons were the most represented class of volatile. Amongst their derivatives,  $\alpha$ -phellandrene (46.64–22.16%),  $\beta$ -phellandrene (28.53–6.49%),  $\alpha$ -pinene (4.94–5.20%), and  $\beta$ -myrcene (5.04–0.84%) were the main components. Even if the oil samples showed the same main constituents, there was a considerable qualitative and quantitative difference.

In summary, both species could be considered as potential sources of volatile oil because of their higher essential oil yields. Such feature appears to be characteristic of the genus *Schinus*. Moreover, the occurrence of some volatile compounds (e.g  $\alpha$ -phellandrene,  $\alpha$ -pinene,  $\beta$ -myrcene and  $\beta$ -caryophyllene) with documented biological activities could justify the traditional uses of these species.

**Key words:** *Schinus molle* - *Schinus terebinthifolius* - Leaves- essential oil composition- GC/MS.

**Introduction**

*Schinus molle* and *Schinus terebinthifolius* (Anacardiaceae) are evergreen trees native to South America, but they have been introduced and naturalized in many countries of the world (Taylor, 2005). In Tunisia, both species have been introduced as ornamental species at the end of the 1900s by the French colonizers. Their successful introduction in a non-native range is attributed to their high drought and heat tolerance, great potential to compete for nutritive resources and light, high growth rate and prolific seed production, as well as, their phytotoxic activities (Iponga et al., 2008; Zahed et al., 2010).

These species are highly aromatic and as consequence, numerous investigations of their volatiles oils have been undertaken. The basic constituents of the oils were  $\alpha$ -phellandrene,  $\beta$ -phellandrene, myrcene and  $\alpha$ -pinene (Marongui et al., 2004; El Hayouni et al., 2008; Zahed et al., 2010), to which are attributed the antibacterial, anti-fungal, anti-inflammatory, cytotoxic, insecticidal and allelopathic activities (Yequin et al., 2003, Abdel-Sattar et al., 2010, Zahed et al., 2010). However, most previous studies concerned with the chemical composition of the essential oil of these species were focused on fruits, and little is known about the leaf oil constituents of these species. Therefore, the present study was intended at identifying the chemical composition of the essential oil of the leaves of *S. molle* and *S. terebinthifolius* from Tunisian origin.

**Materials and methods**

Leaves from *S. molle* and *S. terebinthifolius* were randomly collected from plants growing in El Ghazala (Northern Tunisia), air-dried at room temperature (20±2 °C), ground, sifted through 0.5 mm mesh screen to obtain a uniform size and then submitted to hydrodistillation for 2 h by using a simple laboratory Quickfit apparatus that consists of 1000 mL distillation flask, a condenser and a receiving vessel. The obtained oils were recovered, dried over

anhydrous sulphate sodium and subsequently analyzed by gas chromatography mass spectrometry (GC-MS). GC-MS analyses were performed with an Agilent 6890 N gas chromatograph coupled to an Agilent 5975 B and an Agilent Chemstation software. Separation of oil constituents was performed on DB-5 capillary column (30 m × 0.25 mm, film thickness 0.25 µm). The temperature program was as follow: isotherm at 50 °C for 2 min, then ramped at 3 °C min<sup>-1</sup> to 300 °C and finally held at this temperature for 10 min. Helium was used as carrier gas at a flow of 1 mL min<sup>-1</sup>. One microliter of diluted oil samples in hexane was injected in the splitless mode. Identification of individual compounds was performed by matching their mass spectral fragmentation patterns with corresponding data (NIST 05 library).

### Results and Discussion

The hydrodistillation of the dried leaves yielded 0.75 and 1.06% (w/w on dry weight basis) for *S. molle* and *S. terebinthifolius*, respectively, of pale yellowish oils with a pungent and pepper-like aroma. These values were nearly similar to those obtained by Zahed et al. (2010) for *S. molle* leaves but greatly differed from those reported by Barbosa et al. (2007) who found 0.44% (w/w on fresh weight basis) for *S. terebinthifolius* leaves. The relative amount percentage of the main compounds identified in both oil samples are listed in Table 1. in order of their elution in the DB-5 column. As can be seen, both qualitative and quantitative differences were observed between the analyzed oils. Monoterpenes hydrocarbons were found to be the main chemical classes in both species accounting for 38.59 and 86.64% in *S. terebinthifolius* and *S. molle*, respectively. Whatever the species, this fraction was dominated by  $\alpha$ -phellandrene,  $\beta$ -phellandrene and  $\alpha$ -pinene. However, the leaf oils of *S. terebinthifolius* were distinguishable from those of *S. molle* by the abundance of sesquiterpenes (hydrocarbons and oxygenated sesquiterpenes). The main sesquiterpenes identified were  $\gamma$ -elemene, aromadendrene, allo-aromadendrene,  $\beta$ -cubebene, (*E*)-bisabolene, spathulenol, globulol and  $\gamma$ -gurjinene. At this point, the latter compounds in addition to some other monoterpenes namely (+)-4-carene,  $\gamma$ -terpinene and *cis*-ocimene could be considered as marker compounds since both species were cultivated, processed and under the same conditions and hence the observed differences were considered to be genetically determined. Studies in this way are currently in progress.

From biochemical stand point, the present composition displayed great qualitative and quantitative differences with previous investigations. Even if the main components identified herein were reported in other studies, there were striking differences in term of quality and quantities. In fact, in previous phytochemical investigation on the essential oil from *S. molle* leaves collected from Mograne (Northeastern Tunisia), we have reported that  $\alpha$ -phellandrene, limonene+ $\beta$ -phellandrene, myrcene and  $\alpha$ -pinene were the main components (Zahed et al., 2010). Seven years earlier, Wannaz et al. (2003) studied the chemical composition of the leaf essential oil of *S. areira* and found that  $\alpha$ -phellandrene, limonene,  $\beta$ -phellandrene, myrcene, camphene, sabinene,  $\alpha$  and  $\beta$ -pinene were the basic constituents. The same constituents in addition to elemol were reported as the main compounds in leaf oil constituents of Italian *S. molle* (Maffei and Chialva, 1990). Alpha pinene, limonene and  $\beta$ -pinene were found to be characteristic of the leaf oil constituents of Brazilian *S. terebinthifolius* while sabinene and limonene were found to be the main constituents of *S. molle* leaves (Atti dos Santos et al., 2009). More recently, Abdel-Sattar et al. (2010) reported *p*-cymene,  $\alpha$ -terpinene and  $\beta$ -pinene as the main volatile compounds of *S. molle* leaves from Saudi Arabia.

Overall, the chemical composition of the leaf essential oil from *S. molle* and *S. terinthifolius* varied considerably depending on the genetic background, origin of cultivation, season, plant parts analyzed and analytical methods.

Table 1

Chemical composition of the essential oils from *S. terebinthifolius*. and *S. molle* leaves

Compounds	RI	Percentage (%)	
		<i>S. molle</i>	<i>S. terebinthifolius</i>
$\alpha$ -Pinene	936	4.94	5.20
(+)-4-Carene	1011	–	1.77
<i>o</i> -Cymene	1025	2.92	2.30
$\alpha$ -Phellandrene	1032	46.64	22.16
<i>Cis</i> -ocimene	1048	–	0.90
$\beta$ -Phellandrene	1050	28.53	6.49
$\gamma$ -Terpinene	1057	–	1.23
$\beta$ -Cubebene	1390	–	10.06
$\gamma$ -elemene	1428	–	3.52
$\gamma$ -Gurjunene	1432	–	0.26
(+)-Aromadendrene	1440	–	1.18
<i>allo</i> -aromadendrene	1462	–	1.20
bicyclogermacrene	1496	6.42	27.11
elemol	1540	2.38	–
$\delta$ -cadinene	1578	1.64	2.04
Camphene	955	1.49	–
$\beta$ -caryophyllene	1420	–	3.19
$\beta$ -myrcene	992	5.04	0.84
$\gamma$ -E-Bisabolene	1509	–	3.89
(-)-Globulol	–	–	2.24
<i>o</i> -Menth-8-ene	–	–	1.74
Spathulenol	1578	–	1.85

\*RI: Retention index relative to *n*-alkanes (C<sub>7</sub>–C<sub>20</sub>) on DB-5 column

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