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Chemical Composition of the Essential Oil of *Pistacia lentiscus* L. from Eastern Morocco

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Abstract : The essential oil from leaves of *Pistacia lentiscus* L., an aromatic member of the Anarcadiaceae family from Eastern Morocco, obtained by hydrodistillation, was analysed by GC-FID and GC-MS. The constituents were identified by their mass spectra and Kovats'indices. About 104 constituents were detected in the oil. From these components, about 40 could be identified and quantified, comprising over 88.6% of the oil. The main constituents of the oil were: myrcene (39.2%), limonene (10,3) β-gurjunene (7.8), germacrene (4.3%), α-pinene (2.9%), muurolene (2.9), α-humulene (2.6), Epi- bicyclosesquiphellandrene (2.5), β-pinene (2.2). The results of this study shows both qualitative and quantitative differences with oils from *P. lentiscus* L of other countries.

Keywords: *Pistacia lentiscus;* Anacardiaceae; essential oil composition; myrcene; limonene.

1. Introduction

Pistacia lentiscus L. is an aromatic member of the Anarcadiaceae family. It is found in the flora of many Mediterranean region. In Morocco, *P. lentiscus* L. occurs in various regions, particularly in the mid-west of the Rif Mountains [1]. The aerial parts of *P. lentiscus* L. has traditionally been used in the treatment of hypertension and possesses stimulant and diuretic properties [2]. Mastic gum from *Pistacia* has been used by traditional healers for the relief of upper abdominal discomfort, stomachaches, dyspepsia and peptic ulcer [3]. In the past, *P. lentiscus* L. oil

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is used in several industrial application such as perfumery, food and pharmaceutical [4] and it has been re-evaluated recently as a flavouring in alcoholic beverages and chewing gum [5]. Several studies have also reported that essential oil from aerial parts of *P. lentiscus* L. possesses appreciable biological properties such as antifungal, antibacterial an antimicrobial [6-11].

The genus *Pistacia* has numerous species and their essential oil composition have been studied by several authors [4-22]. Some researches reported the chemical composition of the essential oil from aerial parts of *P. lentiscus* L. of diverse regions of Morocco [6,13] and divers countries of the Mediterranean region [4-11, 13-22]. The chemical composition of the essential oil derived from the aerial parts is not clear, it is greatly influenced by both geographical origin and isolation technique. In relation to our concern for the valorisation of essential oils of the eastern Morocco flora, we have studied the essential oil of leaves of *P. lentiscus* L. grown in Tafoghalt (Eastern Morocco) obtained by hydrodistillation to acquire valuable information about the highest concentration of the major oil components and to compare it with some oils witch come from different regions of Morocco and other countries of the Mediterranean region.

2. Materials and Methods

2.1. Plant material

Samples of *Pistacia lentiscus* L. were collected in Eastern Morocco (Tafoghalt, 513 km northeast of Rabat) in February 2008. Identification of the species was confirmed in Scientific Institute in Rabat (Morocco). A voucher specimen (n° 77618) was deposited at the herbarium in this institute. The oil was obtained by hydrodistillation on a Clevenger type apparatus for 3 h of the leaves of the plant. The oil yield was calculated relative to the dry matter. The essential oil was collected, dried over anhydrous sodium sulphate and stored at 4° C until used.

2.2. Gas Chromatography

Essential oil samples of 1 µl were injected neat (directly) into an HP 6890 gas chromatography equipped with a flame ionisation detector (FID) and a 30 m x 0.25 mm HP-5 (cross-linked Phynel-Methyl Siloxane) column with 0.25 µm film thickness (Agilent), was used for the study. Helium was used as carrier gas, the flow through the column was 1,4 ml/min, and the splitless mode was used. The column was maintained at 40°C for 5 min, increased to 230°C at rate of 10°C/min and finally raised from 230 to 280 at rate of 30°C/min.

2.3. Mass Spectrometry Analysis

The oil was analysed by Gas Chromatography-Mass Spectrometry (GC-MS) using a Hewlett Packard 6890 mass selective detector coupled with a Hewlett Packard 6890 gas chromatograph.

The MS operating parameters were as follows: ionisation potential, 70 eV; ionisation current, 2 A; ion source temperature, 200°C, resolution, 1000. Mass unit were monitored from 30 to 450 m/z. Identification of components in the oil was based on retention indices relatives to nalkanes and computer matching with the WILLEY 275.L library, as well as by comparison of the fragmentation patterns of mass spectra with those reported in the literature [23].

The chromatographic conditions were identical to those used for gas chromatography analysis.

3. Results and Discussion

An oil yield of 0.14 % was obtained. This is in accordance with those obtained by Castola et al. [14]. Nevertheless, it is less than those reported by Zrira et al. [13] for the plants collected from Oulmes, Chaouuen and Mehdia in Morocco and Congiu et al. [21] for the plant collected from Sardinia in Italy. The oil yield obtained by hydrodistillation from a aerial parts of *P. lentiscus* L. was 0.2 [13] and it was 0.4% from the even parts of plant obtained by but supercritical CO_2 [21]. The oil yield of *P. lentiscus* L. seems to depend on the nature of parts of plants used for extraction and also on the mode of extraction.

Due to the complexity of the results, a total of 40 components have been identified in the volatile profile of the essential oil, representing 88.6% of the total oil components which were detected and are listed in table 1 with their percentage composition and Kovat's indices. Our results (Table I) show that the Tafoghalt oil contained about 57.9% monoterpene hydrocarbons. The major constituents of the oil of eastern Morocco *Pistacia lentiscus* L. were myrcene (39.2%) while limonene (10.3%), β-gurjunene (7.8), germacrene (4.3%), α-pinene (2.9%), muurolene (2.9), α-humulene (2.6), Epi- bicyclosesquiphellandrene (2.5), β-pinene (2.2) were also present at relatively high percentage. In a previous study, the chemical composition of essential oils of *Pistacia lentiscus* L. from Morocco populations have been reported [6, 13]. Lamiri et al. [6] reported that myrcene (38%), limonene (15.5%), *p*-cymene (10.1%) and α-phellandrene (7.6%) were the major compenents. The percentage of myrcene (39.2%) in our essential oil revealed a similarity to that described by Lamiri et al. [6]. However, The data presented here are not in agreement with those from Zrira et al. [13] who reported the composition of *P. lentiscus* L oil of 3 samples collected from three regions of Morocco (Mehdia, Oulmes and Chaouen). The authors identified 45 compounds amounting to 92% of the total oils. The main components of Mehdia oil were terpinen-4-ol (14.5-19.3%), caryophyllene oxide (6.5-10.3%) and limonene (6.7–8.1%) while α-pinene (16.5-38.5%), β-myrcene (10.2-11.5%) and limonene (6.8-9.8%) were the abundant constituents of Oulmes oil. From Chaouen oil, terpinen-4-ol (32.7-43.8%), α-pinene (7.1-13.5%) and bornyl acetate (6.8-10.3%) were the major compounds. Differences between the oil components show the role of place in the growth of the plant.

In other contries of the Mediterranean region, several studies have been studied the chemical composition of *P. lentiscus* L. oil [4-11, 13-22] and several compositions were observed. Myrcene (39.2%), which is the major componds of our essential oil, has also the abundant compond in the samples from Morocco (38%) [6], France (Corsica) (76.9%) [14], Spain (27%) [15], Italy (25.2%) [4] and Algeria (23.0-33.1%) [16]. On the other hand, α-pinene was the the major compound of the essential oils from Morocco (Oulmes) (16.1-38.5%) [13], Algeria (20.0-34.2% and 19%) [16-17], Tunisia (16.8%) [10], Greece (24.9-9.4%) [9], Italy (14.8-22.6% and 18%) [11, 18], Spain (13.0%) [5] and France (31.9%) [14]. Besides, terpinen-4-ol was mainly present in the oils from Morocco (Chaoun, Mehdia) (14.5-19.3%) [13], Algeria (17.3-34.7%) [19], Turkey (30.0% and 29.2%) [8,20], and France (25.6%) [14]. Other chemotypes were also reported: longifolene (16.4-12.8% Algeria) [17] ; limonene (47.0% France (Corsica) and 44-29% Algeria) [14,16] ; β-caryophellene (19.3-13.1% Algeria [16] and 31.5% Italy (Sardinia)) [21]. Finally, Egyptian oil contained large amounts of α-3-carene (65.3%) [21].

Table 1. Components of the oil from the *P. lentiscus* L. from Eastern Morocco.

RI	Compound	Percent Composition
915	Tricyclene	0.1
928	α-Pinene	2.9
943	Camphene	0.5
971	β-Pinene	2.2
991	Myrcene	39.2
999	α-Phellandrene	0.2
1014	α-Terpinene	0.5
1023	Unknown	0.2
1029	Limonene	10.3
1047	Trans - β-Ocimene	0.6
1058	Γ-Terpinene	0.7
1086	Terpinolene	0.5
1098	Linalol	0.7
1120	Allo-Ocimene	t
1139	Camphor	0.1
1179	Terpineol-4	1.6
1192	α-Terpineol	0.1
1226	β-Cyclocitral	t
1282	Vitispirane	0.1
1286	Bornyl acetate	t
1290	2-Undecanone	0.5
1352	α-Cubebene	0.1
1381	α-Copaene	0.7
1390	β-Bourbonene	0.1
1395	β-Elemene	1.0
1403	Methyleugenol	t
1429	β-Gurjunene	7.8
1438	Epi- Bicyclosesquiphellandrene	2.5
1463	α-Humulene	2.6
1484	α-Amorphene	1.3
1491	Germacrene D	4.3
1507	α-Muurolene	2.7
1521	Γ-Cadinene	0.3
1530	Δ-Cadinene	2.5
1544	α-Cadinene	0.1
1554	Elemicin	0.1
1562	Nerolidol	0.2
1630	Fonenol	0.2
1664	T-Cadinol	1.2
1767	Benzyl benzoate	0.1

RI: retention indices on HP-5 capillary column.

t : trace, < 0.1%

Table 2. Major constituents of *P. lentiscus* L. oil of different origins.

Origins	**Chemotype**
Morocco (Tafoghalt), Morocco [6], Algeria [16], Italy (Sicily) [4], France (Corsica) [14] and Spain [15]	myrcene
Morocco (Oulmes) [13], Algeria [16-17], Tunisia [10], Greece [9], Italy [11,18], Spain [5] and France (Corsica) [14]	α-pinene
Morocco (Chaoun, Mehdia) [13], Algeria [19] Turkey [8,20] and France (Corsica) [14]	terpinen-4-ol
Algeria [16] and France (Corsica) [14]	limonene
Algeria [17]	longifolene
Italy (Sardinia) [21] and Algeria [16]	β-caryophellene
Egypt [22]	d-3-carene

The majority of leafs oils were characterized by the occurrence of monoterpenes as major components. However, our study and previous studies show clear qualitative and quantitative differences and different chemotypes were observed. It seems that environmental factors such as geography, temperature, day length, nutrients, etc., were considered to play an important role in the chemical composition of *P. lentiscus* L. oil. The genetic characteristics of the plant can also influence the chemotype of *P. lentiscus* L essential oil. These factors influence the plant's biosynthetic pathways and consequently the main characteristic components and their percentage. These phenomena induced the existence of different chemotypes which distinguish *P. lentiscus* L. oil of different origins (Table 2). Further investigation should be carried out to define the genotype of the *P. lentiscus* L.

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