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Chemical Composition of the Essential Oil of Unripe Galls of *Pistacia atlantica* Desf. from Algeria

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Abstract: The essential oils obtained by hydrodistillation of unripe galls of *Pistacia atlantica* and collected from both male and female trees yielded 0.53% and 0.46% v/w, respectively. The essential oils were analyzed by GC and GC-MS showing the occurrence of a new Δ^3-carene rich chemotype showing a content of 75.34%. The second is the well known chemotype *α*-pinene/*β*-pinene, which is rich in *α*-pinene (59.01%) and *β*-pinene (13.26%).

Keywords: *Pistacia atlantica*, essential oil, unripe galls, chemical composition, chemotype, Δ^3-carene.

1. INTRODUCTION

The genus *Pistacia* (Anacardiaceae) is widely distributed in the Mediterranean area [1]. *Pistacia atlantica* Desf. is a tree located in North Africa, which can reach over 20 m in height and grows in arid and semi-arid areas [2]; its popular name is "Butom". The title plant is valuable as the source of mastic gum, exudates which strengthens gums, deodorizes breath, fights coughs, chills, and stomach diseases [3]. Moreover, the galls of *Pistacia atlantica* are used as an embalming agent by rural inhabitants. They are also known in Arabic as "afse" and are edible and sold in markets.

The previously reported few studies on the chemical composition of the essential oils of different parts of *P. atlantica* tree dealt with leaves [4-9], fruits [10], oleoresin [11], and galls [6]. Based on the fact that: the yield, the smell, and the color of the essential oils of the unripe galls are quiet different from those of mature galls, the aim of the present work is to study the chemical composition of these essential oils and to investigate the possible occurrence of new plant chemotypes.

2. EXPERIMENTAL

2.1. MATERIALS AND METHODS

2.1.1. Plant Material

Fresh unripe galls of *Pistacia atlantica* Desf., were collected from the bottom branches of male and female trees in July 2010. The region of the collection belongs to a wild area located 40 km south the town of Laghouat.

2.1.2. Preparation of Samples

The essential oils were obtained by hydrodistillation using a Clevenger apparatus. The obtained essential oils were dried over anhydrous sodium sulphate, and stored at +4°C until analysis.

2.1.3. Gas Chromatography (GC)

A CP-Varian 3800 gas chromatograph was used equipped with a flame ionization detector (FID), and a UB-Wax fused silica capillary column (60m×0.32mm, 0.25µm film thickness). Oven temperature was programmed from 50°C to 250°C at a rate of 3°C/min and maintained at 250°C for 10 min. Injector and detector temperatures were set at 250°C and 260°C, respectively. Helium was the carrier gas at a flow rate of 1mL/min.

2.1.4. Gas Chromatography-Mass Spectroscopy (GC/MS)

The GC/MS analysis was performed on an AGILENT 6890 GC/CMSD 5973 equipped with a capillary column UB-Wax (30m×0.25mm, 0.25µm film thickness) and a 70 eV EI quadrupole detector. Helium was the carrier gas, at a flow rate of 1mL/min. Injector and MS transfer line temperatures were set at 250°C and 220°C, respectively. Column temperature was programmed same as the gas chromatography. Diluted samples (1:100 (v/v), in ethanol) of 1µL were injected manually using split less mode.

2.1.5. Compound Identifications

Linear retention indices were calculated relative to linear homologous series of n-alkanes (C_8-C_{40}). The identifications of the components were based on the comparison of their mass spectra with those of Wiley and NIST (National Institute of Standards and Technology) libraries, as well as by comparison of their retention indices with those of references [7-9] and by co-injections of some pure authentic samples.

3. RESULTS AND DISCUSSION

Freshly collected unripe galls were characterized by a white color tending to a little brownish one. The essential oils were obtained in very similar yield values: 0.46 and 0.53% (v/w). Unlike mature galls, the unripe galls were

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obtained with a transparent color and different smell (light good smell). These yields were higher than of those of mature galls that ranged from 0.1 to 0.2 (v/w).

The composition of two samples (from male and female tree) of unripe galls of *P. atlantica* essential oils were analyzed by GC and GC-MS. Quantitative and qualitative dif-

Table 1. Chemical Composition of Essential Oils of Unripe Galls of *Pistacia atlantica*

Compounds	Sample 1 (Female)	Sample 2 (Male)	RI[a]	Identification
Tricyclene	tr	1,01	1011	MS, RI
α-Pinene	2.2	**59.01**	1025	MS, RI
Camphene	tr	3.91	1063	MS, RI
β-Pinene	0.18	**13.26**	1106	MS, RI
Sabinene	tr	0.69	1119	MS, RI
Δ^3-Carene	**75.34**	0.6	1147	MS, RI
Myrcene	1.73	1.32	1165	MS, RI, AS
α-Phellandrene	0.23	tr	1169	MS, RI
Isocineole	0.31	tr	1183	MS, RI
Limonene	3.21	**5.51**	1205	MS, RI, AS
β-Phellandrene	1.25	1.48	1214	MS, RI
γ-Terpinene	tr	tr	1247	MS, RI
p-Cymene	0.74	1.69	1274	MS, RI, AS
α-Terpinolene	1.53	tr	1296	MS, RI
β-Thujone	0.18	0.11	1450	MS, RI
Camphor	0.12	tr	1477	MS, RI
p-Menth-3-en-1-ol	tr	0.17	1586	MS, RI
Bornyl acetate	tr	1.31	1591	MS, RI
Terpinen-4-ol	0.11	0.67	1617	MS, RI, AS
Myrtenal	0.09	tr	1643	MS, RI
E-Pinocarveol	tr	0.27	1670	MS, RI
Cryptone	0.5	0.72	1694	MS, RI
α-Terpineol	3.41	2.79	1707	MS, RI, AS
p-Cymen-8-ol	0.66	0.46	1869	MS, RI
Spathulenol	0.37	0.69	2143	MS, RI
Myristic acid	0.19	0.1	2726	MS, RI
Palmitic acid	0.14	tr	2912	MS, RI
Total identified	**92.49**	**95.77**		
Monoterpenes HC	86.41	88.48		
Oxygenated monoterpenes	4.88	5.78		
Total monoterpenes	**91.29**	**94.26**		
Essential oil yield % (v/w)	0.46	0.53		

tr = trace (<0.05%).
[a] Linear retention indices relative to homologous n-alkanes C_8-C_{40} obtained on UB-Wax column.
RI: Identification relative to linear retention indices.
MS: Identification relative mass spectra.
AS: Identification relative to retention indices of pure authentic samples.

ferences were found between the studied samples. Twenty-seven compounds of the essential oils were identified representing 92.49% and 95.77% of the total compositions, respectively. The samples were very rich in monoterpenes: 91.29% and 94.26%, respectively (Table **1**). Among monoterpenes identified, the monoterpenes hydrocarbons were the most predominant with percentages of 86.41% and 88.48% respectively. The main components of the essential oils identified in the two samples were *α*-pinene, *β*-pinene, limonene and Δ^3-carene. A new chemotype rich in Δ^3-carene was identified with a high composition percentage of this monoterpene (75.34%) and a low content of *α*-pinene (2.2%) and *β*-pinene (0.18%). The second chemotype is *α*-pinene/*β*-pinene chemotype with high percentage of *α*-pinene (59.01%) and *β*-pinene (13.26%), and a low content of Δ^3-carene (0.6%). This last chemotype was already reported by a previous work related to the essential oil of mature galls [6]. Unlike the *α*-pinene/*β*-pinene chemotype which is characterized by two different compounds, the Δ^3-carene chemotype is characterized by only one main compound. The percentage of limonene is almost the same for the two chemotypes identified with compositions of 3.21% and 5.51%, respectively. The same observation could be extended to the remaining compounds which were contained in low percentages.

CONCLUSION

The essential oils obtained by the hydrodistillation of unripe galls of *P. atlantica* gave higher yields in comparison with those obtained by mature galls. This is economically very important considering that this essential oil is used as natural additive (colorless, spicy odor), as an antioxidant or as an antibacterial. Further studies should be carried out to this. The current investigation showed the occurrence of a new chemotype in the essential oil of unripe galls of *P. atlantica*. This chemotype (Δ^3-carene) is very different of the well known *α*-pinene/*β*-pinene one. Further studies using greater numbers of samples from plants coming from different regions should be performed using statistical analysis (PCA, DFA, HAC…) in order to investigate the distribution and the range percentages of the main compounds in each of the two chemotypes reported herein.

NOTE

Based on the fact that the yield, the smell and the color of the essential oils of the unripe galls found herein our investigation are quiet different from those of mature galls, the aim of the present work is to study the chemical composition of these essential oils and to investigate the possible occurrence of new chemotype within these essential oils. The presence of different chemotypes is very important for the study of the antioxidant and the biological activities of this essential oil.

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