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Moroccan traditional fragrance based essential oils: Preparation, composition and chemical identification

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ABSTRACT

In this work, we have achieved a chemical study on the preparation of fragrance designed for men in traditional Moroccan style, these fragrance are based of essential oils of five medicinal plants of Moroccan origin: Lavandula dentata, Mentha spicata, Thymus vulgaris, Rosmarinus officinalis, Cladanthus mixtus. Essential oils are obtained from the plants by conventional extraction Clevenger, and the chemical composition of essential oils of this species was examined by GC-MS. The species examined shows that Lavandula dentata was rich in 1,8-cineole (47.42%) and sabinene (6.34%), Mentha spicata was rich in menthone (32.51%) and menthol (12.70%), Thymus vulgaris was rich in thymol (43.47%) and p-cymene (16.97%), Rosmarinus officinalis was rich in 1,8-cineole (45.34%), α-pinene (20.74%) and camphor (6.13%), and Cladanthus mixtus was rich in camphor (21.36%), β-myrcene (13.76%), santolinatriene (10.10%) and santolina alcohol (5.37%). Furthermore, the classic strategy of preparing this fragrance from essential oils could potentially be applied in global industries.

Keywords: fragrance, preparation, essential oils, GC-MS, chemical identification.

INTRODUCTION

Nowadays, scientific advance is being used in the development of innovative products. medecine, cosmetics, personal care and beauty/pharmaceutical industries have become a multi-billion dollar international market. Among the areas targeted by the industries and the use of natural products that present an advantage of the use of natural resources, on the one hand marketed as Bio-products. **[1-5]**

Essential oils are aromatic oily liquids obtained from different plant parts and widely used as cosmetic and beauty/pharmaceutical industries. **[6]** Volatile oils have been shown to biological possess (antibacterial, antifungal, antiviral, insecticidal, antioxidant properties …). **[7]** Some oils have been used in tumor treatment, **[8]** while others have been used in food preservation **[9]** aromatherapy **[10]** and fragrance industries. **[11]** There has been an increased interest in looking at biological/pharmaceutical properties of extracts from aromatic plants particularly essential oils. **[12]**

On the other hand, Morocco is undoubtedly both a well-known name and a significant producer in the world of essential oils. This is the result of several main factors: The geography and climate, which is governed by the Mediterranean Sea, the Atlantic Ocean, the desert in the south and its three main mountain ranges. Morocco hosts a complete range of Mediterranean climates and soils that favour an extremely rich biodiversity, including an impressive variety of aromatic plants (both Mediterranean classics and endemic species). **[13-15]**

Lavandula dentata (lavender) locally known ''Khezama'' member of the *Lamiaceae* family. *Mentha spicata* (mint) locally known ''Naanaa'' member of the *Lamiaceae* family. *Thymus vulgaris* (Thyme) locally known "Zaatar"

member of the *Lamiaceae* family, *Rosmarinus officinalis* (rosemary) locally known ''Azir'', member of the *Lamiaceae* family. *Cladanthus mixtus* (Anthemis) locally known '' Babunege'' member of the *Asteraceae* family. All plants are widely used in moroccan folk medicine for its expectorant, antitussive, antibroncholitic, antispasmodic, anthelmintic, carminative and diuretic properties. **[16-20]** This plants species has been reported for their antibacterial activities and for other applications Due to the combination uses of these five plants in Moroccan traditional fragrance, this study aimed to determine chemical identification of essential oils of this plants, and major composition of compounds involved in fragrance.

MATERIALS AND METHODS

2.1. Plant materials

Aerial parts of the plants were purchased from the local market in Casablanca city, Kingdom of Morocco (origin of species are displayed in Table 1), and identified at Department of Biology, Faculty of sciences Ben M'sik, Hassan II University. Voucher specimen of the plants were dried and deposited at the herbarium of laboratory.

Figure 1: Origin of the medicinal plants used in the fragrance

Lavandula dentata	Berkane (Eastern Morocco)
Mentha spicata	Meknes (Atlas median)
Thymus vulgaris	Oujda (Eastern Morocco)
Rosmarinus officinalis	Sefrou (Atlas median)
Cladanthus mixtus	Temara (western Morocco)

2.2. Essential oil extraction

Dried plants were submitted to steam distillation in a Clevenger-type apparatus for 3 h. The essential oils obtained were separated from water and dried over anhydrous Na_2SO_4 then stored at 4 ◦C until use.

2.3. Essentials oils analysis

The qualitative analysis of essential oils is done by gas chromatography coupled to mass spectrometry GC-MS (Hewlett Packard 5971A). Determining the relative proportions of various molecules is obtained by gas chromatography coupled with flame ionization (GC-FID). Analysis by GC-MS and GC-FID are made under identical conditions. GC-MS was performed on a DB-5 column (5% phenyl methyl siloxane) whose dimensions are: length: 30 m; diameter: 250 µm; film thickness 0.32 microns. The applied temperature program was 40 °C for 5 min, 40 to 200 °C at 3 °C/min then held at 200 °C for 5 min. The carrier gas was helium (pressure: 49.9 kPa, flows: 1mL/min). The source of the mass spectrometer to a temperature of 230 °C and the mass range is scanned from 50 to 350 amu.

Identification of the components was based two processes. First method: on the comparison of their GC retention indices (RI) on non polar and polar columns, determined relative to the retention time of a series of n-alkanes with linear interpolation, with those of authentic compounds or literature data. And second method on computer matching with commercial mass spectral libraries and comparison of spectra with those of our personal library. Relative amounts of individual components were calculated on the basis of their GC peak areas on the two capillary Rtx-1 and Rtx-Wax columns, without FID response factor correction.

2.4. Preparation of Fragrance

In a 100mL volumetric flask, were added 0.5 mL of each essential oil, and then were added 30 ml of Moroccan Rose Water pure (rose water from Kalaa Mgouna City - the Atlas Mountains of Morocco), and mixture is completed by ethanol 70° until the gauge of the flask.

RESULTS AND DISCUSSION

Following we described previously, plant essential oils and extracts have been used for many thousands of years, especially in food preservation, pharmaceuticals, alternative medicine and natural therapies. **[21]** It has long been acknowledged that some plant essential oils exhibit biological properties **[22]** and it is necessary to investigate those plants scientifically, which have been used, in traditional medicine to improve the quality of healthcare. In this paper, Another enhancement of essential oils in perfumery, wich the essential oils of *Lavandula dentata*, *Mentha spicata*, *Thymus vulgaris*, *Rosmarinus officinalis* and *Cladanthus mixtus*, used in preparation Moroccan traditional fragrance. The fragrance was prepared by mixing five essential oils with rose water and ethanol 70 °. The smell of the mixture is very remarkable.

After obtaining essential oils by distillation Clevenger, colors and yields were determined, where they are displayed in Table 2. Even so, the quantities are small, the smells of essential oils are strong. The identification of compounds of each essential oil has been realized by gas chromatography coupled to mass spectrometry GC-MS. The results of these analyzes are shown in Table 3.

Table 2: Colors and yields of the essential oils used in the Moroccan fragrance

Essential oil	Color	Yield (%)
Lavandula dentata	Yellow	0.74
Mentha spicata	Yellow -green	0.58
Thymus vulgaris	Yellow - orange	1.12
Rosmarinus officinalis	Yellow	1.24
Cladanthus mixtus	Yellow	0.43

Table 3: Percentages of chemical compositions of the essential oils used in the Moroccan fragrance

Composition	*Lavandula d.*	*Mentha s.*	*Thymus v.*	*Rosmarinus o.*	*Cladanthus m.*
α-bisabolol	-	-	-	-	0.45
α-cadinol	0.01	-	-	0.01	-
α-campholene	0.83	-	-	-	-
α-eudesmol	0.83	-	0.01	-	-
α-fenchene	0.48	-	-	-	-
α-fenchol	0.01	-	-	-	-
α-humulene	-	-	0.20	-	-
α-muurolene	-	-	-	-	0.45
α-pinene	3.78	1.65	1.20	20.72	4.38
α-selinene	1.14	-	-	-	-
α-terpinen-7-al	-	0.01	0.01	-	-
α-terpinene	-	0.04	0.84	0.23	-
α-terpineol	-	0.01	-	2.87	-
α-thujene	-	0.03	2.17	0.28	-
β-caryophyllene	-	0.05	3.51	-	-
β-cubebene	-	-	-	-	0.25
β-myrcene	-	-	1.43	-	13.76
β-pinene	-	1.84	0.40	3.58	-
γ-cadinene	-	-	-	-	0.26
γ-elemene	-	-	-	-	1.12
γ-gurjunene	-	-	-	-	0.37
γ-terpinene	-	-	2.10	-	0.41
(1r)-(-)-myrtenal	4.35	-	-	-	-
(e)-caryophyllene	-	-	-	-	0.79
(e)-nerolidol	-	-	-	-	0.72
(e)-β-farnesene	-	-	-	-	3.01
(z)-pinocarveol	-	-	-	-	1.45
1.10-di-epicubenol	-	-	-	-	0.89
1.8-cineol	47.42	3.64	0.88	45.34	3.14
14-hydroxy-9-epi-(e)-caryophyllene	-	-	-	-	0.61
Bicyclogermacrene	-	-	-	-	0.31
borneol	2.28	0.01	1.33	1.65	0.63
cadinene	-	0.86	1.78	-	-
camphene	0.68	1.19	1.81	2.26	0.02
camphinelone	2.52	-	-	-	3.78
camphor	-	-	0.15	6.13	21.36
camphre	-	-	-	-	0.23
carvacrol	-	-	3.2	-	-
carvone	-	-	0.02	0.06	-
carvotanacetone	0.01	-	0.15	-	-
caryophyllene	-	0.15	0.01	-	-
caryophyllene acetate	-	-	-	-	2.11
caryophyllene oxide	-	-	-	-	0.47
cis-carveol	0.02	-	-	0.31	-
cis-α-bisabolene	-	-	-	-	3.02
cubenol	-	0.01	0.01	0.01	-
cumin	-	-	0.15	-	-
dehydro-sabina ketone	0.06	-	-	-	-
dihydro-eugenol	-	-	0.04	-	-
e-caryophyllene	-	0.34	-	0.02	-
eucalyptol	0.01	-	0.01	-	-
fenchone	-	0.02	-	0.02	-

germacrene	-	2.12	0.40	-	1.27
isoborneol	-	-	0.01	-	-
limonene	0.02	2.10	0.06	1.72	1.24
linalool	3.76	0.02	2.36	0.12	0.01
menthol	-	12.70	-	-	-
menthone	-	32.51	-	-	-
myrcene	-	1.08	-	-	0.86
Myrcenol	-	-	-	-	1.16
Myrtenal	-	0.03	-	-	-
Myrtenol	2.76	-	-	-	-
ortho-cresol	-	-	0.01	-	-
p-cymen-7-ol	0.01	-	-	-	-
p-cymen-8-ol	0.01	-	0.01	-	-
p-cymene	0.51	0.03	16.97	2.02	0.82
Pinene	0.01	0.01	0.02	0.01	-
Pinocarvone	1.32	-	-	-	1.24
Piperitone	-	0.02	-	-	-
p-menth-4(8)-en-9-ol	0.26	-	-	-	-
Pulegone	-	1.73	-	-	-
Sabinene	6.34	2.13	0.71	0.18	0.76
santalol acetate	-	-	-	-	1.30
Santolina alcohol	-	-	-	-	5.37
Santolinatriene	-	-	-	-	10.10
terpinene-4-ol	0.71	0.02	1.89	1.98	0.01
Terpinolene	0.01	-	-	0.06	-
Thymol	-	-	47.43	-	2.12
thymol methyl ether	-	-	0.21	-	-
trans-ocimene	-	-	0.01	-	-
Verbenene	0.11	-	-	-	-
Verbenol	0.18	-	-	0.12	0.23
Verbenone	1.13	-	-	-	-
yomogi alcohol	-	-	-	-	4.11

Lavandula sp. is one of the most useful medicinal plants. Commercially, the lavender is an important source of essential oil that is widely used in fragrance industry including soaps, colognes, perfumes, skin lotions and other cosmetics. **[23]** For the essential oil of *Lavandula dentata*, we identified 81.57% of its chemical composition, while the majority compounds are 1,8-cineol (47.42%) and sabinene (6.34%), and they there are several remarkable compounds with percentages between 2 – 4 % among those constitent we note: (1r)-(-)-myrtenal, α-pinene, linalool, myrtenol, camphinelone and borneol.

Known as mint, *Mentha sp*. is used for medicinal and food purposes. Its cultivation has economic importance, due to its ability to produce and store essential oil, whose main constituent is menthol, used in oral hygiene products, pharmaceuticals, cosmetics, and foods. **[24]** Menthol also has high antifungal and antibacterial potentials, thus becoming one of the most demanded substances by the perfums and fragrances industry. Because of this and other reasons, *Mentha sp*. essential oil ranks high in terms of total sales volume. **[25]** About our chemical study of the essential oil of *Mentha spicata*, we identified 64.35% of the total chemical composition, while the majority compounds are menthone (47.42%) and menthol (12.70%), as they exist more constituents with varying percentages: 1,8-cineol (3.64%), sabinene (2.13%), germacrene (2.12%) and limonene (2.10%).

The aromatic and medicinal properties of the genus Thymus have made it one of the most popular plants all over the world. Its have been used for many thousands of years in several applications. Thymus species are commonly used as herbal tea, flavoring agents and medicinal plants, and it used especially in food preservation, pharmaceuticals, alternative medicine and natural therapies. **[26]** The chemical study that we conducted of the essential oil of *Thymus vulgaris*, gave the identification of 91.50% of the total chemical composition, where the majority compounds are thymol (43.47%) and p-cymene (16.97%), and other compounds were detected with large percentages such as: β-caryophyllene (3.51%), carvacrol (3.20%), linalool (2.36%), α-thujene (2.17%) and γ-terpinene (2.10%).

On the other hand, *Rosmarinus officinalis* is of considerable importance in term of its great an important medicinal and aromatic value. This plant has been widely used in the traditional medicine and cosmetics. They are also used as flavouring agents in foods. *Rosmarinus officinalis* essential oil is also important for its medicinal uses and its powerful antibacterial, cytotoxic, antimutagenic, antioxidant, antiphlogistic and chemopreventive properties, it is now evident that biological activities of the essential oils/extracts are correlated to the presence of specific chemical compounds. **[27]** For the analysis of our study of the essential oil of *Rosmarinus officinalis*, was confirmed the literature studies, hence the identification of the total chemical composition gives 89.70%. The identified compounds are: 1,8-cineole (45.34%), α-pinene (20.74%) and camphor (6.13%) such as major constituents, and

other compounds have had varying percentages, in particular: β-pinene (3.58%), α-terpineol (2.87%), camphene (2.26%) and p-cymene (2.02%).

Other hand, recent studies have shown that essential oils of *Cladanthus mixtus* and their compounds have great potential as antimicrobial agents and in many medical industries. **[28]** About our chemical analysis of the essential oil of Cladanthus mixtus, we identified 94.59% of the total chemical composition, while the majority compounds are menthone camphor (21.36%), β-myrcene (13.76%), santolinatriene (10.10%) and santolina alcohol (5.37%), and other compounds have had varying percentages between 2% at 4%: α-pinene, yomogi alcohol, Camphinelone, 1,8-cineol, cis-α-bisabolene, (E)-β-farnesene, thymol and caryophyllene acetate.

Finally, the identification of the mixture of essential oils used in this work, and they are considered the base for the preparation of Moroccan fragrance, showed that the major compounds are (Figure 1): 1,8-cineole, sabinene, menthone, menthol, thymol, p-cymene, α-pinene, camphor, β-myrcene, santolinatriene and santolina alcohol. And there are other minor compounds, and also others that they were in common: α-pinene, 1,8-cineol, borneol, camphene, limonene, linalool, p-cymene, sabinene and terpinene-4-ol. (Figure 2)

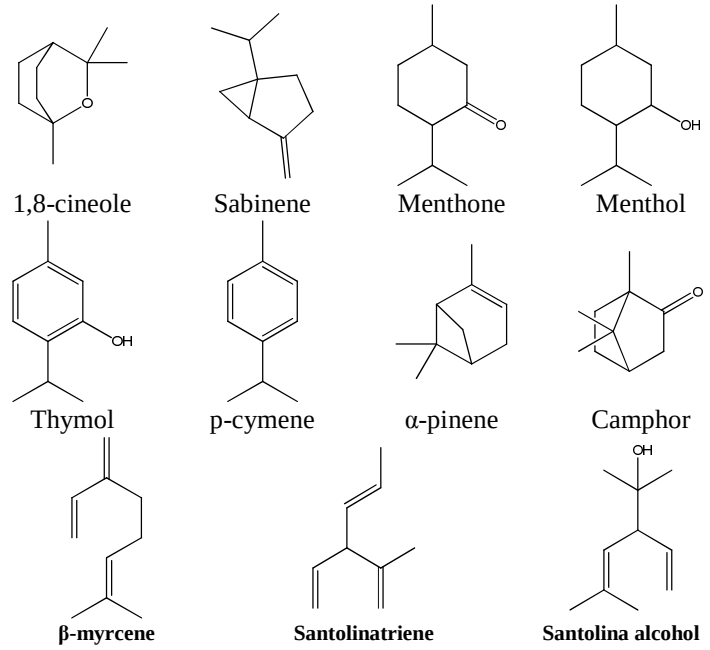

Figure 1: The major constituents of the essential oils used in the Moroccan fragrance

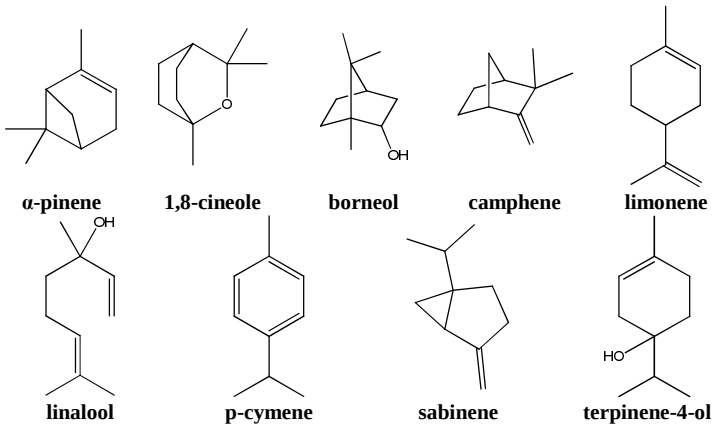

Figure 2: Compounds in common between the five species studied

CONCLUSION

The work we have presented in order to enhance the medicinal plants from Morocco, for the determination of the analysis compositions of the essential oil and the extent of use in perfume industries. The chemical identification of the essential oils showed the presence of major compounds that have very interesting especially: 1,8-cineole, sabinene, menthone, menthol, thymol, p-cymene, α-pinene, camphor, β-myrcene, santolinatriene and santolina alcohol. From these results compositions of these essential oils, fragrances can be synthesized on an industrial scale to be similar to the compositions of the same nature products, and also another way for further research on new formulations fragrances.

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