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Study of the chemical composition of the essential oil of leaves of the dwarfish palm tree (*Chamaerops humilis* L.) of Morocco outside the blooming season

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Abstract
The wild sample of the dwarfish palm tree (*Chamaerops humilis* L.) was collected in the region of Benslimane (center of Morocco) in January, 2015. Leaves of this plant were distilled by a Clevenger device. The obtained essential oil was analyzed by GC/MS. The obtained yield is 0.19 %, with a total of 15 compound. The main components of this oil are Spathulenol (25.49 %); Palmitic acid (14.37 %); Beta.-Eudesmol (9.19 %); the Oxide of Caryophylene (5.23 %), Octadecanal (5.16 %) and Phytol (4.16 %). We confirm that we are the first ones who analyzed the essential oil of this plant outside the blooming season and found this number of constituent.

Key words: *Chamaerops humilis* L., Benslimane, Morocco, Clevenger, essential oil, chemical composition.

1. Introduction
The essential oil is constituted by several chemical molecules of biosynthesis. These molecules are different according to the nature of the plant and the ground in which the plant is growing [1], the period of harvest [2], the studied part of the plant [3], the preparation of the sample [4], as well as the method of extraction [5].
Generally the volatile compounds which frequently play important role in the plant-insect interactions, can be produced either by flowers to attract pollinators or by leaves to dissuade herbivores. The dwarfish palm tree (*Chamaerops humilis* L) represents a unique intermediate between these two organs [6].
Dufay M. and his collaborators [7] have shown that leaves constitute the main organ for the production of the volatile organic compounds which attract pollinators during the blooming season. The chemical composition of this oil varies according to the period of harvest. The objective of the present study was to determine the possible chemical components of the essential oil of the leaves of the dwarfish palm tree (*Chamaerops humilis* L.) of Morocco, by gas chromatograph mass spectrometer (GC-MS).

2. Materials and methods
2.1. Plant material
The leaves of the dwarfish palm tree (*Chamaerops humilis* L.) were collected from the forest of Benslimane (situated at 62 km from Casablanca) in January, 2015. They were taken randomly and then cut in small 0.5 cm pieces and extracted by a Clevenger device.

2.2. Extraction of the essential oil of leaves of the dwarfish palm tree (Chamaerops humilis L.)
There are several techniques of extraction of products with high added value present in plants.–Among the conventional techniques, we find steam distillation or hydrodistillation [8], [9]. The extraction of our essential oil was realized by hydrodistillation of the sample in a Clevenger device, where 100 g of plant material were introduced with 1 L of water into a 2 L flask topped with a column of 60 cm in length connected with a cooler. The distillation lasted three hours after recovery of the first drop of distillate, and the essential oil obtained is recovered by means of a syringe.

3. Results and discussion

3.1. Content in essential oil

The average yield in essential oil was calculated compared to the dry vegetable material of the plant. The sample of *Chamaerops humilis* L supplied a 0.19 % yield. It is relatively low compared to some plants which are industrially considered as sources of essential oil, for example: lavender (0.8-2.8 %), peppermint (0.5-1 %), neroli (0.5-1 %), rose (0.1-0.35 %) etc.[10].

3.2. Chromatography analysis of the constituents of the essential oil of the leaves of Chamaerops humilis L from the region of Benslimane

The analytical study of the essential oil of the leaves of *Chamaerops humilis* L was realized within the Laboratory of Synthesis, Extraction and Physico-chemical Study of the Organic Molecules by a chromatograph in gas phase Shimadzu GC-2010, equipped with a capillary column BP-5 (30 m x 0,25mm id, thickness of the film 0.25 µm; SGE, Ltd.) and of a selective detector of mass Shimadzu QP2010 More (version software 2.50 SU1). The analytical conditions are:

- Temperature of the injector: 240°C
- Temperature of the detector: 260°C
- Programming of the oven: 3°C / min of 60 in 200°C, hanging isothermal landing 5 min in 200°C.
- Vector Gas: helium: 2 mL / min
- Energy of ionization (sources): 70 eV
- Volume of injection: 1µL, mode (fashion) Split 1:40
- Range of scanning, 40 400 u; time (weather) of cycle, 1s

The identification of the components of essential oil was made by comparison of their GC retention times with those based on a series of n-alcanes C_9-C_{20} on the column BP-5 and by the comparison of their mass spectra with those in the library (Shimadzu company and database NIST2005 / system of data ChemStation) and confirmed by MS spectra of the authentic compounds as far as possible.

3.3 Chemical composition of the essential oil of the leaves of Chamaerops humilis L.

To our knowledge, no detailed study was realized on the composition of the essential oil obtained by hydrodistillation concerning the plant *Chamaerops humilis* L of Morocco. On the other hand, there are other studies which were made on the essential oil of *Chamaerops humilis* L of France (Montpellier), obtained by the technique of Headspace during the blooming season [6]. Essential oil obtained is then examined by gas chromatography to determine the relative number of the constituents, their retention times and their proportion, and by mass spectrometry to have the molecular weight and nature of the fragments of each component). The GC-MS spectrum analysis of the essential oil of the leaves of *Chamaerops humilis* L is represented in the (figure 1). Several compounds were identified, the most important are reported in the (Table 1).

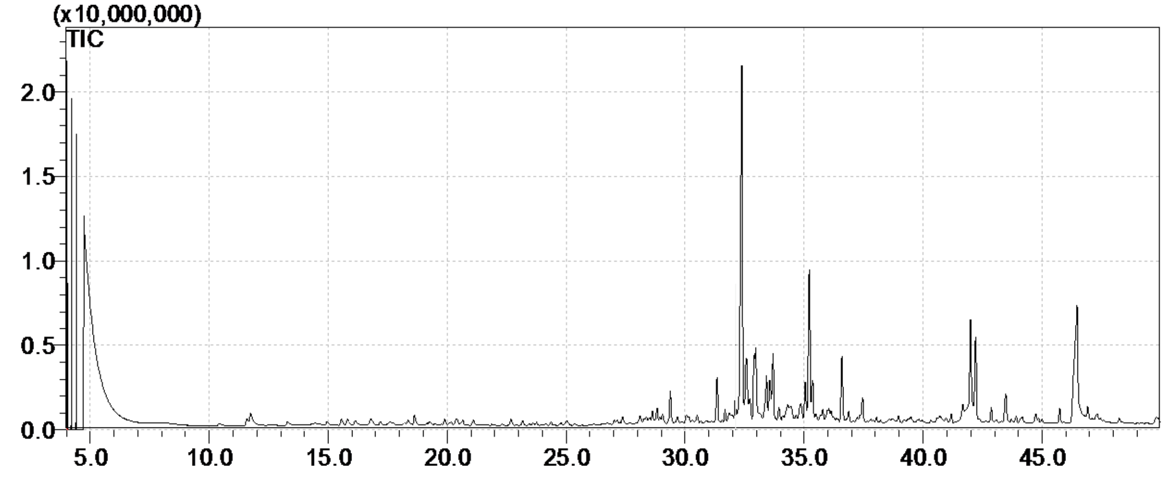

Figure 1: The GC-MS spectrum of the essential oil derived from the leaves of *Chamaerops humilis* L

Tableau 1: Chemical composition of the essential oil derived from the leaves of *Chamaerops humilis* L

RI	Name	KI	%	Compound type	Number
11.73	(E)-β-ocimene	1046	0.57	Monoterpene	1
29.37	Alpha-Farnesene	1505	1.64	Sesquiterpene	2
31.34	-	-	2.49	-	-
31.67	trans-Nerolidol	1564	0.53	Oxygenated sesquiterpene	3
32.38	Spathulenol	1577	25.49	Oxygenated sesquiterpene	4
32.57	Caryophyllen oxide	1582	5.23	Oxygenated Sesquiterpene	5
32.719	-	-	1.32	-	-
32.90	-	-	3.05	-	-
32.96	-	-	3.77	-	-
33.41	-	-	2.81	-	-
33.56	Ledol	1602	2.48	Oxygenated Sesquiterpene	6
33.69	-	-	3.52	-	-
33.94	Delta.-Cadinol	1636	0.68	Oxygenated sesquiterpene	7
35.05	-	-	2.03	-	-
35.21	Beta.-Eudesmol	1649	9.19	Oxygenated sesquiterpene	8
35.35	Juniper camphor	1675	2.11	Oxygenated sesquiterpene	9
36.59	Alpha.-Santalol	1678	3.72	Oxygenated sesquiterpene	10
37.45	Hexadecanal	1818	0.98	Oxygenated hydrocarbure	11
41.99	Octadecanal	1819	5.16	Oxygenated hydrocarbure	12
42.21	Phytol	1942	4.16	Oxygenated diterpene	13
42.86	-	-	0.64	-	-
43.47	-	-	1.87	-	-
45.74	Isophytol	1946	0.71	Oxygenated diterpène	14
46.47	palmitic acid	1957	14.37	Fatty acid	15
Total	**98.52%**				
Identified	**77.02%**				
Non identified	**21.05%**				

According to the table above, we can say that the major components of our oil are Spathulenol (25.49 %); Palmitic Acid (14.37 %); Beta.-Eudesmol (9.19 %); Caryophyllene Oxide (5.23 %), Octadecanal (5.16 %) and Phytol (4.16 %). Below (Figure 2) are the structures of the various compounds identified in the essential oil of *Chamaerops humilis* L of the region of Benslimane.

The chemical composition of the essential oil of the leaves of *Chamaerops humilis* L is widely dominated by oxygenated sesquiterpenes (49.43 %), followed by hydrocarbon sesquiterpenes (1.64 %), oxygenated hydrocarbons (6.14 %) oxygenated diterpenes (4.87 %) and fatty acids (14.37 %). We also notice the presence in small proportions of hydrocarbure monoterpenes (0.57%) and the absence of oxygenated monoterpenes (Figure 3).

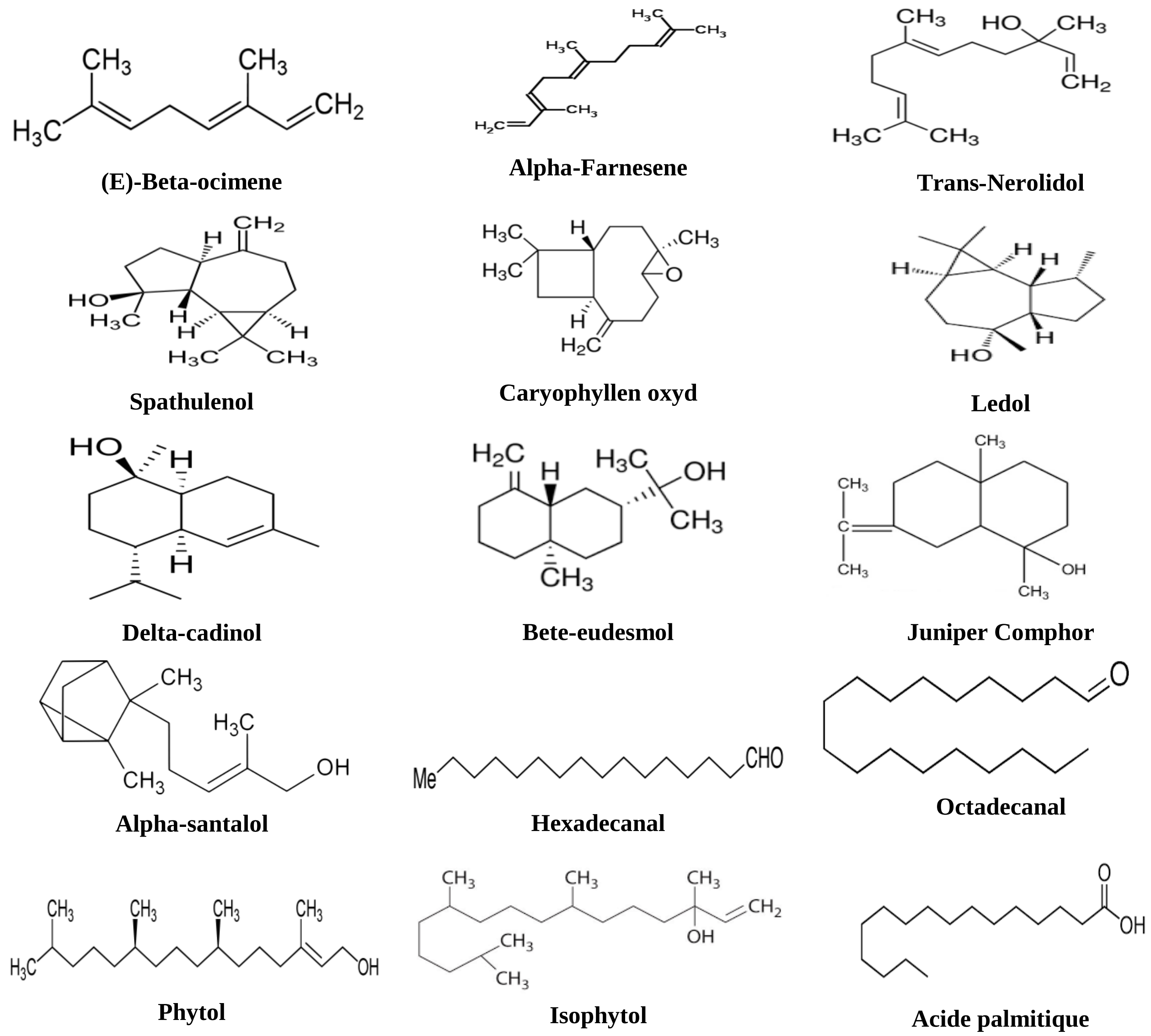

Figure 2: The identified chemical composition of the essential oil derived from leaves of *Chamaerops humilis* L.

This work comes to complete and to enrich studies carried out on the essential oil of the leaves of *Chamaerops humilis* L. Jean-Claude Caissard and his collaborators [6] who analyzed the chemical composition of the essential oil of the leaves of this plant collected in Montpellier in France, found six constituents with an ascendancy of monoterpenes which are: (E) Beta-Ocimene and Linalool. Followed by sesquiterpenes which are alpha-Farnesene and others not identified. In addition to methyl benzoate, benzylic alcohol and indole.
In our knowledge, our study is the first one indicating important abundance in oxygenated sesquiterpenes such as spathulenol, beta-eudesmol and caryophyllene oxide. So, it would seem that a strong chemical diversity exists between the essential oils of different populations. Oxygenated sesquiterpenes are known by their biological virtues, they are industrially used in several applications, for example, in perfumes, in pharmaceutical products for their antioxidant, anti-inflammatory, anticancer properties, etc. Spathulenol presents several biological activities worth knowing such as antileishmanian activity [11], antioxidant activity [12], antimicrobial activity [13] and anticancer activity [14]. This compound can be also used in compositions to flavor food and in sophisticated perfumes. Beta-eudesmol has diverse effects on the nervous system. For example, it acts as an inhibitor of channels nicotinic acetylcholine receptors at the neuromuscular junction [15]. It has other biological activities citing the antioxidant, antibacterial, anti-tumor and anti-angiogenic [16].

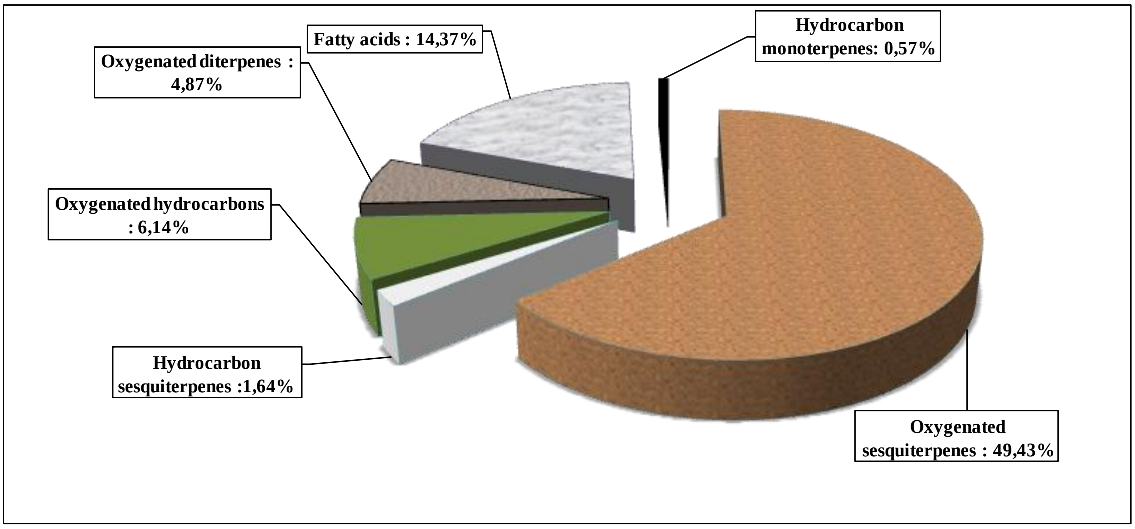

Figure 3: The main families establishing the essential oil of *Chamaerops humilis* L.

Caryophylene oxide in its turn presents several activities, among which, antibacterial, antioxidant and anti-inflammatory activity [17]. As for phytol, it is one of the main acyclic diterpene alcohols. It is a precursor of vitamins E and K. It is an extremely common terpenoïde, that we find in all the plants with chlorophyll. As regards to the difference observed at the level of the chemical composition of the essential oil of leaves of *Chamaerops humilis* L, it is probably due to diverse conditions, most importantly the environment, the genotype, the geographical origin, the period of harvest, the place of drying, the temperature and the duration of drying, the parasites and the method of extraction [18].
According to Raguso and his collaborators, linalool is present only in the essential oil of leaves during the blooming season. Whereas benzylic alcohol is in the state of tracks except this season. Linalool is also known by its nature of attraction of pollinators to flowers [19-21].

Conclusion

-In the essential oil of *Chamaerops humilis* L of Morocco, we identified new natural compounds: Spathulenol (25.49 %); Palmitic Acid (14.37 %); Beta.-Eudesmol (9.19 %); Caryophyllene Oxide (5.23 %), Octadecanal (5.16 %) and Phytol (4.16 %).
-This essential oil presents a chromatographic profile qualitatively and quantitatively different from that observed for essential oil obtained from France described in the literature.
-Oxygenated sesquiterpenes are known by their biological virtues, they are industrially used in several applications, such as cosmetics, pharmaceutical products for their antioxidant, anti-inflammatory, anticancer properties, etc.

References

1. Angioni A., Barra A., Cereti E., Barile D., Coisson J.D., Arlorio M., Dessi S., Coroneo V., Cabras P., *J. Agric. Food Chem*., 52 (2004) 3530-3535.
2.Celiktas O.Y., Hames Kocabas E.E., Bedir E., Verdar Sukan F., Ozek T., Baser K.H.C., *Food Chem.*, 100 (2007) 553-559.
3. Flamini G., Cioni P.L., Morelli I., Macchia M., Ceccarini L., *J. Agric. Food Chem*., 50 (2002) 3512-3517.
4. Mccormick K.A., Olivares J.S., Fisher R.A., Nahir T.M. Phelps C.L., *J. Essent. Oil Res*., 18 (2006) 478-480.
5. Boutekedjiret C., Belabbes R., Bentahar F., Bessière J.M., Rezzoug S.A., *J. Essent. Oil Res*., 16 (2004) 195-199.

6. Jean-Claude C., Aroonrat M., Sylvie B., Marie-Charlotte A., *Am. J. Bot.*, 91 (8) (2004) 1190-1199
7. Dufay M., Marie-Charlotte A., *OIKOS*, 100 (2003) 3-14
8. Rmili R., Ramdani M., Ghazi Z., Saidi N., El Mahi B., *J. Mater. Environ*. Sci. 5(5) (2014) 1560-1567.
9. Abdellatif F. and Hassani A., *J. Mater. Environ. Sci*. 6 (1) (2015) 207-213
10. Akrout A., *Zaragoza: CIHEAM*, (2004) 289-292.
11. Ivone L.A.C., *Doctorat De L'universite De Toulouse, Délivré par l'Institut National Polytechnique de Toulouse, Présentée et soutenue publiquement* le 19 décembre (2007).
12. Maria G.M., *A Short Review*, *Molecules*, 15 (2010) 9252-9287.
13. Murgananthan G., Sathya C.P., *IRJP*, 3 (1) (2012).
14. Mity T., Aldo T., Mohanakrishnan M., Subburaj M., Pradeepkumar K.M., Shafi P.M., *Int J Pharm. Bio. Sci.,* 4(1) (2013) 46-49.
15. Hiroshi T., En-Long M., Shinjiro K., Naoto S., Kouji M., Toshiyasu S., Min-Wei W., Ikuko K., *Eur. J. Pharmacol*., 512 (2005) 105-115.
16. Nut K., Kesara N.B., Juntra K., *Asian Pac. J. of Trop. Med.*, 7645 (2014) 600-699.
17. Svoboda K. P., Hampson J.B., *Plant Biology, SAC Auchincruive, Ayr,Scotland, UK., KA6 5HW,* (1999).
18. Laib I., *Rev. Nat. et Tech.*, (2012) 44-52.
19. Raguso R.A., Pichersky E., *Plant Syst. Evol.*, 194 (1995) 55-67.
20. Dudareva N., Cseke L., Blanc V.M., Pichersky E., *Plant Cell.*, 8 (1996) 1137-1148.
21. Borg-Karlson A.K., Tengo J., Valterova I., Unelius C.R., Taghizadeh T., Tolasch T., Francke W., *J. Chem. Ecol.*, 29 (2003) 1-14.

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