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COMPOSITION OF THE OILS FROM *Mentha pulegium* GROWN IN DIFFERENT AREAS OF THE EAST OF ALGERIA

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Mentha pulegium L. (Lamiaceae) is the most common of the Mentha species growing in Algeria [1]. It is a perennial, herbaceous, aromatic plant species occurring in the whole Mediterranean basin, Western, Central and Eastern Europe, Asia Minor, and Northern parts of Iran. It can be found on humid terrains, near roads, and in more abundance in mountain pastures [2]. It is used in folk medicine as an infusion preventing different gastric disorders and inflammations of the respiratory tract [3]. Several studies on *Mentha pulegium* essential oil composition have been published already [4–15].Three chemotypes have been established, pulegone type, piperitenone/piperitone type, and isomenthone/neoisomenthol type [10]. We present in this study the chemical composition of essential oils of species from twelve stations of different areas of the East of Algeria. All these results were compared with literature data and showed the presence of a new chemotype (reduced levels of pulegone and important nonoxygenated terpenic fractions).

The yields of pulegone for other species are similar with those described in the literature (43.3–87.36%). The proportions of the other metabolites (menthone, isomenthone, piperitone, piperitenone) were also discussed.

The oil prepared from the aerial parts of *M. pulegium* gives the yield obtained from the different samples analyzed, which are between 1, 16 to 2, and 19%. Forty-one constituents were identified in the oils (table 1). All the samples are harvested at the flowering stages. Mountain pastures gave better yields (Tassala, Bir Guecha, and Bouhatem).

According to the composition of the oils, it will be seen under table 1 that the species were mostly related to the pulegone type (43, 3 to 87, 3% yield of pulegone). For these species the other main components were piperitenone (maximum yield 26/73%, Oued Zrafa), isomenthone (maximum yield 22.6%, Tassala 3), menthone (maximum yield 6.7%, Bouhatem 2), and in lesser amounts piperitone (2.13%, Tassala 3). For all the species these C-3 oxygenated *p*-menthane compounds constituted the bulk of the oils, while the level of nonoxygenated terpenic fractions was relatively low (<5%). The levels of menthone and isomenthone and piperitenone are slightly smaller than those reported in the literature with the difference in their relative ratio. The high level of piperitenone (14.4–26.7%) is most of the time associated with the high level of menthone (3.9–6.46%) and smaller amount of isomenthone (0.9–2.2%) (OZ, B1, B2, AR). Conversely, a high level of isomenthone (10.3–22.6%) is often associated with a moderate quantity of piperitenone (8–8.2%) and reduced yield of menthone (0.6–1%) (T1, T3).

Two locations (M3: Ghdir d'achouat and J3: Jijel aeroport) exhibited more reduced yield of pulegone and high levels of nonoxygenated terpenic fractions (α-pinene, β-pinene, camphene, sabinene, α-terpinene, β-phellandrene, myrcene) and relatively high level of 1,8 cineol.

From the results of the literature data, it appears that Algerian oils can be classified following two chemotypes: Pulegone type with 52–87% yield of pulegone and some variations of the other constituents and a new chemotype, with poor yield of pulegone and relatively high yield of the nonoxygenated terpenic fraction.

Plant Material. The plant material described in this work was collected at the flowering stage from different areas of the east of Algeria (Table 1) and identified at the Department of Botany where herbarium specimens have been deposited (CMP 01/07/04 to 12/07/04).

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TABLE 1. Chemical Composition of Algerian Samples of *Mentha pulegium*

Compound	M3	OZ	BG	T1	T2	T3	B1	B2	AR	J2	J3
α-Pinene	11	0.62	0.67	0.33	8.09	0.15	1.71	1.19	0.44	0.18	10.5
α-Thujene	11	-	-	-	-	-	-	-	-	-	10.5
Camphene	0.29	0.03	0.06	0.06	5.38	0.04	0.14	0.09	0.03	0.51	0.2
β-Pinene	20.93	0.49	0.53	0.77	7.99	0.71	1.16	0.98	0.47	0.4	19.5
Sabinene	15.8	0.18	0.17	0.45	0.44	0.3	0.5	0.16	0.18	0.14	17.5
Myrcene	0.1	0.37	0.36	0.22	0.37	0.62	0.88	0.64	0.31	0.12	0.86
α-Terpinene	0.6	-	-	-	-	-	-	-	-	-	0.79
Limonene	0.46	1.05	1.39	0.72	1.98	3.55	0.36	5.60	1.55	1.17	0.13
1,8-Cineol	9.92	0.18	0.17	1.14	0.61	0.29	-	5.75	0.35	0.18	11.35
β-Phellandrene	16.04	-	-	-	-	-	-	-	-	-	10.25
3-Methylcyclopentanone	-	0.02	0.03	0.02	0.07	0.04	0.68	0.77	0.05	0.02	-
γ-Terpinene	1	-	-	-	-	-	-	-	-	-	0.27
Octan-3-one	7.17	0.3	0.01	1.1	0.66	1.17	-	1.34	0.23	0.04	13.3
p-Mentha-2,8-diene	0.9	-	-	-	-	-	-	-	-	-	0.85
p-Cymene	1	0.03	0.04	0.03	0.03	0.02	-	0.07	0.04	0.04	0.11
Terpinen-4-ol	0.3	-	-	-	-	-	-	-	-	-	0.29
3-Methylcyclohexanone	0	0.02	0.03	0.02	0.02	0.06	-	0.01	0.03	0.04	0
Octan-3-yl-acetate	0.1	0.2	0.15	0.1	0.06	0.12	-	0.06	0.04		0.1
Octan-3-ol	0.22	3.66	2.6	2.16	2.75	4.77	3.62	3.63	1.24	1.46	0.19
Menthone	0.18	6.46	6.78	0.61	0.36	1.04	3.96	6.17	3.67	0.6	0.2
Menthofurane	0.08	0.03	0.06	0.01	0.03	0.09	0.06	0.07	0.01	0.02	0.28
Neomenthone	0.08	-	-	-	-	-	-	-	-	-	0.03
Isomenthone	-	0.9	3.59	10.32	11.55	22.6	0.8	2.29	1.14	0.02	-
cis-Limonene oxide	0.1	0.25	0.28	0.4	0.44	0.02	0.36	0.34	1.90	0.03	0.07
trans-Limonene oxide	0.41	0.33	0.43	0.56	0.57	0.93	0.4	0.37	0.9	0.03	1.38
β-Caryophyllene	2.69	-	-	-	-	-	-	-	-	-	0.06
Neomenthol	0.32	0.09	0.22	0.28	0.24	0.3	0.14	0.27	0.23	0.51	0.03
Terpinen-4-ol	0.3	-	-	-	-	-	-	-	-	-	1.06
Neoisomenthol	0	0.08	0.07	2.3	0.09	0.1	-	0.16	0.16	3.17	-
Pulegone	4.36	54.9	55.9	63.6	48.3	51.6	59.3	57.5	43.5	87.3	5.71
α-Humulene	0.91	-	-	-	-	-	-	-	-	-	0.12
Germacrene D	0.45	-	-	-	-	-	-	-	-	-	0.02
Piperitone	0.08	1.23	2.13	1.72	1.03	2.33	0.49	0.79	1.28	0.3	0.07
Carvone	-	0.05	0.04	0.11	0.01	0.03	-	0.08	0.03	0.22	-
Hydroxide of piperitone	-	0.11	0.06	0.025	0.06	0.03	-	0.06	0.1	-	-
Isopiperitenone	-	0.26	0.31	0.22	0.24	0.27	0.11	0.22	-	0.05	-
cis-Piperitone oxide	-	-	0.08	0.026	0.012	0.02	0.22	0.05	-	0.12	-
trans-Piperitone oxide	0.04	-	-	-	-	-	-	-	-	-	-
Piperitenone	0.29	26.7	0.08	8.25	6.28	8.01	15.1	14.4	19.2	0.28	0.27
cis-Piperitenone oxide	-	0.13	0.23	0.18	0.04	0.02	0.9	0.05	0.04	0.13	-
β-Caryophyllene oxide	-	0.05	-	0.06	0.07	0.05	0.16	0.29	0.23	0.01	-

Yields of the oils obtained (%): Ghdir achouat (M3, 1.68); Bir Guecha (BG, 1.99); Tassala 1 (T1, 2.19); Tassala 2 (T2, 2.04); Tassala 3 (T3, 1.16); Bir Guecha (BG, 1.34); Ahmed Rachedi (AR, 1.70); Oued Zrafa (OZ, 1.38); Bouhatem 1 (B1, 1.76); Bouhatem 2 (B2, 1.89); Jijel 2 (route de Bejaia) (J2, 1.47); Jijel 3 (Jijel aeroport) (J3, 1.16).

Isolation and Analysis of the Oil. Isolation was performed by steam distillation in a Clevenger-type apparatus. The yield of essential oil of each sample was determined and the composition analysis of the essential oil was performed by GC and GC/MS on a Hewlett-Packard instrument equipped with a fused silica WCOT capillary column (50 m $\times$ 0.3 mm; df:0.25 μm), CPWAX 51, temperature programmed from 50°C to 230°C at 3°C/min, injector and transfer line temperatures 280°C, carrier gas at flow rate of 3 mL/min, carrier gas He, ionization energy 70 ev.

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