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Chemical Composition of the Essential Oils from Flowers, Stems and Roots of Dorema ammoniacum D.Don from Iran

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ABSTRACT

The Essential oils obtained by hydrodistillation of the flowers, stem and roots of Dorema ammoniacum D.Don. were analyzed by GC and GC-MS. Thirty components comprising 95.4 % of the flower oil , twenty- one components comprising 93.37 % of the stem oil and twelve components comprising 90.3 % of the root oil were identified. The major components in the flower oil were δ-cadinene (11.58%) and α-himachalene (7.71%). The stem oil contained δ-cadinene (16.24 %), liguloxide (8.69 %) and δ-amorphene (8.43 %) as the major components, while the root oil had 3-n-butyl phthalide (62.49%), benzyl butanoate (6.57%) and liguloxide (5.15 %) as the major components.The oils of flower,stem and root were richer in sesquiterpenes than monoterpenes.

Keywords: Dorema ammoniacum D. Don, Compositae, essential oils, sesquiterpenes, monoterpenes.

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INTRODUCTION

Essential oils obtained from many plants have recently gained in popularity and scientific interest. Many plants are used for different purposes, such as food, drugs and perfumes [1]. The genus Dorema D.Don (Apiaceae) is represented in the flora of Iran by seven species,among two of which are endemic, *D. ammoniacum* D. Don. and D. aucheri Boiss [2,3]. D.ammoniacum, a vulnerable species, grows to a height of about 1-2 m and in spring and early summer contains a milky juice. It is one of the most important endemic medicinal plants in many arid and semi- arid regions of Iran such as Yazd, Isfahan, Semnan and Kerman provinces, which are known by the local persian names of Kandal, Vasha and Koma-kandal [2,4]. *D. ammoniacum* produces a medicinal gum resin, commonly known as ammoniacum gum, wich is found in cavities in stems, roots, and petioles [5]. A literature survey revealed that the essential oil compositions of D. aucheri aerial parts [6], *D. ammoniacum* leaves [7] and *D. ammoniacum* fruit [8] have already been reported. Herein we report the chemical composition of the flower,stem and root oils of *D. ammoniacum* for the first time.

Experimental

Plant material

Fresh flowers, stems, and roots of *D. ammoniacum* were collected, during the flowering stage, from Hezar mountain (at an altitude of 2900 m) in Rayen area, Kerman Province, Iran, in June 2010. A voucher specimen (AS-85406) has been deposited in the Herbarium of Ecology and Systematic Department, Research Institute of Applied Science, Shahid Beheshti University, and Tehran, Iran. The plant materials were air-dried at room temperature, protected from light, for 1 week.

Isolation of the essential oil

The air-dried flower, stem and root of the plant (500 g) were subjected to hydrodistillation for 3 h using a Clevenger-type apparatus according to the method recommended in the British Pharmacopoeia[9]. The oils were dried over anhydrous sodium sulfate and stored in a sealed vial at 4°C until analysis. The yields of the oils were calculated based on dried weight of plant material.

GC and GC-MS analysis

GC analysis of the volatile components was carried out using a Hewlett-Packard 6890 instrument coupled to a flame ionization detector (FID). Compounds were separated on a HP-5 capillary column (30 m × 0.25 mm, film thickness 0.25 μm). The column temperature was kept at 60°C for 3 min and programmed to 220°C at a rate of 5°C/min. Injector and detector temperatures were 270°C and the flow rate of helium as carrier gas was 1 mL/min. A mixture of aliphatic hydrocarbons ($C_8 - C_{23}$) in hexane was directly injected into the GC injector under the above temperature programme in order to calculate the retention indices of each compound. The relative proportions of the essential oil constituents were expressed as percentage obtained by peak area normalization. GC-MS analysis was

performed using a Hewlett-Packard 5973 mass spectrometer coupled to a Hewlett-Packard 6890 gas chromatograph equipped with a HP-5MS capillary column (30 m × 0.25 mm, film thickness 0.25μm). The carrier gas was helium and the chromatographic conditions were as above. All mass spectra were acquired in electron-impact (EI) mode with an ionization voltage of 70 eV. The ion source and interface temperatures were 200 and 280°C, respectively. The identification of volatile constituents was based on retention indices (RI) and computer matching with the WILEY 275 and NIST 08 libraries, as well as by comparison of the fragmentation patterns of the mass spectra with those reported in the literature [9,10].

RESULT AND DISCUSSION

The identified compounds of the oils are listed in (**Table 1**), in which the percentage and retention Indices (RI) of the compounds are given. Constituents are listed in order of their elution from an HP-5MS column.

Flower oil

Hydrodistillation of the dried flowers of *D. ammoniacum* D.Don afforded yellowish oil with pleasant aroma, yield 0.09% (w/w). Thirty components comprising 95.4% of the oil were identified. δ-cadinene (11.58%), α-himachalene (7.71%), α - Pinene (6.37%), liguloxide (6.15%) and α- guaiene(6.14%) were identified as the major components of the flower oil. Among the identified components, eight components comprising 18.13% were monoterpene hydrocarbons, sixteen components comprising 63.35% were sesquiterpene hydrocarbons and three components comprising 10.09% were oxygenated sesquiterpenes and three components comprising 3.83% were oxygenated monoterpenes.

Stem oil

Hydrodistillation of the dried stems of *D. ammoniacum* D.Don afforded pale-yellow colored oil with pleasant aroma, yield 0.08% (w/w). Twenty- one components comprising 93.37% of the stem oil were identified. δ-cadinene (16.24%), liguloxide (8.69%), δ-amorphene (8.43%), α – selinene (7.21%), β- selinene (6.62 %) and α- himachalene (6.41%) were identified as the major components of the stem oil. Among the identified components, five components comprising 9.42% were monoterpene hydrocarbons, twelve components comprising 68.57% were sesquiterpene hydrocarbons and three components comprising 14.35% were oxygenated sesquiterpenes. This oil is characterized by the absence of oxygenated monoterpenes.

Root oil

Hydrodistillation of the dried roots of *D. ammoniacum* D.Don afforded pale- yellow colored oil with pleasant aroma,yield 0.08 % (w/w).Twelve components comprising 90.30% of the oil were identified. 3-n-butyl phthalide (62.49%), benzyl butanoate (6.57%) and liguloxide(5.15%) were identified as the major components of the root oil. Among the identified components, eight components comprising 15.34% were sesquiterpene hydrocarbons and oxygenated sesquiterpene was represented by one Component 5.15%

and two components comprising 69.06% were aliphatic components. . This oil is characterized by the absence of oxygenated monoterpenes. The analyses of the three oils showed that they were predominantly sesquiterpenes in nature. Major Components, β-selinene, α- himachalene, α- guaiene, α- amorphene, δ-amorphene and Liguloxide were detected in all the three oils. Though a qualitative difference between the oils from the flowers, stem and root was apparent , the flower and stem oils showed more similarity in their chemical composition. There are nineteen components which are common in both flower and stem oils with δ-cadinene as the major component.

Table 1. Chemical composition of the essential oil from flower stem and root of the *Dorema ammoniacum* D.Don.

Compound	RI	Flower	Stem	Root
α - Pinene	939	6.73	-	-
Camphene	957	1.55	-	-
β- Pinene	980	0.80	-	-
Myrcene	991	-	0.92	-
p-Cymene	1026	1.12	0.74	-
Limonene	1030	4.61	3.74	-
β- Phellandrene	1035	0.94	2.59	0.75
(E)- β- ocimene	1045	1.28	-	-
Terpinolene	1090	1.10	1.46	-
Thymol methyl ether	1235	2.41	1.03	-
Carvorol methyl ether	1245	0.31	-	-
Bornyl acetate	1285	1.11	-	-
α- Cubebene	1352	0.33	-	-
α -Copaene	1378	4.23	3.73	-
Aristolene	1400	2.08	1.48	-
α- Gurjunene	1410	0.93	-	-
β-Caryophyllene	1418	0.63	-	-
β-Gurjunene	1432	0.38	-	-
Aromadendrene	1440	1.01	-	-
α-Guaiene	1442	6.14	3.45	2.20
Benzyl butanoate	1442	-	-	6.57
α-Himachalene	1450	7.71	6.41	2.37
allo Aromadendrene	1460	3.90	2.52	0.91
Dehydroaromadendrane	1465	2.53	2.70	1.33
α- Amorphene	1485	4.54	5.04	1.20
β-Selinene	1490	5.21	6.62	2.41
α- Muurolene	1498	3.44	4.09	-
α-Selinene	1500	5.27	7.21	2.34
δ-Amorphene	1515	6.88	8.43	2.58
δ-Cadinene	1525	11.58	16.24	-
Liguloxide	1536	6.15	8.69	5.15
(E)-Nerolidol	1561	0.50	1.57	-
3-n-Butyl phthalide	1550	-	-	62.49
Monoterpene hydrocarbons	-	18.13	9.42	0.75
Oxygenated monoterpenes	-	3.83	-	-
Sesquiterpene hydrocarbons	-	63.35	68.57	15.34
Oxygenated Sesquiterpenes	-	10.09	14.35	5.15
Total identified	-	95.4	93.37	90.3

In an earlier investigation into the essential oils composition of *D. ammoniacum* leaves [9], shows that α-gurjunene (49.5%), β- gurjunene (19.0%) and α-selinene (4.6%) were the main constituents, while in a study of the essential oil composition of *D. ammoniacum* fruit 10 (Z) and (E)-ocimenone ,β-cyclocitral and ar-curcumene were characterized as the major components, wich could be attributed to their ecological variability or plant part. Masoudi et al, have reported α-eudesmol (31.2%) and δ-cadinene (10.9%) as the main components of the essential oil of D. aucheri aeria part [6].

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