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Essential oils of the flowers *Urginea maritima* (L.) Baker (Liliaceae) grown in Jordan

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Abstract: The present work concerns the study of the essential oil of the flowers (EOs) of *Urginea maritima* L. from Jordan. A quantitative analysis using a GC-MS analysis of the flowers revealed the presence of monoterpenes and oxygenated sesquiterpenes (30.4%); followed by monoterpenoids hydrocarbons (18.9 %); aliphatic derivatives (15.8 %); fatty acid derivatives (11.0%); sesquiterpene hydrocarbons (7.8%); furano derivatives (7.3%); ionones (4.1%) and cinnamylaldehyde derivatives (3.3%). The principal oil component was 23.3% cedrenol, 9.7% (2E,4E) –decadienal, 8.4% α –pinene,7.8% δ-3-carene, 7.3% 2-pentyl-furan and 5.8% hexadecanoic acid methyl ester.

Keywords: *Urginea maritima*, Liliaceae, flowers, essential oils, Jordan.

INTRODUCTION

Urginia maritima (L.) Baker syn. *Drimia maritima* (L.) Stearn syn. *Scilla maritima* L., belonging to the family Liliaceae, is the giant among all Mediterranean geophytes (Zohary, 1972; AL-Eisawi, 2013). It is a winter-active perennial bulb, native to the Mediterranean coastal regions, commonly known as white squill, sea squill, and crusader spear (Gentry, *et al*., 1987). The name of the genus *Urginea* comes from the Algerian tribe of Ben Urgin (Bridgitte, *et al*., 1996; El-Seedi, *et al.*, 2013). The bulb resists the occasional fires common in the Mediterranean area, rodents don not eat the bulbs since they are poisonous (Gentry, *et al*., 1987; El-Seedi, *et al.*, 2013). The inflorescence flower will shoot up in August or September while the plant is leafless, but some individuals have white flowers with a distinct pink midrib on the petals and in extreme cases, the flowers are all pinkish; both forms have whitish inner tunics (Zohary, 1972; Gentry, *et al*., 1987; El-Seedi, *et al.*, 2013). Red squill-dried powders have been used for the control of rodents since the 13th century (Crabtree, 1947). Although red squill has many alkaloids, scilliroside is the most toxic and provides

rodenticide activity and not the white squill. The red squill is mixed in baits and applied at a 10% concentration and mixed with meat, fish, and cereals (Crabtree, 1947; Spies, *et al*., 1992). White Squill contains a large number of related steroidal cardioactive glycosides. Those found in the greatest concentration in the bulb include scillaren A and proscillaridin A, the aglycone of both being scillarenin (Gentry, *et al*., 1987; El-Seedi, *et al.*, 2013; Spies, *et al*., 1992; Verbiscar, *et al*., 1989). Methanolic fraction of *U. maritima* showed antioxidant and antibacterial activities (Belhadad, *et al.*, 2017). The flowers of *U. maritima* have never been studied, as far as we are aware, this the first report about the chemistry and essential oils of the plant.

MATERIAL AND METHODS

Plant material: The flowers and young twigs of *Urginea maritima* were collected in September 2020, from Jerash area (35 km north of Amman). The taxonomic identities of the collected plant material were confirmed by the assistance of a Plant Taxonomist (Dr. Mohammad Gharaibeh, Faculty of Agriculture, Jordan University of Science and Technology) and by the comparison of a collected voucher specimen with those of known identity in the herbarium of the Faculty of Agriculture, Jordan University of Science and Technology. A voucher specimen (ID No.: Phar 2020-9-1) of the collected plant was deposited in the research laboratory of the Department of Medicinal Chemistry and Pharmacognosy, Faculty of Pharmacy, Jordan University of Science and Technology.

Oil distillation: The flowers of the collected plant material of *Urginea maritima* were air-dried and ground to about 0.5 mm particle size (30-35 mesh). The essential oils were obtained by subjecting 730 g of the ground materials to hydro-distillation using the Clevenger-type apparatus (JSGW, India) for 4 h. The obtained oils (n = 2) were dried over anhydrous sodium sulfate, Na2SO4, and stored in dry dark glass bottles at 4°C for later analysis.

Analysis of the essential oils: A quantitative analysis using gas chromatography with a flame ionization detector (GC-FID) was conducted using a Hewlett Packard HP-8590 gas chromatograph equipped with a split-splitless injector (split ratio 1:50) and an FID detector. The column (OPTIMA5 (5 % diphenyl 95 % dimethyl polysiloxane)) was a fused silica capillary column (30 m × 0.25 mm; 0.25 μm film thickness). The oils were separated under a linear temperature program set at 3°C/min heating rate from 60-250°C and then held at 250°C for 5 min. The temperature of the injector and detector were maintained at 250°C and 300°C, respectively. The relative peak area for each component of the oil was measured. The concentrations of the oil components were calculated as a percentage content using their relative peak areas assuming a unity response by all components. Each sample was analyzed twice.

GC-MS analysis: The GC-MS analysis was performed on a Varian chrompack CP-3800 GC/MS/MS-200 equipped with a split-splitless injector and DB-5 GC column (5% diphenyl 95% dimethyl polysiloxane, 30 m x 0.25 mm ID, 0.25 μm film thickness). The injector temperature was set at 250℃ with a split ratio of 1:10. Detector and transfer-line temperatures were 160℃ and 230℃, respectively. A linear temperature program was used to separate the different oil components. Temperature programming was applied at 3°C/min heating rate starting from 60°C

to 250°C and then held at 250°C for 5 min. The mass detector was set to scan ions between 40-400 m/z using full scan mode and electron impact (EI, 70 eV). Each sample was analyzed twice. A hydrocarbon mixture of n-alkanes (C8-C20) was applied separately on a GC-MS using the same chromatographic conditions. The Linear retention index (arithmetic Kovat's index) was calculated for each component separated by GC-MS using the values of its retention time and the retention times of the reference n-alkanes applying the Van Den Dool equation (Barakat, *et al.*, 2016; Den Dool, and Kratz, P, 1963; Adams, 2007). The identification of oil components was performed by matching their spectra with the data bank mass spectra (Wiley, Nist, and Adams 2007 libraries), and also by comparing their calculated arithmetic indices with the reported values in the literature (Adams, 2007; Hudaib, *et al*.,2015; Olimat, *et al*., 2020).

RESULTS

The simultaneous use of mass spectral and retention (Kovat's) index matching allowed for unequivocal identification of more than 98% of the components of the collected oil, obtained from the aerial parts of the plant under study, as determined by GC and GC-MS. The oil yield (expressed as % v/w of dried material) was 0.35%. The analyses permitted the identification of 21 compounds in the oils of *Urginea maritima*. The identified components and their corresponding contents are presented in Table 1. α –Pinene (1), 2-pentyl-furan (2), δ -3-carene (3), terpinolene (4), 1-nonanal (5), (2E, 4Z) - decadienal (6), (2E,4E)-decadienal (7), α -funebrene (8), (z)- caryophyllene (9), α -humelen (10), germacrene-D (11), (E)- β- ionone (12), 6-methyl- α -ionone (13), cedrol (14), cedrenol (15), epi-cedrol (16), cedryl acetate (17), (Z)- 2-hexyl-cinamaldehyde (18), 2,4,6-trihydroxybenzylaldehyde (19), phenyl acetyl octanoate (20) , pentadecanoic acid (21), n-nonadecane (22) and hexadecanoic acid methyl ester (23), Table 1.The oil was characterized by high percentage levels of monoterpenes and oxygenated sesquiterpenes (30.4%); followed by monoterpenoids hydrocarbons (18.9 %); aliphatic derivatives (15.8 %); fatty acid derivatives (11.0%); sesquiterpene hydrocarbons (7.8%); furano derivatives (7.3%); ionones (4.1%) and cinnamylaldehyde derivatives (3.3%), Table 2. The principal oil component was 23.3% cedrenol (15), 9.7% (2E,4E) –decadienal (7), 8.4% α –pinene (1), 7.8% δ -3-carene (3), 7.3% 2-pentyl-furan (2) and 5.8% hexadecanoic acid methyl ester (23), as shown in bold in Table 1. There are nine compounds presented in the ratio between 2 to 5%; terpinolene (4), 1-nonanal (5), (z)-caryophyllene (9), α -humelen (10), germacrene-D (11), 6-methyl- α -ionone (13), cedrol (14), epi-cedrol (16), phenyl acetyl octanoate (20).Eight compounds were found in the ratio between 0.0 to 2%; (2E, 4Z) - decadienal (6), α -funebrene (8), (E)- β- ionone (12), cedryl acetate (17), (Z)- 2-hexyl-cinamaldehyde (18), 2,4,6-trihydroxybenzylaldehyde (19), pentadecanoic acid (21), n-nonadecane (22).

CONCLUSION

The results give further insights into the chemical compositions, pharmacological activity, and beneficial effects of *Urginea maritima*. The results show that the flowers are rich in essential oils which are absent in the bulb of the plant.

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Table1: Chemical composition the essential oil hydro-distilled from the flowers parts of Jordanian *Urginea maritima*

No	RI exp	RI lit	Content %	Compound
1	917	918	8.4	**α –Pinene**
2	987	984	7.3	**2-Pentyl-furan**
3	1008	1008	7.8	**δ -3-Carene**
4	1082	1086	2.7	Terpinolene
5	1100	1100	4.4	1-Nonanal
6	1287	1293	1.7	(2E, 4Z) - Decadienal
7	1311	1315	9.7	**(2E,4E) -Decadienal,**
8	1402	1402	1.6	α -Funebrene
9	1410	1410	3.2	(z)- Caryophyllene
10	1444	1452	2.6	α -Humulene
11	1471	1484	2.0	Germacrene-D
12	1477	1488	1.9	(E)- β- Ionone
13	1502	1521	2.2	6-Methyl- α -ionone
14	1593	1600	2.0	Cedrol
15	1588	1600	23.3	**Cedrenol**
16	1605	1618	2.0	Epi-cedrol
17	1750	1767	1.5	Cedryl acetate
18	1760	1774	1.9	(Z)- 2-Hexyl-cinamaldehyde
19	1818	1808	1.4	2,4,6-Trihydroxybenzylaldehyde
20	1847	1837	2.0	Phenyl acetyl octanoate
21	1857	1857	1.7	Pentadecanoic acid
22	1892	1900	1.5	n-Nonadecane
23	1916	1921	5.8	**Hexadecanoic acid methyl ester**

RI exp: Linear (arithmetic) retention index calculated on DB-5 equivalent column
RI lit: reference retention index value from literature
*Average% content of 4 determinations (2 oil samples, 2 replicates each), for which the standard deviation (SD) values were within 2% (+2%) of the mean
Compounds in bold are the major components (≥5.0%)

Table 2: The different groups of (EO) presents in the flowers of *Urginea maritima*

Content %	(EO) groups
30.4	Monoterpenes and oxygenated sesquiterpenes
18.9	Monoterpenoids Hydrocarbons
15.8	Aliphatic derivatives
11.0	Fatty acid derivatives
7.8	Sesquiterpene hydrocarbons
7.3	Furano derivatives
4.1	Ionones
3.3	Cinnamylaldehyde derivatives

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DECLARATION OF CONFLICT OF INTEREST

The author has stated that there is no conflict of interest associated with the publication and no financial support, which could have influenced the outcome.

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