Available online at http://www.ijabbr.com

International journal of Advanced Biological and Biomedical Research

Volume 2, Issue 1, 2014: 105-109

Chemical Composition of the Essential Oil from the Aerial Parts of *Ixiolirion tataricum* (Pall.) Herb.

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Abstract

The genus *Ixiolirion*, belonging to the Amaryllidaceae family, contains about 3 species distributed in center and southwest of Asia and northeast of Africa. The Iranian flora consists of only one bulbous flowering species; *Ixiolirion tataricum* (Pall.) Herb., with the Persian name of "Khiarak". In the present work, *I. tataricum* was collected, during the flowering stage, from the Sarduiyeh area in Jiroft, Kerman Province, Iran in April 2012. The essential oil of the aerial parts of the plant was extracted using hydrodistillation method and analyzed by GC and GC-MS. Thirty-five compounds were identified in the essential oil, representing 85.2% of the total oil detected. The main constituents were 2-phenylethyl phenylacetate (16.8%), β-selinene (14.8%), bicyclovetivenol (4.8%), thymol (4.3%) and (*E*)-chalcone (4.3%). Consequently, nonterpenoids (44.2%) were the major group of components in the essential oil of the plant.

Key words: *Ixiolirion tataricum*, Amaryllidaceae, Hydrodistillation, Essential oil, 2-phenylethyl phenylacetate.

Introduction

The family Amaryllidaceae is a large family of monocotyledonous, bulbous flowering plants of around 1000 species in 79 genera. Although tropical and subtropical in distribution, members of the family are prominent within three distinct geographical locations, including Andean South America, the Mediterranean and South Africa (Nair and Staden, 2013). These plants are known for their horticultural and ornamental appeals, as well as their highly valued medicinal properties (Nair *et al.*, 2012). Plants of the Amaryllidaceae family are known to produce structurally unique alkaloids with a wide range of

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interesting physiological effects, including antitumor, antiviral, cytotoxic, acetylcholinesterase inhibitory, immunostimulatory, antiinflammatory, analgesic, and DNA-binding activities and some of them have also been used in the treatment of Alzheimer's disease (Osorio *et al.*, 2010).

The genus *Ixiolirion*, belonging to the Amaryllidaceae family, contains about 3 species distributed in center and southwest of Asia and northeast of Africa (Zhizun and Gilbert, 2000). The Iranian flora consists of only one bulbous flowering species with the Persian name of "Khiarak" which is distributed all over the country; *Ixiolirion tataricum* (Pall.) Herb. (Mozaffarian, 2006; Mazhari, 2004). The species is a West Irano-Turanean plant. The distribution of this geophyte extends beyond the West Irano-Turanean region into the neighboring East-Mediterranean territories of Syria, Lebanon and Turkey (Galil, 1983).

A literature search did not reveal any references to previous work on the essential oils of *Ixiolirion* species. The present work studies the chemical composition of the essential oil from the aerial parts of *I. tataricum* for the first time.

Materials and Methods

Plant material

Fresh aerial parts of *Ixiolirion tataricum* were collected, during the flowering stage, from the Sarduiyeh area (at an altitude of 2800-2900 m) in Jiroft, Kerman Province, Iran in April 2012. A voucher specimen (No. 1486) has been deposited in the Herbarium of Shahid Bahonar University of Kerman, Iran. The plant material was air-dried at room temperature, protected from light, for 1 week.

Isolation of the essential oil

The air-dried aerial parts of the plant (200 g) were crushed and subjected to hydrodistillation using a Clevenger-type apparatus for 3 h. The distilled oil was dried over anhydrous sodium sulfate and stored in a tightly closed dark vial at 4°C until the analysis. The yield of the oil was calculated based on dried weight of plant material.

GC and GC/MS analysis

GC analysis of the oil 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). Helium was used as the carrier gas at a constant flow of 1 mL/min. 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 kept at 250°C and 270°C, respectively. A mixture of aliphatic hydrocarbons (C_6–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.

GC/MS analysis was performed using an Agilent 5975C mass spectrometer coupled to an Agilent 7890A gas chromatograph equipped with a HP-5MS capillary column (30 m × 0.25 mm, film thickness 0.25

μm). The carrier gas was helium, and the chromatographic conditions were as above. Spectrometer was scanned over the 40-400 amu range with an ionization voltage of 70 eV and an ionization current of 150 μA.

Identification of components

The constituents of the volatile oil were identified by comparison of their retention indices with those reported in the literature and by comparison of their mass spectra with the Wiley and NIST libraries or with the published mass spectra (Adams, 2004; Massada, 1976). The percentage composition of the individual components was computed from the GC-FID peak areas without the use of correction factors.

Results and Discussion

The yield of the essential oil obtained from the aerial parts of *Ixiolirion tataricum* was 0.1% (w/w). The identified compounds of the oil are listed in Table 1, in which the percentage and retention indices (RI) of the components are given. Constituents are arranged in order of their elution from the HP-5MS column. As is shown, 35 compounds were identified in the essential oil of the plant, representing 85.2% of the total oil. The main constituents were 2-phentlethyl phenylacetate (16.8%), β-selinene (14.8%), bicyclovetivenol (4.8%), thymol (4.3%) and (*E*)-chalcone (4.3%), followed by dibutyl phthalate (3.6%), α-curcumene (3.1%) and 2-phenylethyl tiglate (3.0%).

Apparently, the oil consisted of two oxygenated monoterpenes (5.4%), five sesquiterpene hydrocarbons (21.4%), eight oxygenated sesquiterpenes (13.3%), one diterpene hydrocarbon (0.9%) and nineteen nonterpenoid compounds (44.2%). Consequently, nonterpenoids were the main group of components in the essential oil.

The dominant compound in the essential oil of *I. tataricum* is 2-phenylethyl phenylacetate. This ester compound has also been reported in the essential oil of *Eucalyptus aggregata* (91%) and *E. crenulata* (35%) as the main constituent. 2-Phenylethyl phenylacetate is a very stable compound that is suitable for use as a detergent and soap perfume. It is a fixative base in sweet woody, oriental and tobacco scents, as well as being supportive to musk perfumes (Williams, 2011).

There is no report on the chemical composition of the essential oil of *Ixiolirion* species. However, the composition of the petroleum ether extract of *I. tataricum* has been previously reported. Thirty components such as α-thujene, β-phellandrene, 3-carene, β-pinene, cumaldehyde, safranal, dodecyl alcohol, tetracosane, pentacosane, hexacosane, heptacosane and octacosane, have been identified in the extract. The great part of the components has proved to be an important physiological activity by pharmacological experiments (Yong and Jieying, 1988).

Conclusion

Essential oils are a group of natural organic compounds that are predominantly composed of terpenes and terpenoids. The essential oil of *Ixiolirion tataricum* (Pall.) Herb. mainly contains nonterpenoids and 2-phenylethyl phenylacetate, an ester compound, is the major constituent of the oil.

Acknowledgment

The authors are grateful to Islamic Azad University, Kerman Branch, for financial assistance of this work.

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Table 1. Chemical Composition of the Essential Oil of *Ixiolirion tataricum*

Compounds	**RI***	**%**
n-Undecane	1099	0.6
n-Nonanal	1101	0.8
n-Dodecane	1198	1.4
Thymol	1290	4.3
n-Tridecane	1299	0.8
(2*E*,4*E*)-Decadiene	1315	0.8
n-Tetradecane	1397	0.8
β-Caryophyllene	1417	1.6
Geranyl acetate	1451	1.1
α-Curcumene	1475	3.1
β-Selinene	1486	14.8
α-Selinene	1494	1.3
Spathulenol	1576	1.6
2-Phenylethyl tiglate	1582	3.0
n-Hexadecane	1596	1.4
β-Oplopenone	1607	1.1
Cadina-1(10),6,8-triene	1615	0.6
γ-Eudesmol	1630	1.8
Bisabolone oxide	1682	0.9
n-Heptadiene	1696	0.8
Bisabolol oxide	1746	0.8
Cyclocolorenone	1755	1.2
γ-Eudesmol acetate	1778	1.1
Bicyclovertivenol	1790	4.8
n-Octadecane	1798	0.8
Neophytadiene	1836	0.9
6,10,14-Trimethyl-2-pentadecanone	1843	1.3
2-Phenylethyl benzoate	1855	1.4
Diisobutyl phthalate	1868	2.5
n-Nonadecane	1899	1.2
2-Phenylethyl phenylacetate	1916	16.8
Dibutyl phthalate	1965	3.6
(*E*)-Chalcone	1992	4.3
n-Eicosane	1995	0.7
n-Heneicosane	2096	1.2
Total identified	–	**85.2**

*Retention indices, experimentally determined.