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Original Article

Chemical Composition of Essential Oil from Leaves, Stems, Flowers and Seeds of *Heracleum rechingeri* Manden. from Iran

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Abstract

Chemical composition of the essential oils extracted from the leaves, stems, flowers and seeds of *Heracleum rechingeri* Manden. were analyzed by GC and GC/MS. Twenty-four components were characterized for the leaf oil with Octyl acetate(47.2%), Octanol(15.2%) and E-caryophyllen (5.7%) as the main constituents. 25 compounds were identified in the stem oil with Elemicin (65.3%), Octyl acetate (13.0%) and Octanol (3.5%) as the major components. 18 compound were identified in the flower oil with Octyl acetate (46.8%), Elemicin (12.8%) and methyl chavicol (10.2%) as the major components. Among 13 compounds studying in the seed oil of *H.rechingeri*, the major constituents were Octyl acetate (91.7%), Octanol (3.5%) and Octanal (1.2%).

Key words: *Heracleum rechingeri*, Essential oil, Octyl acetate, Elemicin

Introduction

The genus *Heracleum* L. with more than 120 species in the world is one of the largest genera of the umbelliferae (Apiaceae) family. This genus is widely distributed in asia [1] and is represented in Iran by 10 species, four of which (*Heracleum Rechingeri* Manden, *Heracleum Gorganicum* Rech, f., *Heracleum Nephrophyllum* Leute *and Heracleum Anisactis* Boiss. & Hohen.) are endemic in Iran[2]. The essential oils and extracts different species of *Heracleum* have reported as follow: different biological properties such as cytotoxic activity for *Heracleum sibiricum* L. [3]. Antioxidant and antimicrobial activity for *Heracleum nepalense* D. Don [4]. Immunostimulant in *Heracleum maximum* W. Bartram [5] and anticonvulsant effect for *Heracleum persicum* Desf. ex Fisch., C.A.Mey. & Avé-Lall. [6]. The amount of 56.5% hexyl butyrate, 16.5% octyl acetate, 5.2% hexyl 2-methyl butanoate and 3.4% hexyl isobutyrate in the essential oil of *H. persicum* with anti-inflammatory and analgesic effects identified by Hajhashemi *et al*. [7]. The main oil compounds of aerial parts of *Heracleum rechingeri* were octyl acetate (29.49%), elemicine (23.06%), (E)-caryophyllene (9.26%), caryophyllene oxide (6.42%), terpinolene (6.12%) and (Z)-3-octenyl acetate (4.72%)[8]. In this study, we investigated the oils of all parts of *Heracleum rechingeri* manden, which grow wild in Iran, such as leaves, stems, flowers and seeds (or frouts) individually. A literacher search revealed references about the oil of *H. rechingeri* leave [8]. But there is no reference to previous work on the oil of *H. rechingeri* fruits, flowers or stems. Therefore, we decided to investigate the chemical composition of the essential oil of *H. rechingeri* from Iran.

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Material and Methods

Plant material

The aerial parts of *H. rechingeri* were collected from Chaloos, Alamde in Mazandaran province during flowering stage. The herbarium specimen has been deposited in the Herbarium of the Research Institute of forest and Rangelands (TARI).

Isolation procedure

Dried leaves of every treatment (80g) were subjected to hydro-distillation of 2h using an all glass Clevenger- type apparatus, according to the method recommended by the European pharmacopoeia (1983) to produce oils in yield presented in table 1. The oils were dried over anhydrous sodium sulfate and stored in sealed vials at low temperature(2 $^{\circ}$C)

Gas Chromatography

GC analyses of the oils was conducted using a thermo-UFM instrument equipped with a DB-5 fused silica column (10m×0.1mm, film thickness 0.4 µm). Oven temperature was started at 60 $^{\circ}$C and the programmed to 280 $^{\circ}$C at a rate of 80 $^{\circ}$C/min. Helium was used as the carrier gas at the constant flow of 0.5 ml min^{-1}, and then held for 3 min. The injector and detector (FID) temperature were kept at 280 $^{\circ}$C, respectively. The split ratio was 1:100.

Gas Chromatography-Mass Spectrometry

GC-MS analyses were carried out on a varian 3400 GC-MS system equipped with a DB-5 fused silica coloumn (30m×0.25mm i.d., film thickness 0.25µm); Oven temperature was similar to oven temperature in GC. Injector temperature was adjusted 10 $^{\circ}$C higher than final-temperature. Carrier gas helium with a liner velocity of 31.5 cm/s, Ionization energy 70 eV. mass range 40-300a.m.u.

The components of the oils were identified by comparison of their mass spectra with those of a computer library or with authentic compounds and confirmed by comparison of their retention indices, either with those of authentic compounds or with data published in the literature [9-11]. The retention indices were calculated for all volatile constituents using a homologous series of n-alkanes.

Results

The oils isolated by hydro-distillation from the leaves, stems, flowers and seeds of *H. rechingeri* were obtained in yields of 0.3%, 0.11%, 5.93% and 6.69%(w/w). Twenty four components were characterized for the leaf oil and 25compounds were identified in the stem oil. Eighteen compound were identified in the flower oil and 13 in the seed oil of *H. rechingeri*. The identified components and their percentage are given in table 1. The components are listed in order of their elutionon the DB-5 column.

As shown in the table, the main component of leaf oil were octyl acetate (47.2%), octanol (15.2%) and E-caryophyllene (5.7%). While stem oil contained Elemicin (65.3%), octyl acetate (13.0%) and octanol (3.5%). The main constituents of the flower oil were octyl acetate (46.8%), Elemicin (12.8%) and methyl chavicol (10.2%). Also, seed oil contained octanol acetate (91.7%), octanol (3.5%) and octanal (1.2%), respectively. Although octanol acetate was main component of oils obtained from the leaves, flowers and seeds of *H. rechingeri*, It was found a little in stem oil. In other words, there was a sharp difference between the chemical composition of stem oil with the oils of other parts of this plant. The main component of stem oil of *H. rechingeri* were Elemicin (65.3%).

Discussion

The constituents of essential oils of *Heracleum* species have been isolated by many researchers. [12,13]. and have frequently been reported as octyl acetate,n- octanol, myristicin and elemicin. Moreover n- octanol was the main component of H. Sphondylium [14]. The other reports of the chemical composition of essential oil from leaf of *H. rechingeri*, were characterized twenty-seven compounds, representing 94.62% of the total oil,. Octyl acetate (29.49%) and elemicin (23.06%) were found to be main constituents [8]. Our results are similar to this report. The presence of elemicin and octyl acetate as a predominant compound is in accordance with this study but since their components belong to aerial parts of plants there is some differences. The composition of essential oils from aerial parts of *H. persicum*, a widely used medicinal plant, and three other *Heracleum* species growing wild in Iran were analysed by GC and GC–MS. Myristicin (53.6%), (*E*)-anethole (25.0%), hexyl butanoate (29.7%) and elemicin (41.1%) were the major compounds of *H. pastinacifolium*, *H. persicum*, *H. rechingeri* and *H. transcaucasicum*, respectively [15].

Table 1 Chemical composition of the Essential Oils from different parts of *H. rechingeri* Manden

Compound	RI	Percentage in oil			
		Leave	Stem	Flower	Seed
α-pinene	940	0.13	-	-	-
Myrcene	991	-	0.08	0.64	-
Octanal	1001	0.54	0.19	3.90	1.15
Hexyl acetate	1010	-	-	0.29	-
p-cymene	1027	1.08	1.51	0.30	0.43
E-β-Ocimene	1052	0.21	-	0.48	-
γ-Terpinene	1063	1.62	0.63	0.62	0.50
Octanol	1074	15.24	3.54	4.46	3.45
Linalool	1098	-	-	1.55	-
Nonanal	1103	-	0.12	-	-
Camphor	1145	3.82	0.09	-	0.03
Hexyl isobutyrate	1152	-	-	0.58	0.03
Methyl chavicol	1198	0.45	0.16	10.16	1.25
Decanal	1205	0.12	0.07	1.51	0.30
Octanol acetate	1213	47.19	13.04	46.76	91.73
Hexyl 2-methyl butyrate	1235	0.23	0.07	1.21	0.36
E-Anethole	1284	0.28	0.78	-	-
Octyl isobutyrate	1343	-	-	2.68	-
Citronellyl acetate	1356	0.05	-	-	-
Decanol acetate	1412	0.37	0.22	3.56	0.25
E-caryophyllene	1420	5.72	1.40	4.90	0.08
Octyl 2-methyl butyrate	1434	-	-	3.36	-
α -trans bergamotene	1436	0.35	0.45	-	-
α- Humulene	1456	0.33	0.08	-	-
Allo-aromadendrene	1461	-	0.10	-	-
Germacrene D	1483	0.61	0.27	-	-
Ar-Curcumene	1485	1.21	2.16	-	-
α-Zingiberene	1497	2.33	2.00	-	-
β-bisabolene	1511	1.91	2.69	-	-
Myristicin	1522	-	0.93	-	-
β-Sesqui Phellandrene	1525	1.04	1.16	-	-
E-γ- bisabolene	1536	2.53	2.88	-	-
Elemicin	1556	12.49	65.30	12.78	0.34
Total(%)	-	99.85	99.92	99.74	99.9
Yield(%)	-	0.3	0.11	5.93	6.69

In the oil of *H. crenatifolium*, 22 compounds, representing 99.3% of the total oil, main constituents were identified as octanol and octyl acetate (3.1% and 88.4% respectively). The essential oils obtained from the crushed fruits (yield of 3.7%0 of *H. crenatifolium* collected from konya, Turkey were reported previously to contain octyl acetate (93.7%) as the major constituent [16]. It is concluded that, leaves, flowers,stems and seed extracts of *H. rechingeri*, have the high amounts of Octanol acetate, Elemicin and octanol .Octanol is consumed as a precursor to perfumes. It has been examined for controlling essential tremor and other types of involuntary neurological tremors [4]. Because of its fruity odor of **Octanol acetate**, it is used as the basis for artificial flavors and in perfumery [17].

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