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Chemical composition of the essential oils of *Achillea eriophora DC*. growing wild in Iran

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ABSTRACT

Achillea eriophora DC. is known locally as "Bumadaran-e- shirazi" or "Sàrzàrdu", in Fars Province- Iran. It is a specific endemic medicinal plant in this area. GC-MS analysis of essential oil hydrodistilled from their aerial part obtained from Fasa city (Fars Province)-Iran, resolved into 46 compounds representing 99.58% of the essential oil. The chemical analysis of Sàrzàrdu, revealed the most abundant component was 1, 8-Cineole (16.772%) and the other major compounds of the oil were, Borneol, β-Phellandrene, Camphor, α-Pinene, δ-3-Carene and β-pinene with amounts of 16.169, 15.288, 9.771, 4.361, 3.986 and 3.902% of the total oil, respectively. Information about the essential oil composition assists us for estimate the quality of oils intended to their specific uses.

Keywords: *Achillea eriophora DC*, Bumadaran, Essential oil composition, Gas Chromatography- Mass Spectrometry

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INTRODUCTION

Plants have been used as remedy as old as the history of mankind [1]. Their derived ingredients have recently become the great interest due to their multipurpose applications. They are appropriate new resources for construction of novel synthetic agents [2]. Furthermore, Natural products are frequently inexpensive and claimed to be safe and have insignificant side effects in compare to the synthetic chemicals [3, 4].

World Health Organization (WHO) revealed that around 20,000 herb species were being used as medicine all over the world out of the about 2,50,000 existing plant species on earth [5].

Many plants contain mixture of volatile constituents like monoterpenes and sesquiterpenes termed essential oils that obtained from their flowers, buds, seeds, rhizomes, leaves, bark, wood, fruits and roots [6]. The native use of essential oil and their components offer enormous scope in developing plant derived bio-safe products of direct utility to humans [7, 8].

The herb Achillea, belonging to the family Asteraceae (Compositae), is a genus represented by 115 species all around the world [9, 10]. It is believed to be named after Achilles, who used *Achillea spp*. intended for healing soldiers injured during the Trojan War [1]. These plants are medicinal perennial rhizomous herbs that are native to

Europe, Western Asia, North Africa, though they are also found in Australia, New Zealand and North America [9-12].

The *Achillea* genus has a wide-ranging distribution from deserts, rock clefts, and sea coasts to marine pioneer biota and ruderal habitats [13].They were used in traditional medicine for the treatment a number of diseases and ailments [14], as diuretic, emmenagog agents, wound healing, for curing stomachache, diarrhea and antispasmodic [15], antiseptic and infection preventing agents [16], and some uses in cosmetics, fragrances and plant protection [16-18]. A 19 species of the genus are designated in the Flora Iranica. That is originated in the central and western areas of Iran and Iraq [19, 20].

"Bumadàran" is a widely held name for some species of *Achillea* in Persian language [17]. Briefly in botany; plant reaches a height about 80-100 cm with singular, arranged in corymbs of a complex character and about 10 cm in diameter flower, As well as the elevated, numerous longitudinally stripped, simple and thickened at base stems, addition to the green, linear, pinnate, lobed and serrated, hairy and rough leaves [21, 22].

Achillea eriophora DC. One the most imperative genus of *Achillea,* is known locally as "Bumadaran-e- shirazi" and "Sàrzàrdu", in Fars Province- Iran. It is a particular endemic plant in Iran [21- 23]. It grows exclusively In "Fars" province [23]. Sàrzàrdu, also, grows wildly in fasa localities in this province. Since antiquity, the ancient peoples in this area were aware of their medicinal properties and have been used as anti-inflammatory, anti-spasmodic, diaphoretic, diuretic, emmenagogic agents and for treatment of hemorrhage, pneumonia, rheumatic pain, wounds [17, 24] diabetes mellitus and abdominal pain [25]. The Rhazes and Avicenna, two Iranian earliest scientists were correspondingly, familiar with the plant and mentioned its medicinal uses in their admirable books, "Continens" and "The Canon", respectively [26].

There were analyzed and reported the major components of essential oils, in several studies on different Iranian Achillea species [10].

Achillea eriophora DC., contains higher level of essential oil in comparison to other species [23]. However, their morphologic and chemical compositions were affected by environmental conditions [27].

The individual chemicals parted from essential oil are more often used than oil, in addition to further cognizance and knowledge of essential oil composition helps to assess the quality of oils that lets a better and specially its directed application [28].

Hence, the objective of the present study was undertaken to identify the chemical composition of a hydrodistilled essential oil of *Achillea eriophora DC.* plant collected from Fasa, in the Fars province of Iran, by a GC/MS method, as well as assessment of biological activities of main compositions via literature review.

EXPERIMENTAL SECTION

Chemicals

All chemicals and solvents used for extraction and analysis of plant were analytical grade and purchased from Sigma (MO, USA) and Merck (Germany) Chemical Companies, USA.

Sample collection

Aerial parts of the *Achillea eriophora DC* were collected from Fedeshkouyeh, a region around Fasa urban from Fars province of Iran, in summer at 2013. In the area covered for present study, because of their geographical and climatic conditions, grows wildly the plentiful of plant. The plants were identified by Fars Research Center for Agriculture and Natural Resources and voucher specimens were deposited under the Herbarium of Fasa Islamic Azad. About 2500 g of randomly collected fresh and non-infected aerial parts of plant were cleaned to remove any adhering flesh and dried on stainless steel tables in the shade, at room temperature for a week to their final moisture content. Dried plant materials were pulverized and packed in polyethylene bags for further analysis.

Essential Oil Extraction

The essential oil of *A. eriophora DC* was attained from totally 300 grams of powdered aerial part of shrub. There were hydro-distilled via a Clevenger type device for three hours, designed for 3 times, each stage 100 g. The

obtained oil were filtered and dehydrated with sodium sulfate and kept at 4°C until analysis. The yellow with pleasant, sweet and intense odor oil sample in yield of extraction was 0.25% w/w base on dry weight.

GC-MS analysis

Gas chromatography provides an operative resolution of the individual components in a mixture and their identification can frequently be accomplished through their characteristic molecular fingerprints, mass spectra [29, 30].

The oil composition analysis of *A. eriophora DC* was conducted by GC-MS Agilent Technologies-5975C-MS, 7890 A-GC , equipped with a HP-5MS, 30m× 0.25mm (ID) × 0.25 µm film thickness (FT) capillary Column, the oven temperature was programmed as follows: 60-210 ºC with Rate of 3 ºC/min, Then 210-240 ºC with Rate of 20 ºC/min , Hold Time:8.5min, Run Time: 60min; injector temperature: 280°C; MS detector temperature 280°C; Carrier Gas: He, with flow rate of 1ml/min; split ratio, 1:15; that was processed on Chemstation Software. The quadrupole mass spectrometer was operating at ionization energy (IE) mode of 70eV; also a 1.0 µl sample was injected to injector. The Identification of compounds was carried based comparison of their mass spectra with the Wiley and NIST Adams library of mass spectral data [31]. The percentage composition on the oil sample was considered from GC-MS peak areas.

RESULTS

The essential oil from the aerial parts of *A. eriophora DC* was analyzed by GC and GC-MS method. Thoroughly, 46 peaks were separated and 45 Chemical constituents, comprising 99.58% of the total content were detected (Figure1).

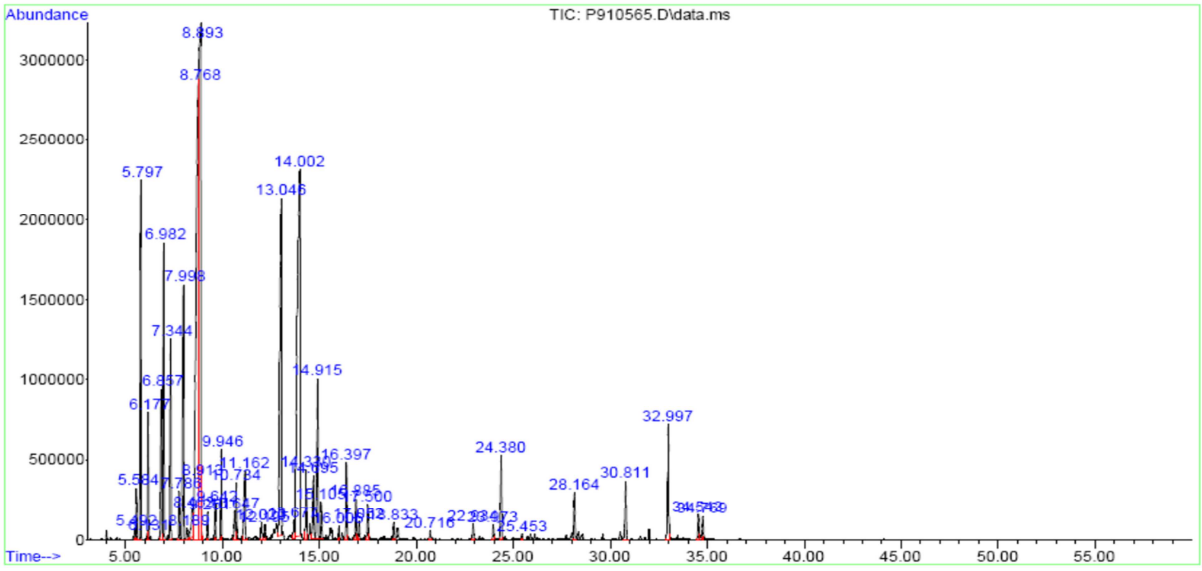

Fig. 1: Typical GC-MS chromatograms of *Achillea eriophora DC.* essential oil obtained *from* fasa, Iran

The essential oil was made up of 90.428% monoterpens (52.599% oxygenated compounds and 37.829% hydrocarbons) as the main component and 6.05%. sesquiterpens. The most abundant component of oil was 1, 8-Cineole, representing 16.772% and other main components recognized were Borneol, *β*-Phellandrene, Camphor, *α*-Pinene, *δ*-3-Carene and *β*-pinene, containing 16.169, 15.288, 9.771, 4.361, 3.986 and 3.902% of the total oil. The lowest part of detected compound was related to α-Fenchene (0.037%).the other values were ranging from 0.113 to 2.929% (Table 1).

Table1: Chemical composition (%) of *Achillea eriophora DC*.oil from Fasa (Fars province)-Iran

	Compound	RT (min)	Area (%)		Compound	RT (min)	Area (%)
1	**Tricyclene**	5.492	0.113	24	**Camphor**	13.046	9.771
2	**α-Thujene**	5.584	0.519	25	**Pinocarvone**	13.677	0.317
3	**α -Pinene**	5.797	4.361	26	**Borneol**	14.002	16.169
4	**α -Fenchene**	6.131	0.037	27	**Terpinene-4-ol**	14.33	1.009
5	**Camphene**	6.177	1.33	28	**Cryptone**	14.695	1.322
6	**Sabinene**	6.857	1.98	29	**α -Terpineol**	14.915	2.929
7	**β-pinene**	6.982	3.902	30	**Myrtenal**	15.105	0.56
8	**Myrcene**	7.344	2.666	31	**trans-Carveol**	16.006	0.18
9	**α -Phellandrene**	7.786	0.748	32	**Isobornyl formate**	16.397	1.167
10	**δ-3-Carene**	7.998	3.986	33	**Cumin aldehyde**	16.885	0.61
11	**α -Terpinene**	8.189	0.213	34	**Carvone**	17.052	0.265
12	***p*-Cymene**	8.453	0.936	35	**Geraniol**	17.5	0.574
13	**β -Phellandrene**	8.768	15.288	36	**Bornyl acetate**	18.833	0.249
14	**1,8-Cineole**	8.809	16.772	37	**Hexyl tiglate**	20.716	0.13
15	**(Z)- β -Ocimene**	8.913	0.429	38	**Geranyl acetate**	22.934	0.234
16	**(E)- β -Ocimene**	9.251	0.306	39	**α -Gurjunene**	23.973	0.217
17	**γ-Terpinene**	9.642	0.401	40	**(E)-Caryophyllene**	24.38	1.374
18	**cis-Sabinene hydrate**	9.946	1.124	41	**cis-Muurola-3,5-dien**	25.453	0.083
19	***p*-Mentha-2,4(8)-diene**	10.647	0.366	42	**γ -Cadinene**	28.164	0.79
20	**Terpinolene**	10.734	0.767	43	**Caryophyllene oxide**	30.811	1.12
21	**Linalool**	11.162	1.225	44	**epi- α -Cadinol**	32.997	2.054
22	**cis- β -Menth-2-en-1-ol**	12.02	0.367	45	**α -Bisabolol**	34.543	0.412
23	**α -Campholenal**	12.195	0.208	46	**Unknown**	34.769	0.417
Total (%)					**99.58**		

DISCUSSION

The current study is undertaken to identify the Chemical composition present in the aerial parts of *A. eriophora DC* plant from Fasa-Iran (Fedeshkouyeh village). There are several similar studies on a number of genus of Achillea, in far and wide of the world [32-34], but due to their exclusive and wild growing of *eriophora DC* ., and nativity in Fars Province, Iran; there was asserted on revealed genus.

Weyerstahl et al., (1997) [35] investigated the Constituents of the essential oil from *Achillea eriophora DC* cultivar in Bajgah region from Shiraz, Iran. The oil sample in yield of extraction was around 1.7% and 90 compounds were identified. The chemical investigation of the genus showed the presence of terpenes such as monoterpenes and oxygenated monoterpenes. 1, 8-Cineole has been found to be the major compound of A.eriophora (34.2%). the main constituents were α-Pinene (7. 6%), β -pinene (6.2%), α -Terpineol (5.1%) and linalool (4.1%).

In the similar study Jaimand and Rezaee (2004) [20] were evaluated the chemical compositions of *Achillea eriophora* flower and leaf essential oils collected from Bamoo park in Shiraz-Iran by GC and GC/MS method. The percentage of flower oils by different methods of steam distillation and hydrodistillation were 1.2, 1 and for leaf were 1 and 0.9%, respectively. From 35 identified compounds, the major constituents determined by steam distillation in flower were 1, 8-cineole (45.0%), β -pinene (16.6%) and (E) - nerolidol (7.6%), and in leaf were 1, 8-cineole (41.5%), (E)-nerolidol (10%) and β - pinene (9.8%). The major constituents, determined by hydro-distillation method in flower were 1, 8-cineole (41.3%), β -pinene (12.4%) and α -thujene (6.5%), and in leaf were 1, 8-cineole (41.0%), β -pinene (13.8%) and terpinen-4-ol (9.1%).

A comparable study was done by Ghani et al., (2009) [23], on the essential oil composition of the top flowering part of the *Achillea eriophora* DC, collected from two different area of Iran, "Mohammad Abad" a community of Jahrom in the South of Fars province (wild growing) and the other, cultivated in Mashhad. The samples were extracted by Clevenger apparatus and analyzed by GC and GC-MS method. The essential oils content of the wild and cultivated samples were 2% and 2.25% v/w respectively. In wild samples 30 components were identified and their major components were, Camphor (30.4%), 1, 8-Cineole (25.24%), Camphene (6.21%), α-Pinene (4.49%) and Myrcene (3.91%). Also, 36 components detected in the cultivated samples with main components of Camphor (28.98%), 1, 8-Cineole (26.98%), Camphene (5.98%) and α-Pinene (4.23%). *β*– pinene (4.8%) was detected only in cultivar sample (Mashhad).

Saberi-ameli et al., (2009) [36] was analyzed the A. *eriophora* DC essential oil from "Khebr" National Park of Kerman-Iran by employing GC-MS. The chemical composition of analysis resulted in the identification of 32 compounds. The essential oil of *R. officinalis* L. gave an average yield of 1.5% v/w. The main Compounds were Camphor (46.43%), 1, 8- cineole (9.85%), α- Thujone (8.16%), camphene (4.88%), and β-Thujone (4.66%).

The result of our analysis is in agreement with Weyerstahl et al., (1997) [35] as well as, Jaimand and Rezaee (2004) [20] that were reported the 1, 8-cineole as the major component in A. *eriophora* essential oil samples. However, they had different percent values ranging from 16.77 to 45%. While, the main component in our study was different from that quoted by Ghani et al., (2009) [23], and Saberi-ameli et al., (2009) [36], identified as Camphor. Besides, 1, 8-cineole was taken in following stage in both studies.

There were Also similarity between our oil and the other oils in presence of *β*– pinene in main compounds, excluding Saberi-ameli et al., (2009) [36].

As viewpoints of the number of identified components, revealed studies were not the same (n: 30-90), as well as, the averages yield of extracted oil (0.25-2.25%).

Comparisons between different Studies show that the quality and yield of essential oils from A. *eriophora* DC plants is influenced by several conditions like extraction method, the geographic location, characteristics of soils, harvesting season, the choice and stage of drying conditions, choice of plant part and so on [4].

As indicated, the most abundant components of oil were 1, 8-Cineole, Borneol, *β*-Phellandrene, Camphor, *α*-Pinene, *δ*-3-Carene, *β*-pinene, α –Terpineol**,** Myrcene and epi- α -Cadinol , respectively. Reports on their biological properties, have been increased, and considered in several studies. Some biological properties of ten main chemical compositions of *Achillea eriophora DC*. essential oil obtained from Fasa, Iran was shown in table (2).Alongside, their toxicology studies should be considered.

Table 2: Some biological properties of ten main chemical compositions of *Achillea eriophora DC.* essential oil obtained *from* Fasa, Iran

	Compound	Percent (%)	biological properties
1	1, 8-Cineole	16.772	Antimicrobial activities (37- 40); anti-nociceptive effects (41, 42), Anti-inflammatory activity (42).
2	Borneol	16.169	Antimicrobial activities (43).
3	*β*-Phellandrene	15.288	Hyperthermic; irritant; spasmogenic; tumor-promoter (4)
4	Camphor	9.771	Antimicrobial activities (44, 45, 37, 46, 47, 39, 40); Allelopathic; analgesic; anesthetic; antiacne; antidiarrheic; antidysenteric; antiemetic; antifeedant; antifibrositic; antineuralgic; antioxidative, antipruritic; antiseptic; antispasmodic; CNS-stimulant; cancer-preventive; carminative; convulsant; cosmetic; counterirritant; decongestant; deliriant; ecbolic; emetic; epileptigenic; expectorant; fungicide; herbicide; insect-repellent; insectifuge; irritant; nematicide; occuloirritant; P450-2B1-inhibitor; pesticide; respirainhibitor; respirastimulant; rubefacient; stimulant; transdermal; verrucolytic; vibriocide (4).
5	*α*-Pinene	4.361	Anti-microbial activity (48, 49, 43, 39).
6	*δ*-3-Carene	3.986	**NR*
7	*β*-pinene	3.902	Antimicrobial activities (bactericidal effects), cytotoxicity to murine macrophages (49); anti-nociceptive effects (42).
8	α -Terpineol	2.929	Anti-microbial activity (50, 51)
9	Myrcene	2.666	Analgesic activities (52); Antimicrobial activities (50, 38, 39); [as a fragrance in cosmetics, scent in household products, and flavoring additive in food and alcoholic beverages] (53, 54).
10	epi- α -Cadinol	2.054	**NR*

**NR: No report*

CONCLUSION

In conclusion, meanwhile, the essential oils attained from each climate and land may be different in their chemical composition; consequently, change their biological activities. Therefore, authors suggest the analysis of *A. eriophora DC.* essential oil, before any usage and objective; specially, the remedial practices.

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