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Original Article

Composition of Essential Oil of *Dorema aucheri* Boiss. and *Allium Jesdianum* Boiss. medicinal plants

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ABSTRACT

Background: Medicinal plants contain plant materials such as leaf, root, flower and seed using for producing drugs. Essential oils and extracts of various species of edible and medicinal plants, herbs, and spices constitute of very potent natural biologically active agents. *Allium jesdianum* Boiss and *Dorema aucheri* Boiss are important and endangered medicinal plants whose main habitats are located in the Zagros Mountains of Iran. *Allium jesdianum* (Alliaceae family) and *Dorema aucheri* belong to Umbelliferae family that were collected at summer 2020 from Yasouj in Kohgiluyeh and Boyer-ahmad province during to fruiting stage. The main purpose of this study was to evaluate composition of essential oil of *Allium Jesdianum* and *Dorema aucheri* from Kohgiluyeh and Boyer-ahmad province in south west of Iran.

Methods: The essential oils of *Allium jesdianum* and *Dorema aucheri* were obtained by hydro distillation using a Clevenger type apparatus and in *Dorema aucheri* was extracted by n-hexane and were analyzed by GC/MS.

Results: (E)-Caryophyllene (14.63%), γ-Cadinene (8.58%), Hexadecanoic acid (6.11%), Caryophyllene oxide (5.15%), (E,E)-α-Farnesene (4.05%), Z-Phytol (3.22%), δ-Cadinene (3.18%), Camphor (3.04%) and γ-Eudesmol (2.92%) were the most components of *Dorema aucheri*, whereas Hexadecanoic acid (18.34%%), Neral (Z-Citral) (13.74%), Dimethyl trisulfide (12.15%), Caryophyllene oxide (8.05%), Gereninal (E-Citral) (5.25%), Borneol (3.31%), Trans-propenyl propyl disulfide (3.17%), Geranyl acetate (2.74%), and β-Caryophyllene (2.65%) were the most constituents in *Allium jesdianum* oil, respectively.

Conclusion: Kohgiluyeh and Boyer-Ahmad has good ethnobotanical potential for medicinal plants. This study is the first contribution to the ethnobotany of this region. We acquired some considerable knowledge about local medicinal plants such as *Allium jesdianum* and *Dorema aucheri* for treating common health problem that is ready to be further investigated in the laboratory.

Keywords: (E)-Caryophyllene, GC/MS, Hexadecanoic acid, Phytochemical.

1. Introduction

Herbal medicines are a group of herbs that contain a number of important compounds for medicine and pharmacy [1]. Effective herbal remedies have attracted global attention because of their easy access and low side effects [2]. Medicinal herbs and/or herbal supplements have been mostly applied to sustain or upgrade health, and the community believes that natural herbal compounds have no side effects and they are safe. The World Health Organization (WHO) reported that 80% of people in developing countries use herbal medicine to treat their health problems [3]. Herbs have been used for medical treatment since ancient times [4]. Recent investigations have shown that the positive treatment effects and antioxidant properties of medicinal plants could be correlated with bioactive components such as alkaloids, bitters, flavonoids, bioflavonoids, glycosides, mucilage, saponins, tannins, phenols, phenolic acids, guinones, coumarins, terpenoids, essential oils, lectins and polypeptides [5 , 6]. The use of these compounds as natural antioxidants plays an important role in protecting and prevention of DNA damage [6] cancer, atherosclerosis diseases, and the aging processes [7]. Also, these compounds have been effective in protecting the plant against microorganisms, fungi, insects, and herbivores [5].

Among these, many studies have encouraged the use of Allium species as food and/or medicine so that people all over the world consume Allium vegetables especially onions and garlic, as a part of their daily diet. Various studies have been conducted to investigate the potential health-promoting effects of Allium species [8].

Seven species have been reported in the genus Dorema, family Umbelliferae, in the flora of Iran, among which two are endemic: *D. aucheri* Boiss. and *D. ammoniacum D. Don* [9]. In Iranian traditional medicine, *Dorema aucheri* has been employed as stimulant, nervonic, antispasmodic, bronchodilator, expectorant, kidney stone repellent, emmenagogue and analgesic for visceral pain. This plant is eaten as a green by some people in west part of Iran. D. aucheri in microliter scale to mice caused getting cancer dramatically. There are several reports on chemical composition, antihyperlipidemic and antihypercholesterolamic effects of this plant [10].

Dorema aucheri Boiss is a perennial mono carpic species endemic to the southern parts of Iran. Traditionally, gums, young leaves and branches are used for medicinal and nutritional purposes. The gums are harvested for local and international trading.

The genus of Allium L. is the largest and important representative genus of the Alliaceae family comprising 700 species; each with different tastes, forms and colors; nonetheless, they are close in biochemical, phytochemical, and nutraceutical properties [11]. Allium species are revered to possess antibacterial, antifungal, antiviral, antiprotozoal, and anthelmintic activities and they contain the powerful antioxidants, sulfur and other numerous phenolic compounds, that have aroused great interests for food industries [12 , 13]. The *Allium jesdianum* (AJ) plant, with proved pharmacological properties, is a native herbal product of Middle East regions [14]. The antioxidant features of the biochemical components of AJ (like flavonoids and phenolic) are applied by activation of white blood cells in response to superoxide produced via NADPH oxidase (nicotinamide adenine dinucleotide phosphate oxidase) [15]. This plant is also used in traditional medicine to relieve acute gastrointestinal pains and rheumatoid arthritis [16].

Hosseini *et al.* [17] indicated the supportive/regenerative influences of phytochemicals on pancreatic β-cells damages. In their extensive investigation, they found some critical therapeutic features of medicinal plants, including; *Abroma augusta*, *Annona muricata*, and *Anastatica hierochuntica*, which potentially elevate the number of beta cells, *Alchornea cordifolia*, *Anacardium occidentale*, *Amaranthus spinosus*, and *Amaranthus caudatus* that can potentially induce regeneration of β-cells, Allium sativum, which can increase the islets' diameter and finally, the *Azadirachta indica*, which can increase the density of β-cells [17].

Several studies have indicated that medicinal plants contain compounds like peptides, unsaturated long chain fatty acids, aldehydes, flavonoid, alkaloids, essential oils, phenols and water or ethanol soluble compounds. These compounds are significant in therapeutic application against human and animal pathogens, including bacteria, fungi and viruses [18,19]. These secondary metabolites produced by plants are organic chemicals of high structural diversity, which play different functions including chemotherapeutic, bacteriostatic, bacteriocidal and antimicrobial functions [20], and are used in nutraceutical industry.

The Allium species have been used for a long time as a medicinal for the prevention and treatment of certain diseases such as diabetes, arthritis, colds and flu, stress, fever, coughs, headache, hemorrhoids, asthma, arteriosclerosis, cancer, respiratory, gastrointestinal, rheumatic, and inflammatory disorders [21-24]. Biological and medical functions of Allium species are due to their sulfur compounds, such as S-alk(en)yl-Lcysteine sulfoxides [25]; however, the presence of phenolic compounds is also beneficial for human health [26]. Assessment of essential oil variation in medicinal plants is a prerequisite for developing new products for pharmacological and food industries. The essential oil content and the composition of plants can be highly influenced by genetic as well as environmental factors such as temperature, precipitation, soil characteristics and altitude [27].

The main purpose of this study was to evaluate the composition of essential oil of *Allium Jesdianum* and *Dorema aucheri* from Kohgiluyeh and Boyer-ahmad province in south west of Iran.

2. Material and methods

Dorema aucheri Boiss. And *Allium jesdianum* Boiss (Figure 1) were collected from Chamkhani area at Kohgiluyeh and Boyer-ahmad province, southwest Iran (30°41′N, 51°31′E and 1830 m above sea level) in May 2020 and identified in Kohgiluyeh and Boyer-ahmad Research Institute of Forests and Rangelands. ethanolic extract and essential oil of dried powdered aerial parts of plant were prepared.

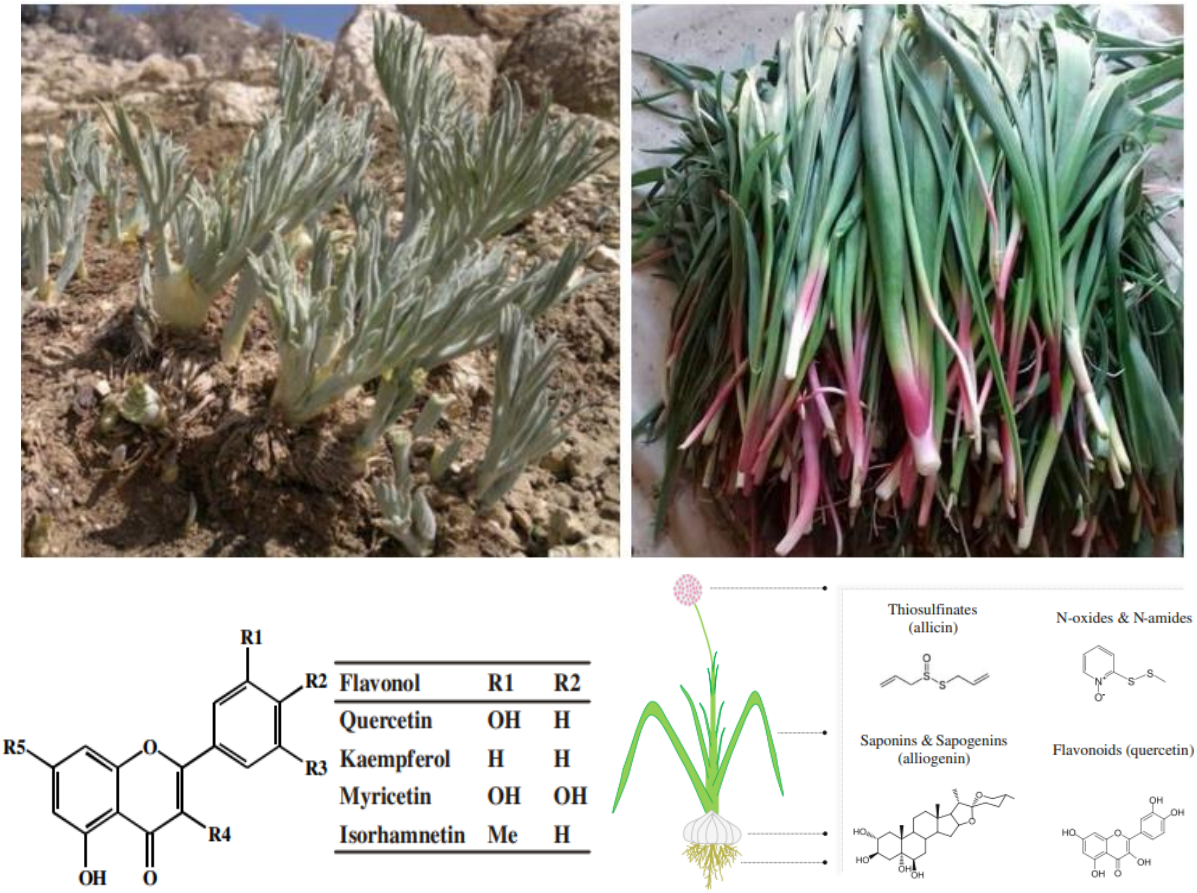

Figure 1. Images of *Dorema aucheri* on the left and *Allium jesdianum* on the right, structure of this flavonoid, the type of flavonols

As for essential oil yield, the leaves and stem were air dried in shade for four days and were prepared for essential oil extraction. 50g of dried leaves were subjected for each hydro- distillation. The round-bottom flask of Clevenger–type apparatus was also applied to extract essential oils. 450 ml distilled water was added and boiled for 4 h and their volatile fractions were isolated by hydro-distillation in a Clevenger type according to the method recommended in British Pharmacopoeia [10]. Then, the essential oil was collected in a container. The essential oil content was determined on the basis of dry matter and measures were carried out in three replicates. Essential oil components were investigated by Gc/Mass. Gas chromatography analysis of volatile components was performed on HP 7890 Network GC System (Agilent Technology), equipped with HP-5MS (DB-5) a fused silica column (30 m × 0.25 mm i.d., film thickness, 0.25 µm). The oven temperature was programmed from 50 to 280 at a rate of 5 °C/min. The temperatures of 250 and 280 °C were used for the injector and the detector, respectively. Helium (99.999%) was served as the carrier gas at a flow rate of 1 mL/min with a split ratio equal to 1/35. The oils were analyzed by GC/MS using a Hewlett Packard 5975 mass selective detector connected to an HP 7890 gas chromatograph at the above conditions. Mass spectra were taken at 70 eV ionization energy.

3. Results

Table 1 shows the qualitative and average quantitative composition of the main constituents in the oil samples of *Dorema aucheri* obtained during the

period of full flowering. The oil yield was calculated referring volume of oil to the weight of every dried sample. Data and calculations refer to leaves, and also flowers during flowering periods. Fifty constituents were identified that represented 91.21% of the total oil. The chemical composition of the essential oil is demonstrated in table 1. The principle components of the essential oil were (E)-Caryophyllene (14.63%) and γ-Cadinene (8.58%).

Table 1. Main Components of *Dorema aucheri* essential oil identified by Gc and GC/MS

No.	Combination name	KI	Persentage
1	(E)-Caryophyllene	1408	14.63
2	γ-Cadinene	1129	8.58
3	Hexadecanoic acid	1958	6.11
4	Caryophyllene oxide	1571	5.15
5	(E,E)-α-Farnesene	1495	4.05
6	Z-Phytol	2100	3.22
7	δ-Cadinene	1511	3.18
8	Camphor	1503	3.04
9	γ-Eudesmol	1618	2.92
10	6,10,14-Trimethyl pentadecan-2-one	1831	2.52
11	Caryophylla-4(14),8(15)-dien-5.α-ol	1626	2.41
12	α-Eudesmol	1643	2.18
13	4-Heptanol	874	2.16
14	Germacrene D-4-ol	1562	2.02
15	Germacrene D	1470	1.79
16	E-Phytol	2126	1.62
17	Borneol	1151	1.55
18	β-Gurjunene	1418	1.54
19	Ethyl tetradecanoate	1781	1.35
20	Hexenal	786	1.23
21	Isobornyl acetate	1270	1.19
22	7-hydroxy-Coumarin	1823	1.1
23	(E)-β-Farnesene	1442	0.98
24	α-Pinene	919	0.95
25	Limonene	1017	0.92
26	14-hydroxy-9-epi-(E)-Caryophyllene	1657	0.88
27	β-Funebrene	1400	0.85
28	(E)-β-Ionone	1473	0.81
29	α-Humulene	1440	0.78
30	(E)-Nerolidol	1549	0.76
31	2E-Dodecenyl acetate	1595	0.75
32	(Z)-9-Octadecanoic acid=linoleic acid	2135	0.69
33	Viridiflorene	1481	0.68
34	n-Nonanal	1088	0.62

35	Spathulenol	1562	0.62
36	2E-Hexanal	832	0.6
37	β-Elemene	1376	0.59
38	Germacrene B	1545	0.58
39	6-methyl-5-Hepten-2-one	968	0.54
40	Benzene aceta1dehyde	1023	0.54
41	β-Himachalene	1484	0.53
42	(2Z,6Z)-Farnesol	1702	0.53
43	Benzyl salicylate	1848	0.5
44	Phytol	1931	0.48
45	p-Cymene	1002	0.47
46	Myrcene	973	0.46
47	Aromadendrene	1425	0.43
48	Iso-Longifolene	1372	0.42
49	2E-Nonen-1-a1	1141	0.36
50	3-Octanene	980	0.35

Table 2 shows the qualitative and average quantitative composition of the main constituents in the oil samples of *Allium jesdianum* obtained during the period of full flowering. The oil yield was calculated referring volume of oil to the weight of every dried sample. Data and calculations refer to leaves, stem and also flowers during flowering periods. Fifty-four constituents were identified that represented 93.16% of the total oil. The chemical composition of the essential oil is demonstrated in Table 1. The principle components of the essential oil were Hexadecanoic acid (18.34%) and Neral (Z-Citral) (13.74%).

Table 2. Main Components of *Allium jesdianum* Boiss essential oil identified by Gc and GC/MS

No.	Combination name	KI	Persentage
1	Hexadecanoic acid	1251	18.34
2	Neral (Z-Citral)	1221	13.74
3	Dimethyl trisulfide	955	12.15
4	Caryophyllene oxide	1572	8.05
5	Gereninal (E-Citral)	1948	5.25
6	Borneol	1154	3.31
7	Trans-propenyl propyl disulfide	1109	3.17
8	Geranyl acetate	1369	2.74
9	β-Caryophyllene	1407	2.65
10	(Z,Z)-9,12-Octadecadienoic acid	2121	1.73
11	α-Cadinol	1641	1.51
12	n-Heptadecane	1689	1.39
13	Iso-Verbanol	1167	1.07
14	Epi-α-Muurolol	1628	1.03
15	1,3,5-Trithiane	1149	0.94
16	(E)-β-Ionone	1470	0.92
17	Methyl 2-propenyl trisulfide	1113	0.89
18	Di-1-propenyl sulfide	1299	0.81

19	2-Pentadecanone	1828	0.79
20	δ-Cadinene	1508	0.77
21	α-Humulene	1439	0.63
22	n-Nonanal	1088	0.62
23	Cis-Phytol	2097	0.59
24	n-Heneicosane	2079	0.55
25	Dimethyl tetrasulfide	1196	0.54
26	Methyl propyl trisulfide	1129	0.53
27	Neryl acetate	1341	0.53
28	β-Cubenene	1375	0.52
29	2-acetyl-Naphthalena	1594	0.5
30	Germacrene D	1464	0.48
31	Benzene acetaldehyde	1021	0.44
32	γ-Cadinene	1497	0.44
33	(E)-β-Damascone	1399	0.41
34	Hexenal	775	0.39
35	n-Hexadecanol	1848	0.39
36	Linalool	1081	0.36
37	Ethyl hexadecanoate	1973	0.33
38	Benzyl benzoate	1746	0.31
39	Dehydroxy-trans-Linalool oxide	972	0.28
40	n-Decanal	1186	0.28
41	(E,E)-α-Farnesene	1489	0.25
42	Farnecyl acetone	1898	0.25
43	(E)-β-Farnesene	1433	0.24
44	1-Octen-3-ol	960	0.23
45	β-Elemene	1374	0.23
46	Tetracosane	2381	0.22
47	Safranal	1179	0.19
48	α-Muurolol (Torreyol)	1628	0.19
49	Nonacosane	2909	0.19
50	Linalyl acetate	1238	0.18
51	Hexacosane	2595	0.18
52	1-Heptanal	878	0.16
53	6-Methyl-5-hepten-2-one	967	0.15
54	Ar-Turmerone	1645	0.13

4. Discussion

The chemical composition of the essential oil from Dorema Glabrum revealed delta-Cadinene (12.77%) as the main component of the root that is followed by beta-bisabolene (7.48%), alpha-Fenchyl acetate (6.32%), and Copaene (5.68%) [28], while elemicin (38.6%) and myristicin (14.3%) were reported as main compounds of aerial parts [29]. The investigation of Dorema Aucheri's essential oil revealed β-caryophyllene, thymol, βgurjunene, carvacrol, and cuparene as the major components [30]. In this study fifty of the identified components represented about 90.25–95.10% of the oil in the studied populations (Table 1). (E)-Caryophyllene (14.63%), γ-Cadinene (8.58%), Hexadecanoic acid (6.11%),

Caryophyllene oxide (5.15%), (E,E)-α-Farnesene (4.05%), Z-Phytol (3.22%), δ-Cadinene (3.18%), Camphor (3.04%) and γ-Eudesmol (2.92%) were the most components of *Dorema aucheri*. High amount of caryophyllene in D. aucheri can introduce it as a good source of this valuable compound. According to the results of the present research, the amount of β-caryophyllene in D. aucheri was comparable or higher than some other medicinal plants such as Vitex negundo (5.3%) and Inaguensis millsp (8.0%), while it was lower than some other medicinal plants such as Inula cappa (27.5%) and Salvia species [31].

Most of the previous studies have reported the chemical composition of different plant organs of *D. ammoniacum* [32], while there was only one report in respect to essential oil composition of *D. aucheri* collected from South Eastern part of the country in Kerman province. Masoudi et al. [33] reported a different chemotype including α-eudesmol (31.2%), δ-cadinene (10.9%), 2-pentadecanone (5.9%) and β-caryophyllene (4.9%) in the shoots of D. aucheri collected during flowering stage. However, the leaves and stem in the present research were harvested just before flowering stage in South Western regions of the country and the major constituents were (E)-Caryophyllene (14.63%), γ-Cadinene (8.58%) and Hexadecanoic acid (6.11%). So, it seems that phenological stage, collection site and climatic condition highly affected the chemical variation of D. aucheri. For better interpretation of the results and to determine the effect of each climatic factor on chemical polymorphism of D. aucheri, multivariate analysis was conducted in studied populations.

Results of a study [34] indicated that the total phenolic contents in extracts from four varieties of A. cepa varied from 4.6 to 74.1 mg GAE/g. Within the vegetable family, the composition and quantity of the phenolics vary significantly according to different intrinsic and extrinsic factors, such as plant genetics and cultivar, soil and growing conditions, maturity state and harvest conditions [35].

In the present study Hexadecanoic acid (18.34%%), Neral (Z-Citral) (13.74%), Dimethyl trisulfide (12.15%), Caryophyllene oxide (8.05%), Gereninal (E-Citral) (5.25%), Borneol (3.31%), Trans-propenyl propyl disulfide (3.17%), Geranyl acetate (2.74%), and β-Caryophyllene (2.65%) were the most constituents in *Allium jesdianum* oil. Steam-distilled essential oil from sliced and incubated bulbs of *Allium macmchaetum* was analyzed by GC and GC/MS. Twelve compounds representing 92.52% of the oil were characterized with diallyl disulphide (53.80%), diallyl trisulphide (26.19%), allyl methyl trisulphide (5.89%) and allyl methyl disulphide (5.21%) as major constituents [36]. Capillary gas chromatography and GC/MS were used to analyze the volatile flavor compounds of *Allium fistulosum* L. grown in Cuba. A total of 28 compounds were identified, of which the main compounds were dipropyl disulfide (30.6%), methyl propyl trisulfide (1 2.0%) and dipropyl trisulfide (1 2.3%) [37]. The compositions of A. vineale are similar to those reported for Allium ursinum (broad-leaved garlic, bear's garlic, wild garlic) volatile oils, which showed allyl methyl disulfide (13.0–18.9%), methyl (E)-1-propenyl disulfide (3.4–6.2%), dimethyl trisulfide (3.5–7.5%), diallyl disulfide (16.2–19.9%), allyl (E)-1-propenyl disulfide (7.5–10.2%), and allyl methyl trisulfide (12.6–15.0%) [38]. It seems that the quantitative and qualitative differences in the composition of essential oils in different studies are due to various ecological, geographical, climatic and altitude factors.

The existence of great variety in the essential oil compositions of the two plants (*Allium jesdianum* and *Dorema aucheri*) confirms the fact that the numerous medicinal properties mentioned for these plants are due to the diversity in their chemical compositions.

5. Conclusion

Kohgiluyeh and Boyer-Ahmad has good ethnobotanical potential for medicinal plants. This study is the first contribution to the ethnobotany of this region. We could acquire considerable knowledge about local medicinal plants for treating common health problem that is ready to be further investigated in the laboratory.

Conflict of interest

We have no competing interests.

Consent for publications

Author had read and approved the final manuscript for publication.

Availability of data and material

Author declares that all data are embedded in the manuscript.

Authors contributions

Y.A. designed the study, carried out experiments, analyzed the data, performed the statistical analysis and revised the manuscript before submission, Edited and submitted to the journal.

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Ethics approval and consent to participate

In this study, no animal or human samples were used and the whole process was performed under the protocol of the Research Division of Forest, rangeland and watershed and University.

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