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Original Article

Effect of some Ecological Factors on Quantity and Quality of the Essential Oils of *Zhumeria majdae*

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Abstract

Zhumeria majdae Rech.f. & Wendelbois the medicinal, endomic and endangered plant that has been distributed in the south of Iran. This plant is seen on very sharp slope of mountains at 520-1450 meters altitude of sea level. It has noticed by natives and is used for digestion painful as swelling, diarrhea, stomatchache and coolness. In this research, the leaves of plant and soil samples were collected from different localities (Geno, Sarchahan and Tangezagh mounts). The plant materials were hydri-distilled in order to obtain their essential oils. The oils were analyzed by capillary GC and GC/MS. The results showed that with increasing of height, Ca^{+2}, Mg^{+2}, $HCO3^{-}$, Na^{+}, EC, O.C.%, sand% contents and also with decreasing of rainfall, moisture, temperature, $K^{+}$and neutralized materials, oil yield and componentnumber of essential oils of *Z. majdae* would have decreased. Constituents as Linalool, Limonene, α-Pinene, Octan-3-one, Myrcene, Terpinolene and trans-Linalool oxide will increased and constituents as Camphor, Geraniol, Neral, Geranial, Thymul, Terpinene, β-Elemene, β- Bizabulene will decreased. Therefore, height is effective on quantity and quality of the essential oils of *Z.majdae*.

Key words: Essential oil, *Zhumeria majdae*, Ecologicalfactors**,** Geno, Sarchahan and Tangezagh mounts

Introduction

Zhumeria majdae Rech. f. & Wendelbo is the species of Lamiaceae family that distributed in the south of Iran [1,2, Fig. 1]. It is monotypic genus of Lamiaceae [3]. Although natives have known it and its health benefitsfrom many years ago, but it was unknown for scientific communitiesto 1967. MajdeZhumer (Norwegian researcher) collected it for the first timefrom Ghotabad in 80 Km north of Bandarabbas (Hormozgan province) at 1966 [4]. It was determined as a new genus of the Lamiaceaefamily and published by Rechinger and Wendelbo at 1967 [5].

Z. majdae, Plant reliability, based on the hard wooden bin and green, greenish -white or gray, to a height of 50 cm and is very fragrant. Stems woody at the base, branched, with grayish -white skin. The leaves are almost all clones, flattened oval or oval or elliptical and petiole short term. The flowers are purple or violet, blue, large, length 20 mm, peduncle right, Bractwiden long, straight, bowls reliable, oval with 5 veins, covered with fine dense glandular and baseless, double-edged, two- part upper lip, flattened elongated, almost pointy, lower lip tridentate with unequal tooth, pipe bowls,cups left, right, flags, four out of the cup, the rods away from the cream, too long, the stigma of unequal double-edged, oval beads, oval, almost three-sided, brown, simple, non- lattice and is glazed[6, Fig. 2-3].

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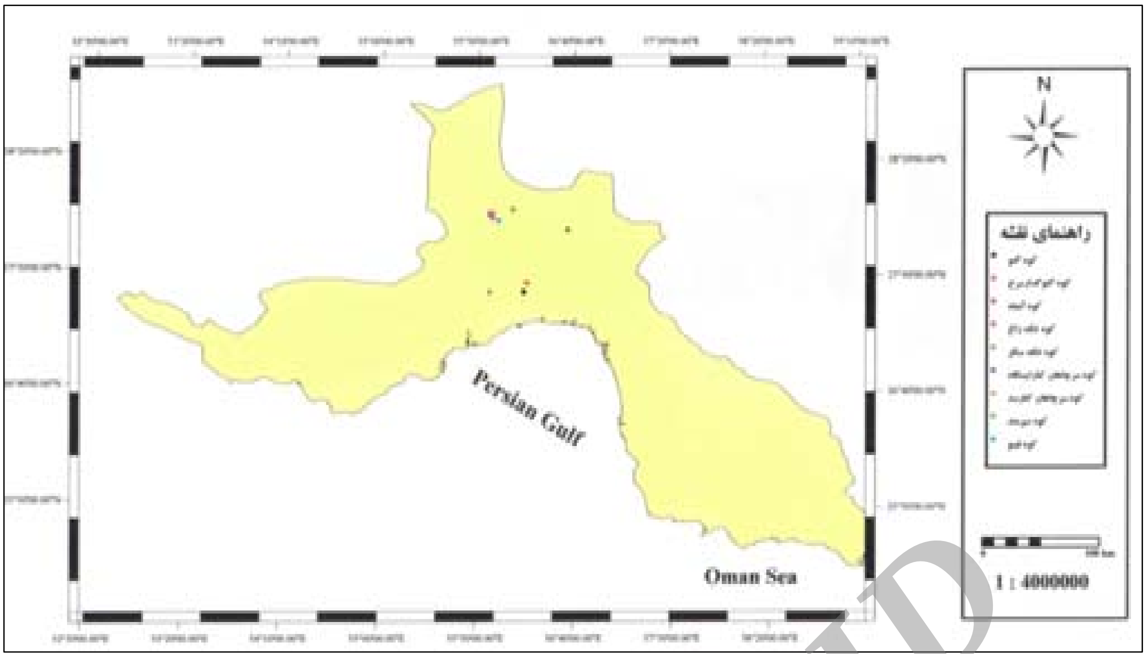

Fig. 1 Distribution map of *Zhumeria majdae* Rech. f. & Wendelbo

Fig. 2 Flower and leaf of *Zhumeria majdae*Rech.f. &Wendelbo

Fig. 3 Trimming of *Zhumeria majdae* Rech. f. & Wendelbo

*Z. majdae*is commonly used in traditional medicine and its therapeutic properties have long been considered. The natives boiled the leaves to treat gastrointestinal disorders such as diarrhea, bloating, abdominal pain and pickles stomach, heartburn, colds and headaches and to improve healing of crushed fresh leaves are used as well as the coolness [7,8]. In addition to it is exported as traditional to countries of the Persian gulf and Oman sea area and Pakistan [9]. Therefore, high and traditional using, and its roll of rural livings have been caused to limit distribution of it and the species has been refuged to impracticable rock [9] and it is classified as endangered [10,11].

There are studies that show ecological factorsare effective on quantity and quality of essential oil of medicinal plants. Azarnivand *et al.* (2009) showed height and nitrogen are effective ecological factors on quantity and quality of essential oil of *Achillea millefolium* that with height increasing, the composition of the essential oil of *Achillea millefolium* flower became from 44 to 50 but the composition of the essential oil of *Achillea millefolium* leaf reached from 36 to 32. Oil yield had decreasing trend and some compounds such as cis-Cadin, γ-Murulene, Camphor and Odesmul value increases with increasing height [12]. Hoseinzadegan and Bakhshi Khaniki (2013) showed that altitude, rainfall, moisture, temperature, EC, Mg^{+2} and Na^{+} are effective factors on quantity and quality of essential oil of *Teucrium polium* [13]. Mirazadi and Pilehvar showed that altitude and aspects as primary factors and soil nutrients such as phosphorus, organic carbon, potassium and nitrogen aresecondary factors affect on *Myrtus communis* essential oil and chemical composition amounts [14]. Dehghan *et al.* (2010)

showed that ecological factors are effective on essential oil yield and composition of *Ziziphora clinopodioides* [15]. Rasti *et al*. (2001) showed that with increasing height in the yield and essential oil composition of *Juniperusexcelsa* reduced. α-Pinene, main composition of plant essential oil, increases with height increasing [16]. Najafi *et al*. (2004) showed thequantity and quality of the essential oils of *Tanacetum polycephalum* are much in low height and with increasing height, Oil yield and main composition as α-Tujone and Borneol decreased. The compositions as Camphor, para-Cymen, β-Tujone and Pinocarene increased with height increasing [17]. Habibi *et al*. (2004) showed in *Thymus kotschyanus*, the height of sea level will have decreasing effect on the oil yield and increasing and significant effect on effective material production [18].

Material and Methods

Plant Material

The leaf samples of *Z. majdae* were collected from three main habitats at different elevation in Hormozgan province. Soil samples was also collected from three above habitatand were measured some physical and chemical properties of soil (EC, pH, O.C.%, K^+, sand%, silt%, clay%, neutralized materials (%),SO_4^{-2}, HCO_3^-, Cl^-, Ca^{+2}, Mg^{+2} and Na^+). Climate characteristics (rainfall, moisture, temperature and evaporation) of 20 late years was also studied.Ecological characteristics of *Z.majdae*habitates has been showed in Table 1.

Essential oil extraction

The Leaf samples of *Z. majdae*after collection were placed in the shade away from the sun for several days to dry. In order to obtain of essential oil, 100 g of chopped leaves were weighed and placed in a flask, distillation apparatus. Then 1000 ml of distilled water was added and flask was placed on an electric heater for two hours. Essential oil were stored in small glass bottle with aluminum paper was kept in the refrigerator.

Gas Chromatography

GC analyses were performed using a Shimadzu GC-9A gas chromatograph equipped with a DB-5 fused silicacolumn (60 m ×0.25 mm i.d., film thickness 0.25 µm).Oven temperature was held at 40 °C for 5 min and thenprogrammed to 280 °C at a rate of 4 °C/min. Injector anddetector (FID) temperature were 290 °C; helium was usedas the carrier gas at a linear velocity of 32 cm/s.

Gas Chromatography–Mass Spectrometry

GC–MS analyses were carried out on a Varian 3400 GC–MS system equipped with a DB-5 fused silica column(30 m × 0.25 mm i.d.); oven temperature was 40–220 °C at a rate of 3 °C; transfer line temperature, 240 °C; injectortemperature, 230 °C; carrier gas, helium with a linear velocityof 31.5 cm/s; split ratio, 1/60; flow rate, 1.1 ml/min;ionization energy, 70 eV; scan time, 1 s; mass range,40–350 amu.

Identification of the compounds

The identification of compounds was based on direct comparison of the retention indices and mass spectral data with those for the standards and by computer matching with the Wiley 229, Nist 107, Nist 21 Library, as well as by comparing the fragmentation patterns of the mass spectra with those reported in the literature. For quantification purpose, relative area percentages were obtained by FID without the use of correction factors, where the FID detector condition was set on a duplicate of the same column applying the same operational conditions.

Results

The yield of essential oil of *Z. majdae*in Geno, Sarchahan and Tangezagh mount region was 6.5, 6.1 and 5.3 percentrespectively (Table 2). In essential oil of *Z.majdae*leaves in Geno mount were identified 23 compounds in a total of 98.9 made up of essential weight percent.

Table 1 Ecological characteristics of *Zhumeria majdae* Rech.f. & Wendelbo habitates.

Regions	Height (m)	Geographical characteristics	Vegetative Type	Slope side	Slope (%)
25 Km. north of Bandarabbas, Geno mount	720	27 23 23 56 14 30	*Gymnocarpus decander-Convolvulus spinosus*	South West	85-100
50 Km. south of Hagiabad, Sarchahanmount	1100	27 56 59 55 56 31	*Gymnocarpus decander–Ebenusstellata*	North	85-100
110 Km. north of Bandarabbas, Tangezagh mount	1450	27 55 24 55 57 55	*Convolvulus spinosus-Ebenusstellata*	South	85-100

Main compouns were Linalool (57.2%) and Camphor (26.7%). Other combinations with much of one percent were Limonene (2.8%), Camphene (2.1%), Geraniol (1.8%), Borneol (1.2%), γ-terpinene(1.1%).In essential oil of *Z. majdae*leaves in Sarchahan mount were identified 21 compounds in a total of 99.3 made up of essential weight percent. Main compouns were Linalool (58.9%) and Camphor (24.1%). Other combinations with much of one percent were Limonene (3.8%), Camphene (2.8%), Geraniol (1.6%), Borneol (1.2%), β-Caryophylene (1.1%). In essential oil of *Z. majdae*leaves in Tangezagh mount were identified 20 compounds in a total of 99.7 made up of essential weight percent. Main compouns were Linalool (63.2%) and Camphor (18.8 %). Other combinations with much of one percent were Limonene (6.1%), Camphene (2.5%), α- Pinene (1%), Geraniol (1%) and Octan-3-one (1%)(Tables2 and 3). From all of 25 compounds in the essential oil composition of *Z.majdae*leaves, two combinations (trans-Linalool oxide and Z-Jasmene) in Geno samples, four combinations (β-Ocimene, cis-Linalool oxide, trans-Linalool oxide and β-Bizabulene) in Sarchahan samples and five combinations (Terpinene-4-ol, Z-Jasmene, Thymol, β-Bizabulene) in Tangezagh samples were not seen (Table 3). The components of Linalool, Limonene, α- Pinene, Octan-3-one, Myrcene, Terpinolene and trans-Linalool oxid showed aincreasing trend and the composition of Camphor, Geraniol, Borneol, Geranial, Neral, Thymol, Terpinene, β-Elemene and β-Bizabulene showed a decreasing trend (Tables 5 and 6).

Table 2 The constituents of *Zhumeria majdae* Rech. f. & Wendelbo essential oil in different regions.

Regions	Oil yield (%)	Components
Geno	6.5	23
Sarchahan	6.1	21
Tangezagh	5.3	20

Table 3 The constituents of *Zhumeria majdae* Rech.f. & Wendelbo essential oil in different regions.

Row	Component	RI	Regions		
			Geno	Sarchahan	Tangezagh
1	α- Pinene	926	0.6	0.7	1
2	Camphene	939	2.1	1.4	2.5
3	Octan-3-one	960	0.5	0.7	1
4	Myrcene	977	0.5	0.7	0.7
5	Ortho Cymene	1008	0.5	0. 3	0.7
6	Limonene	1017	2.8	3.8	6.1
7	β- Ocimene	1032	0.1	0	0.3
8	γ-Terpinene	1044	1.1	0.7	0.9
9	Cis Linalool oxide	1052	0.2	0	0.4
10	*trans* Linalool oxide	1066	0	0	0.3
11	Terpinolene	1073	0.2	0.3	0.3
12	Linalool	1080	57.2	58.9	63.2
13	Camphor	1117	26.7	24.1	18.8
14	Borneol	1147	1.2	1.2	0.6
15	Terpinen-4-ol	1160	0.3	0.3	0
16	α- Terpineol	1171	0.6	0.7	0.4
17	Nerol	1210	0.3	0.6	0.4
18	Neral	1214	0.6	0.6	0.3
19	Geraniol	1232	1.8	1.2	1
20	Geranial	1240	0.8	0.5	0.4
21	Thymol	1259	0.4	0.2	0
22	β- Elemene	1358	0.3	0.2	0
23	β- Caryophylene	1410	0.3	0.2	0
24	β- Bizabulene	1490	0.3	0	0
25	Z-Jasmene	1386	0	0.2	0

Table 4 Climate and edaphic parameters of *Zhumeria majdae* Rech. f. & Wendelbo habitates.

Regions	Rainfall (mm)	Moist. (%)	Temp. (□ □)	Evapor. (mm)	sand (%)	silt (%)	clay (%)	pH	EC
Geno	298 a	79.4 a	28.6 a	3352 a	57.6a	32 a	10.4a	8.36a	0.89 b
Sarchahan	226.8 b	59 b	25.3 b	3144.7 b	59.6 b	32 a	8.4 b	8.5a	0.97 ab
Tangezagh	225.9 c	58.2 b	25.4 c	3097.5 c	65.6 c	26 b	8.4 b	8.4a	1.1a

Continue of **Table 4** Climate and edaphic parameters of *Zhumeria majdae* Rech.f. & Wendelbo habitates.

Regions	N. M. (%)	O.C.%	K+ absor.	Na+	Mg+²	Ca+²	SO_4-²	HCO_3-¹	Cl^-
Geno	52.53a	0.248 c	29 a	0.95 c	4.7 b	2. 5 c	1.5 a	0.24 c	2 a
Sarchahan	51.68 b	0.269 b	28 b	1.3 b	4.8 b	3 b	1 b	0.75 b	2.2 a
Tangezagh	50.83 c	0.286a	21 c	1.7 a	5 a	4 a	0.26 c	1 a	2.1 a

Table 5 The constituents of *Zhumeria majdae* Rech.f. & Wendelbo essential oil in different regions that is increased with height in creasing.

Row	Component	regions		
		Geno	Sarchahan	Tangezagh
1	Linalool	57.2	58.9	63.2
2	Limonene	2.8	3.8	6.1
3	α- Pinene	0.6	0.7	1
4	Octan-3-one	0.5	0.7	1
5	Myrcene	0.5	0.7	0.7
6	Terpinolene	0.2	0.3	0.3
7	Trans Linalool oxide	0	0	0.3

Table 6 The constituents of *Zhumeria majdae* Rech.f. & Wendelbo essential oil in different regions that is decreased with height increasing.

Row	Component	regions		
		Geno	Sarchahan	Tangezagh
1	Camphor	26.7	24.1	18.8
2	Geraniol	1.8	1.2	1
3	Borneol	1.2	1.2	0.6
4	Geranial	0.8	0.5	0.4
5	Neral	0.6	0.6	0.3
6	Thymol	0.4	0.2	0
7	Terpinen-4-ol	0.3	0.3	0
8	β- Elemene	0.3	0.2	0
9	β- Bizabulene	0.3	0	0

As showed Table 4, Climate and edaphic parameters were different at three habitats and they showed significant difference. In three habitats, rainfall and evaporation are different but temperature and moisture in Sarchahan and Tangezagh are same and they have significant difference with Geno habitats. All of soil factors except of pH and Cl^- have significant difference in three habitats. Besides of them, Height of see level was also different at three habitats.It was 730, 1100 and 1450 m. in Geno, Sarchahan and Tangezagh mounts, respectively.

Discussion

The results showed that with increasing of height, Ca^{+2}, Mg^{+2}, HCO_3^-, Na^+, EC, O.C.%, sand% contents and also with decreasing of rainfall, moisture, temperature, K (AV.)and neutralized materials, essential oil yields are reduced. It is conformity to researches of Azarnivand *et al.* (2009) on *Achillea millefolium* [12], Rasti *et al.* (2001) on *Juniperus excels* [16], Najafi *et al.* (2004) on *Tanacetum polycephalum* [17] and Habibi *et al.* (2004) on *Thymus kotschyanus* [18]. Also, the composition of the essential oil of the leaves is reduced that is conformity to researches of Azarnivand *et al.* (2009) on *Achillea millefolium* [12], Rasti *et al.* (2001) on *Juniperus excels* [16], Najafi *et al*. (2004) on *Tanacetum polycephalum* [17]. The compounds of Linalool, Limonene, α-Pinene, Octan-3-one, Myrcene, Terpinolene and trans-Linalool oxide increased and the composition of Camphor, Geraniol, Borneol, Geranial, Neral, Thymol, Terpinene, β-Elemene and β-Bizabulene decreased. This subject has also been reported in Azarnivand *et al*. study on *Achillea millefolium* [12], Rasti *et al*. (2001) study on *Juniperus excels* [16], Najafi *et al*. (2004) study on *Tanacetum polycephalum* [17] and Habibi *et al*. (2004) study on *Thymus kotschyanus* [17] that with height increasing, the amount of some combinations rise and others decrease. Thus we saw that ecological factors are effective on both the quantity and the quality of essential oil of *Z. majdae*.

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