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Chemical composition of the essential oil of *Stachys inflata* Benth. from Iran

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ABSTRACT

In order to investigate essential oils from local wild plants, one of the Stachys species, S. inflata, was screened. The essential oil was obtained from the aerial parts of the plant by hydro-distillation, and was analyzed for their chemical composition by gas chromatography (GC) and gas chromatography-mass spectrometry (GC-MS). Were the major compounds of the 51 identified components which accounted for 100% of the total oil of S. inflata. The major components of the oil were Caryophyllene oxide (13.43%), E-citral (13%), Z-citral (12.9%), Spathulenol (10.65%), ar-Curcumine (6.51%), 1, 8-Cineol (4.89%), limonene (4.6%), and α-Terpineol (2.55%).

Keywords: *Stachys inflata*, essential oil, GC/MS analysis.

INTRODUCTION

Stachys Vahl. is a genus about 300 species of annual and perennial herbaceous plants and shrubs in the family Lamiaceae. The distribution of the genus covers Europe, Asia, Africa, and Australia [1].Iran as a center of diversity of *Stachys* houses about 35 species [2]. The majority of species prefers alpine and subalpine habitats and grows under various ecological conditions in habitats like rocky places, mountain steppes, and stream banks or sometimes in forests. A large number of essential oils were obtained by hydrodistillation from species of *Stachys*. Stachys has been taken from the word Chistets means cleaning and healing wounds which reflects the widespread use of essential oils or extracts of species of this genus that are as anticeptic and healing skin diseases [3].The investigations on the chemical composition of these oils were strongly expanded in the last ten years by developed GC-MS analysis techniques. Obviously monoterpenoids and sesquiterpenoids are the prevailing constituents. However, in some oils the occurrence of diterpenoids was observed as quite minor constituents or traces; usually these products were merely identified but not isolated [4]. Many studies of the essential oil and extracts content of *Stachys* species have been performed. The essential oils of the dried flowering aerial parts of *Stachys byzantina*, *Stachys inflata*, *Stachys lavandulifolia* and *Stachys laxa* collected from Iran were isolated. Study of anti-inflammatory and pacifier effects of some species from this genus (*S. candida, S. chrysantha and S. inflata*) leads to the observe health benefits similar to or stronger than drugs group of NSAIDs that shows possibility of potential therapeutic use of these extracts can be considered [5]. However, investigators reported that extracts or constituents of plants belonging to the genus *Stachys* exert significant anti-inflammatory, antitoxic, antihepatitis, antibacterial, anti-anoxia and anti-nephritic effects. Also *S. inflata* use in respiratory disease and arthritis for its anti-inflammatory effects [5]. As active principals phenylethanoid glycosides, triterpenoids, steroids and flavonoids were identified in the genus *Stachys* [6]. *Stachys inflata* Benth. is a native plant widely distributed in Iran [2], being popularly named "Poulk" or "Ghol-e-Argavan". Aerial parts from sterile stems of *S. inflata* have been used as a folk medicine and the people in the north of Iran believed it to cure infective, asthmatic, rheumatic and other inflammatory diseases. Hydroalcoholic extract of the aerial parts of *S. inflata* shows potent anti-inflammatory activity in rat [7, 8]. In the present study a sample of *S. inflata* with different chemical composition has been reported.

MATERIALS AND METHODS

The aerial parts of of *S. inflata* species was collected in flowering stage, from Touyserkan, Hamedan Province, Iran. Voucher specimens have been deposited at the Herbarium of Biology Department, Payame Noor University,Touyserkan, Hamedan, Iran. The volatile oil of the aerial parts of *S. inflata* was obtained by hydrodistillation using a Clevenger-type apparatus for 3 h. The oil was decanted and dried over anhydrous sodium sulfate.

GC/MS analyses was performed with a TRACE MS apparatus equipped with a HP-5MS capillary column (60 m ´ 0.25 mm; coating thickness 0.25 μm) and a TRACE MS mass selective detector. The oven temperature was programmed from 60–250°C at 5°C/min. Carrier gas, helium, was adjusted to a flow of 1.1 mL/min. The MS operating parameters were: ionization voltage, 70 eV; ion source temperature, 200°C.

RESULTS AND DISCUSSION

The average yield of essential oil obtained after hydrodistillation of the aerial parts of *S. inflata* was about 0.4%. Table 1 reports the chemical composition of the essential oil under study. 51 components were identified, accounting for %100 of the total oil. The major components of the oil were Caryophyllene oxide (13.43%), E-citral (13%), Z-citral (12.9%), Spathulenol (10.65%), ar-Curcumine (6.51%), 1,8-Cineol (4.89%), limonene (4.6%),and α-Terpineol (2.55%) (fig1).

Table: 1. Composition of the Essential Oil of *S. inflata*

RI	components	%	RI	components	%
939	α-pinene	0.12	1439	trans-caryophyllene	2.34
974	1-octen-3-ol	0.36	1443	β-cedrene	0.14
978	sabinene	0.76	1446	trans-α-bergamotene	0.31
982	6-methyl-5-heptene-2-one	1.7	1452	Neryl acetone	0.24
1027	p-cymene	0.2	1459	Aromadendrene	0.15
1033	limonene	4.6	1464	Sesquisabinene	0.57
1037	1,8-Cineol	4.89	1472	Geranyl propanoate	0.5
1071	cis-sabinene hydrate	0.79	1490	ar-Curcumine	6.51
1099	linalool	0.56	1499	Germacrene D	0.2
1102	pirollene	0.15	1529	δ-Cadinene	0.28
1102	trans-sabinene hydrate	0.13	1533	Cubebol	0.72
1138	cis limonene oxide	0.28	1536	δ-Cadinene	0.41
1142	trans limonene oxide	0.18	1568	E-Nerolidol	1.17
1174	rosefuran epoxide	0.45	1599	spathulenol	10.65
1180	E-isocitral	0.39	1606	Caryophyllene oxide	13.43
1184	4-Terpineol	0.33	1615	globulol	0.4
1196	α-Terpineol	2.55	1632	ledenoxide	0.98
1243	z-citral	12.9	1658	α-Cadinol	1.55
1250	carvone	0.5	1693	cadalin	0.85
1261	piperitenone	0.22	1847	6,10,14-trimethyl-2-pentadecanone	0.47
1272	E-citral	13	1873	isobutyl phthalate	0.3
1352	ethyl nerolate	0.27	1968	dibuthyl phthalate	2.02
1380	neryl acetate	1.19	2013	Nerylphenylacetate	0.34
1391	α-copaene	1.43	2204	n-docosane	0.32
1394	ethyl geranate	0.38	1433	α-cedrene	0.29
1401	β-borbonene	0.39			

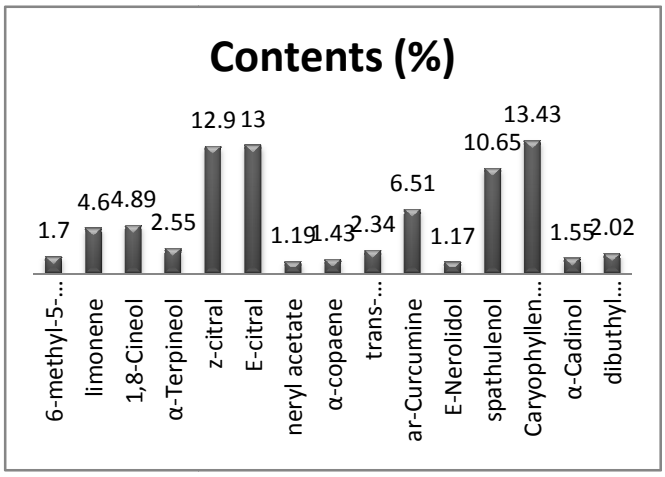

Fig: 1: The major components of essential oil of *S. inflata*

Previous studies on the volatile oil of members of *Stachys* genus showed various compositions. In a study that took place on *Stachys* Subsect. Swainsonianeae in Creek in order to classify, several major compounds were identified including β- elemene, Caryophyllene, δ-Cadinene and Caryophyllene oxide [9]. *S. glutinosa* has been studied in France and the main components have been known were Germacrene D, Terpin-4-ol, α- pinene, β- Phellandrene and δ-Terpinene [10]. Also, the main components of *S. lavandulifolia* including phthalate,decane, p-Xylene,dodecaneand α-pinene were reported [8]. The combination of 36 ingredients of essential oil of *S. athorecalyx* has been reported by Emin Duru et al. in Turkey. The main component were Oct-1-en-3-ol, Linalool and α- Pinene [11]. Study on *S. ixodes* shows that the basic compounds are Myrtenyl acetate, Globulol, Caryophyllene oxid and Spathulenol [12]. The main ingredients in *S. setifera* were Pulegone, Piperitenone oxid and α- Terpinyl acetate [13] and in *S. laxa* were Germacrene D, β-Phellandrene, Caryophyllene oxide, Linalool and α-Cadinol [14]. In *S. recta* Oct-1en-3-ol, Linalool, α- Pinene and in S. balansae from Turkey β-Caryophyllene and α-Pinene were the major compounds [15]. Isocaryophyllene, β-Caryophyllene, Germacrene D, α-Humulene and β-Bourbonene present in high frequency in essential oil of *S. officinalis* [16]. In essential oil of *S. oblique* [17], *S. balansae* and *S. schtschegleevii* Germacrene D was the principal compound [18].

Our Results were different with report by Sajjadi et al. [19] on chemical components of *S. inflata* Benth. Essential oil that was collected from Sofe Mountain in Isfahan Province. In that study Germacrene D, Bicyclogermacrene, α-Pinene, β-Phellandrene was mind components. Our results were proximal in agreement with report by Ebrahimabad et al. on chemical components of *S. inflata* Benth. Essential oil; linalool and terpinol were major components [20]. In conclusion, *S. inflata* with different chemical compositions have been reported. It is known that many factors influence the chemical constitution of *S. inflata* oils. We have shown that the volatile oil composition of *S. inflata*, in Iran is extremely variable. The composition of the essential oil of *S. inflata* depends on many factors of genetic, environmental and their interaction effects, such as plant part, harvest-time, extraction-method, ecotype and geographic origin (climate, edaphic, elevation and topography). With regard to the wide distribution of *S. inflata* in Iran can explain that this species in different ecological conditions will be exiting chemical components.

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