ResearchArticle

GC-MS Analysis of Chemical Compounds from Some Yemeni Medicinal Plants

Nabil Qaid M. Al-Hajj[1],AbdullBaky Al-Zaemy[2], *Hongxin Wang[3], Chaoyang Ma[3],Zaixiang Lou[3], Riyadh Thabit[3]

1. Marine Science and Biological Research Authority, Aden, P.O. Box: 1231, Aden, Yemen.
2. Dept. of Food Science and Technology, Faculty of Agriculture, Sana'a University, Sana'a, Yemen.
3. School of Food Science and Technology, Jiangnan University, Wuxi 214122, PR China.

ABSTRACT

The traditional medicine still plays an important role in the primary health care in Yemen. The current study represents the investigation of *OcimumForskolei*plant , which were collected from (Sana'a -Yemen). Basil (*OcimumForskolei*) is an important medicinal herb belonging to the basil family, Lamiaceae. Basil, one of the most popular herbs grown in the world, is native to Asia (Yemen, India, Pakistan, Iran, Thailand, and other countries) and can be observed growing wild in tropical and sub-tropical regions. Essential oils are volatile, natural, complex mixtures of compounds characterized by a strong odour and are formed by aromatic plants as secondary metabolites. Essential oilextracted from roots of*OcimumForskolei* wasinvestigated using gas chromatography/mass spectrometry techniques (GC/MS). Fifty-four compounds were identified, comprising about 100 % of the total oil. Bicyclo [3.1.1] hept-2-ene, 2 (23.364 %),Bicyclo[3.1.1] hept-2-ene, 2 (9.00 %), trans-Caryophyllene (3.238 %), Naphthalene, 1,2,3,4,4a,5,6, (19.32 %), alpha.-selinene (3.98 %), alpha.-Humulene (2.95%), Naphthalene 1,2,3,4,4a,5,6,(5. 927 %), Naphthalene, 1,2,3,4,4a,5,6 (3.01%), Phytol (4.700 %), Azulene, 1,2,3,5,6,7,8,8a-oc (6.21 %), Copaene (1.48%), Estragole (1.733%), Cedrene (1.00%) and other compounds were found to be the major fraction of the oil. The different types of compounds, which could be responsible for antioxidants and antimicrobial activities.

Keywords: Chemical compounds*, Essential oil, Ocimumforskolei,* Yemen

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***Address for correspondence:**
Hongxin Wang
School of Food Science and Technology, Jiangnan University, Wuxi 214122, PR China.
E-mail:whx1964@126.com

INTRODUCTION

Ocimum is a member of Lamiaceae family with a distinction of the most studied genus among all the aromatic plants. This genus has been identified with up to 160 species [1]. *Ocimum* plants are also called basil with many widespread medicinal uses. The genus *Ocimum* pubescent, grows about one meter high, and has an obtusely quadrangular, stem. The leaves, which have greyish-green on the bottom and dotted with dark oil cells, are opposite The leaves of basil are used in folk medicine as a tonic and vermifuge [2]. The oil of the plant has been found to be beneficial for the alleviation of mental fatigue, colds spasm, rhinitis, and as a first aid treatment for wasp stings and snakebites [6]. Moreover the medicinal and aromatic properties of basil are associated with the presence of an essential oil that

accumulates in the largest amount in its leaves and flowers. The fresh and dried basil herb is used as an aromatic spice and a source of essential oil, and its main components are also used as plant drugs, since it has antimicrobial, antimutagenic and fungistatic activity [3]. Ocimum plants are also called basil with manywidespread medicinal uses. Based on essential oil composition, there has been many chemotypes reported from basil species, which fall either under terpenoid or phenylpropanoid class. Moreover, monoterpenoids dominate basil essential oils invarious proportions. [4-6]. 1,8-cineole [7-8], linalool [9], terpinen-4-ol [9], citral [10], anisole and methyl-(E)-cinnamate

[10]. Similarly, O*. kilimandscharicum* has been reported with high camphor proportion from various locations [11]. *Ocimumfrskolei*an aromatic perennial woody shrub up to 2 m tall. In Rwanda the plant is used in traditional medicine to cure eye infections [12] and in Kenya it is used as a grain protectant against insect pests [13]. Members of the genus find a number of uses in African traditional medicine [12-14]. Tanzanians, especially those living along the Indian Ocean coastal regions, use the plants to repel mosquitoes and as flavouring agents. Plants of the genus Ocimum are also reported for many biological activities, such as mosquito repellent and antimicrobial activity [14-15]; insecticidal activity against crop pest insects [16], antipyretic [17] and antioxidant activity [18]. There is no previous study on thechemical compositions of the essential oils of *O.forskolei*.Therefore, this study reported for the first time the chemical compositions of the *Ocimumforskolei* by gas chromatography mass spectrometry.

Fig 2: Macrograph of *Ocimumforskolei*

EXPERIMENTAL

Plant collection and identification

The roots of *O.forskolei* at flowering stage were collectedduring summer (June 2013) from (Sana'a-Yemen). The sample was air-dried and taxonomically identified by Prof. Abdellah Amine (College of Agriculture, Sana'a University). A voucher specimen of the plant material was deposited at the department of biology (Sana'a University) of College of Agriculture.

Extraction of essential oils

The roots essential oils of *O. forskolei (*3kg*.)* were ground in blender. The essential oils were obtained by hydrodistillation at 100 °C with a clevenger- type apparatus for 4 h with 3 L. of distilled water. The distilled essential oils were dried over anhydrous sodium sulphate, filtered and stored in sealed vials at 4 °C, prior to further analyses.

Analysis of the essential oil

The components of the essential oils were identified by GC-MS analysis [19]. Gas chromatography-mass spectrometry (Varian 1200L) was incorporated with a relatively no polar capillary column (DB-5, 30 m length, 0.25 mm film thickness, 0.25 internal diameters). The injection port and interface were held at 220 and 260 °C, respectively. The temperature was programmed from 50 °C to 220 °C at 15 °C per min and a hold at 220 °C for 25 min with helium as the carrier gas. Mass spectra: electronic impact, ionisation potential 70 e V, ion source temperature 200 °C and mass range 35 – 500 Da.

Compounds identification

Most of the compounds were identified according Toes Kovats indexes in reference to n –alkanes(NIST, 2010) and mass spectra (authentic chemicals and Wiley spectral library collection).

RESULTS

Chemical composition of the essential oil

The composition of the essential oils obtained by hydrodistillation from the roots of *O. forskolei* was analyzed by GC/MS, and show in Table 1 and figure 1. Fifty four components were identified with the main components in leaves essential oil of *O. forskolei including* Bicyclo [3.1.1] hept-2-ene, 2 (23.364 %),Bicyclo[3.1.1] hept-2-ene, 2 (9.00 %), trans-Caryophyllene (3.238 %), Naphthalene, 1,2,3,4,4a,5,6, (19.32 %), alpha.-selinene (3.98 %), Naphthalene 1,2,3,4,4a,5,6,(5. 927 %), Naphthalene, 1,2,3,4,4a,5,6 (3.01%), Phytol (4.700 %), Azulene, 1,2,3,5,6,7,8,8a-oc (6.21 %), Copaene (1.48%), Estragole (1.733%), Cedrene (1.00%) and other compounds (**Table 1 and Figure 1**).

Table 1:Chemical composition of *Ocimumforskolei* roots essential oil

Peak	RT (min.)	Area (%)	Compounds	RT index	Percentage
1	2.338	4.18	2-Propanone (CAS)	988	0.30
2	14.006	3.29	Bicyclo[2.2.1] heptan-2-one,	958	0.21
3	15.201	5.42	alpha.-Cubebene	939	0.425
4	15.819	1.88	Copaene	952	1.48
5	16.145	9.24	Bicyclo[2.2.1] heptan-2-one,	936	0.07
6	16.236	3.26	beta. BOURBONENE	960	0.252
7	16.545	9.87	1H-Cyclopenta[1,3]cyclopropa	940	0.73
8	16.599	5.00	Naphthalene, 1,2,3,4,4a,5,6,	860	0.392
9	17.136	7.95	alpha.-Ylangene	900	0.623
10	17.532	2.83	Bicyclo[3.1.1] hept-2-ene, 2,	933	23.364
11	17.554	1.12	Bicyclo[3.1.1] hept-2-ene, 2,	933	9.00
12	17.694	4.442	trans-Caryophyllene	959	3.238
13	17.774	3.03	gamma.-Gurjunene	927	0.22
14	18.09	1.07	beta.-Cedrene	876	0.844
15	18.374	2.20	Estragole	881	1.733
16	18.498	3.74	alpha.-Humulene	863	2.955
17	18.633	5.82	Cedrene	886	1.00
18	18.739	1.67	trans-Caryophyllene	886	1.37
19	18.788	1.38	1,6,10-Dodecatriene, 7,11-di	906	1.087
20	19.189	2.45	Naphthalene, 1,2,3,4,4a,5,6,	911	19.32
21	19.28	7.86	Azulene, 1,2,3,5,6,7,8,8a-oc	934	6.21
22	19.341	3.83	Naphthalene, 1,2,3,4,4a,5,6,	939	3.01
23	19.367	5.04	alpha.-selinene	936	3.98
24	19.483	3.70	1H-Cyclopenta[1,3]cyclopropa	889	0.028
25	19.701	7.37	Naphthalene, 1,2,3,4,4a,5,6,	894	5.927
26	19.889	1.38	alpha.-Cubebene	892	0.107
27	19.989	1.56	Naphthalene, 1,2,4a,5,6,8a-h	910	0.12
28	20.414	1.42	Naphthalene, 1,2,3,4-tetrahy	951	0.113
29	20.984	2.55	alpha.-Patchoulene	814	0.202
30	21.553	1.56	1-Hydroxy-1,7-dimethyl-4-iso	827	0.12
31	22.105	1.26	(E)- β-Caryophyllene	935	0.2
32	22.222	7.21	Benzene, 1,2-dimethoxy-4-(2-	936	0.56
33	22.287	6.17	trans-Z-.alpha.-Bisabolene e	775	0.041
34	22.392	1.40	Hexadecanal (CAS)	948	0.11
35	22.795	3.14	Cubenol	839	0.246
36	22.871	3.63	Cubenol	893	0.028
37	22.943	8.81	Cyclohexanemethanol, 4-ethen	918	0.695
38	23.153	6.36	(-)-Caryophyllene oxide	814	0.71
39	23.355	8.49	2-Pentadecanone, 6,10,14-tri	835	0.67
40	23.428	3.19	Isoaromadendrene epoxide	835	0.02
41	23.869	2.55	tau.-Cadinol	929	2.017
42	24.001	3.65	tau.-Muurolol	880	0.285
43	24.232	1.54	alpha.-Bisabolol	914	0.12
44	24.434	4.44	alpha.-Cadinol	888	0.33
45	24.781	1.25	Isophytol	952	0.099
46	25.322	5.63	CYCLOPENTANEACETIC ACID, 3-O	933	0.044

47	25.551	9.34	(+)-.alpha.-Cyperone	893	0.07
48	25.606	2.57	5,9,13-Pentadecatrien-2-one,	809	0.2
49	25.868	8.54	Cyclopentanecarboxylic acid,	842	0.061
50	26.689	9.51	Octacosane	912	0.071
51	27.069	1.27	GERANYL LINALOOL ISOMER	901	0.1
52	27.166	1.17	Palmitaldehyde, diallylacet	798	0.093
53	28.098	8.48	Phytol	953	4.700
54	29.042	1.27	Pentacosane	956	0.1
					Total =100%

Rt: Retention time time
RI: Retention Index

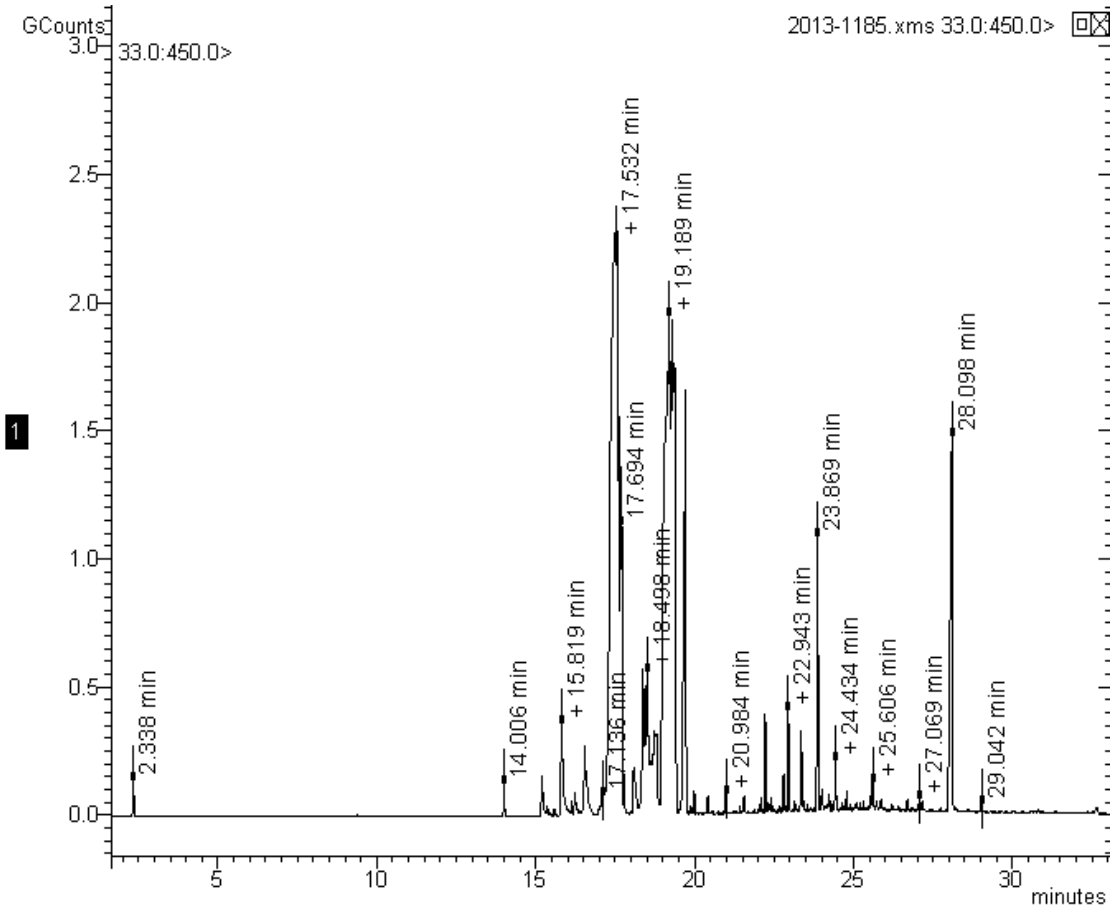

Figure 1:Typical chromatogram of *Ocimumforskolei* essential oil components

DISCUSSION

The yield of volatile oil of *O. forskolei* obtained by steam distillation of the finely powdered roots were 2.5 %. The oil was dark coloured with aromatic odor. The chemical composition analysis of *O. forskolei* is shown in Table 1 and Figure 1. In total, 54 components were identified in oil of *O. forskolei* , representing 100% of all components in the oil. The major components for sample were, Bicyclo [3.1.1] hept-2-ene, 2, (23.364%), Bicyclo [3.1.1] hept-2-ene, 2 (9.00 %) and Naphthalene, 1,2,3,4,4a,5,6 (19.32%).

Studies on experimental plants in the USA showed that the fresh flowering herb yielded 0.5–1% ofessential oil, including camphor, that could be separated easilyfrom the oil [12]. As has already been noted,in the Section 2.2, characteristic

colourless crystals were observedin the oil of *O. kilimandscharicum.* These crystals have been subjected to GC–MS analysis and were determined to be pure Bicyclo, which has been the major constituent (22.369%) of the oil. According to this finding, the oil could be classified as a camphor chemotype, as it has been described by [12]. The oil also containedtau.-Cadinol (2.018%) in appreciable amounts, a compound, which was previously identified in *O.Kilimandscharicum*growing in Rwanda [12]. Limonene, a third major compound in this oil, was also reported in appreciable amounts in the oil from Rwanda. To the best of our knowledge, there is no any report on the chemical composition of *O. forskolei* essential oils in the literature. However, there are few reports on the chemical composition of the oils from the other plants belonging to the genus of *O. forskolei*. previous studied on the composition of *O. basilicum* oil show that there are some qualitative and quantitative differences which , can be attributed to growth conditions, genetic factors, geographical variations and analytical procedures [20].

CONCLUSION

The essential oil of *Ocimumforskolei*collected at Sana'a province in Yemen is mainly characterized by the presence of oxygenatedmonoterpenes especially carvotanacetone as forseveral studiedOcimumspecies and could beconsidered as a chemotype of *Ocimum*species. Results showed minor differences with literaturedata. These differences might be due togrowth conditions, genetic factors, geographicalvariations and analytical procedures. Identification of individual compounds was based on comparison of their relative retentiontimes with those of authentic samples on HP-5ms capillary column, and by matching of theirmass spectra of peaks with those obtained fromauthentic samples and/ or the Wiley NIST library spectra and published data.

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