

## CHEMICAL COMPOSITION AND ANTIBACTERIAL ACTIVITY OF ESSENTIAL OILS FROM LEAVES, STEMS, AND FLOWERS OF *Salvia reuterana* GROWN IN IRAN

A. Esmacili,<sup>1\*</sup> A. Rustaiyan,<sup>2</sup> M. Nadimi,<sup>2</sup> K. Larujani,<sup>3</sup>  
F. Nadjafi,<sup>4</sup> L. Tabrizi,<sup>4</sup> and F. Chalabian<sup>5</sup>

UDC 547.913

In the literature there are numerous research works on the essential oils of *Salvia* [1–10].

The essential oils of *Salvia reuterana* Boiss. have been the subject of considerable work in Iran. Twenty one components were identified with (*E*)- $\beta$ -ocimene (32.3%),  $\alpha$ -gurjunene (14.1%), and germacrene D (11.2%) as the major constituents [11]. However, to the best of our knowledge no report on the oils from leaves, stems, and flowers of this plant exists, leading us to the present work.

In this paper, we describe the analyses of the oils from leaves, stems, and flowers of *S. reuterana* Boiss. and their antibacterial activity for the first time.

Chemical components identified in the three oils of *S. reuterana* and their percentage composition are listed in Table 1.

The leaf oil consisted of 21 identified compounds representing 98.4% of the oil composition. The main compounds were germacrene D (28.2%),  $\beta$ -caryophyllene (15.5%), and bicyclogermacrene (13.0%). Another notable constituent was 14-hydroxymurolene (10.8%).

In the stem oil, 18 compounds were identified representing 94.0% of the oil composition. The main compounds were also germacrene D (22.7%),  $\beta$ -caryophyllene (12.5%), and bicyclogermacrene (10.3%), while *cis*-calamene (11.6%) was found in large amount.

Germacrene D (32.5%),  $\beta$ -caryophyllene (16.6%), and bicyclogermacrene (13.3%) were the main components among the 14 constituents characterized in the flower oil representing 91.0 % of the total components detected. Dehydroaromadendrane (11.0%) was present in considerable amounts in the flower oil.

Sesquiterpenes represented the most abundant constituents of the oil of leaves, stems, and flowers (96.0%, 74.0%, and 82.3%, respectively). Germacrene D was the major constituent of these oils (28.2%, 22.7%, and 32.5%, respectively). Another notable constituent was  $\beta$ -caryophyllene (15.5%, 12.4%, and 16.7%, respectively).

The antibacterial assays showed that the oils of leaves, stems, and flowers of *S. reuterana* inhibited the growth of all bacteria. The results are shown in Table 2.

### ACKNOWLEDGMENT

We are grateful to Dr. V. Mozaffarian (Research Institute of Forest and Rangelands, Tehran) for his helpful assistance in botanical identification.

---

1) Department of Chemical Engineering, North Tehran Branch, Islamic Azad University, Tehran, Iran, e-mail: akbaresmaeili@yahoo.com; 2) Marine Science and Technology, North Tehran Branch, I. A. University, Tehran, Iran; 3) Department of Chemistry, Science & Research Campus, I.A. University, O.Box 14515-775 Tehran, Iran; 4) Department of Agronomy, Faculty of Agriculture, Ferdowsi University of Mashhad, Iran; 5) Department of Biology, Islamic Azad University, North Tehran Branch, Tehran, Iran. Published in *Khimiya Prirodnykh Soedinenii*, No. 3, pp. 313-314, May-June, 2008. Original article submitted January 30, 2007.

TABLE 1. Percentage Composition of the Leaves, Stems, and Flowers Essential Oils of *Salvia reuterana*

Compound	RI	Leaf oil	Stem oil	Flower oil
Camphene	953	-	0.4	-
<i>p</i> -Cymene	1026	-	-	0.4
Isobornyl formate	1239	0.3	-	-
$\delta$ -Elemene	1338	0.7	-	-
$\alpha$ -Cubebene	1351	-	-	4.4
$\alpha$ -Copaene	1376	4.8	2.9	-
$\beta$ -Bourbonene	1384	0.5	0.6	-
$\beta$ -Cubebene	1390	0.3	0.7	0.7
$\beta$ -Elemene	1391	2.6	0.9	-
$\beta$ -Caryophyllene	1404	15.5	11.4	16.6
Aromadendrane	1459	-	-	11.0
$\alpha$ -Humulene	1454	0.8	0.5	-
$\beta$ -Cadinene	1470	-	-	1.7
Germacrene D	1480	28.1	22.7	32.5
Indipone	1492	-	9.3	-
Bicyclogermacrene	1494	13.0	10.3	13.3
( <i>Z</i> )-calamene	1521	-	11.6	-
$\delta$ -Cadinene	1524	2.1	1.2	-
$\beta$ -Vetivenene	1526	0.5	-	-
( <i>E</i> )-calamene	1532	-	0.6	0.7
Occidentalol	1548	-	0.4	0.7
Hermacrene B	1556	0.8	-	-
Spathulenol	1576	1.2	-	-
$\beta$ -Copaen-4- $\alpha$ -ol	1584	-	-	0.4
Khusimone	1593	0.6	-	-
$\beta$ -Eudesmol	1648	-	6.9	-
Bulnesol	1666	8.1	-	-
Cadalene	1673	-	9.7	-
Kusinol	1674	0.6	-	-
<i>n</i> -Heptadecane	1700	3.3	-	-
Cedroxyde	1704	-	1.7	-
<i>iso</i> -Lungifolol	1726	0.7	-	-
( <i>Z</i> )-Dihydrooccidentalol acetate	1738	-	-	0.5
$\alpha$ -14-Hydroxyuurolene	1775	10.87	-	-
$\alpha$ -Methyl-pipitzol	1833	-	2.6	-
Methyl hexadecanoate	1927	-	-	4.2
Hexadecanoic acid	1972	3.0	-	-
Tricosane	2300	-	-	4.6

TABLE 2. Antibacterial Activity of Leaves, Stems, and Flowers of *Salvia reuterana* Essential Oils

Bacterial species	Gram +/-	Leaf oil	Stem oil	Flower oil
<i>Staphylococcus aureus</i> PTCC 1113	+	35*	20	18
<i>Staphylococcus epidermidis</i> PTCC 1349	+	20	15	14
<i>Staphylococcus saprophyticus</i> PTCC 1376	+	45	25	20
<i>Salmonella typhi</i> PTCC 1185	-	30	24	20
<i>Shigella flexneri</i> PTCC 1234	-	37	28	22
<i>Escherichia coli</i> PTCC 1330	-	20	17	15
<i>Pseudomonas aeruginosa</i> PTCC 1310	-	16	13	13

\*Values are the mean diameter of inhibitory zones, mm.

## REFERENCES

1. B. Demirci, K. H. C. Baser, B. Yildiz, and Z. Bahcecioglu, *Flavour Fragr. J.*, **18**, 116 (2003).
2. M. M. Endeshaw, O. R. Gautun, N. Asfaw, and A. J. Aasen, *Flavour Fragr. J.*, **15**, 27 (2000).
3. M. Kurkcuoglu, K. H. C. Baser, and H. Duman, *J. Essent. Oil Res.*, **14**, 241 (2002).
4. A. O. Tucker and M. J. Maciarello, *J. Essent. Oil Res.*, **8**, 669 (1996).
5. A. Rustaiyan, S. Masoudi, M. Yari, M. Rabbani, H. Motifar, and K. Larijani, *J. Essent. Oil Res.*, **12**, 601 (2000).
6. A. Rustaiyan, S. Masoudi, A. Monfared, and H. Komeilizadeh, *Flavour Fragr. J.*, **14**, 276 (1999).
7. A. Rustaiyan, H. Komeilizadeh, S. Masoudi, and A. R. Jassbi, *J. Essent. Oil Res.*, **9**, 713 (1997).
8. A. Rustaiyan, S. Masoudi, and A.R. Jassbi, *J. Essent. Oil Res.*, **9**, 599 (1997).
9. P. Salehi, A. Sonboli, M. Dayeni, F. Eftekhari, and M. Yousefzadi, *Chem. Nat. Comp.*, **44**, 102 (2008).
10. M. Mohammadhosseini, A. Pazoki, and H. Akhlaghi, *Chem. Nat. Comp.*, **44**, 127 (2008).
11. M. Mirza and F. Sefidkon, *Flavour Fragr. J.*, **14**, 230 (1999).