

## **Abietane diterpene quinones and a new diterpene epoxide from *Salvia moorcraftiana***

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**Abstract.** A new abietane diterpene epoxide and five known abietane diterpene quinones have been isolated for the first time from *Salvia moorcraftiana* roots. The epoxide has been identified as 5 $\alpha$ -hydroxy-abieta 8,11,13-triene-7-one-1,10-epoxide and the diterpene quinones have been characterised as royleanone; 7 $\alpha$ -hydroxyroyleanone; 7 $\beta$ -hydroxyroyleanone; 7 $\alpha$ -acetoxyroyleanone and 7-oxoroyleanone.

**Keywords.** *Salvia moorcraftiana* Wall.; Labiatae; abietane diterpenoids.

### **1. Introduction**

The seeds and roots of *Salvia moorcraftiana* are used as emetics against cough and also in haemorrhoids (Nadkarni 1976). A few diterpene quinones have been isolated earlier from other *Salvia* species (Watson and Taira 1976; Baojin *et al* 1981; Kakisawa *et al* 1969; Vlasova *et al* 1969, 1971). In our earlier investigations on this plant we have shown the presence of 6,7-dehydroroyleanone (Bakshi *et al* 1984) and a novel phenalenone (Bakshi *et al* 1986).

### **2. Results and discussion**

In this communication we wish to report the isolation of five known abietane diterpene quinones, viz., royleanone (*I*), 7 $\alpha$ -hydroxyroyleanone (*II*), 7 $\beta$ -hydroxyroyleanone (*III*), 7 $\alpha$ -acetoxyroyleanone (*IV*), 7-oxoroyleanone (*V*) and one new abietane diterpene epoxide, viz., 5 $\alpha$ -hydroxyabieta-8,11,13-triene-7-one-1,10-epoxide (*VI*) from the benzene extract of the roots of the plant. The structure of the new compound is elucidated on the basis of chemical and spectral analyses. This is also the first report of 7-oxoroyleanone from the genus *Salvia*.

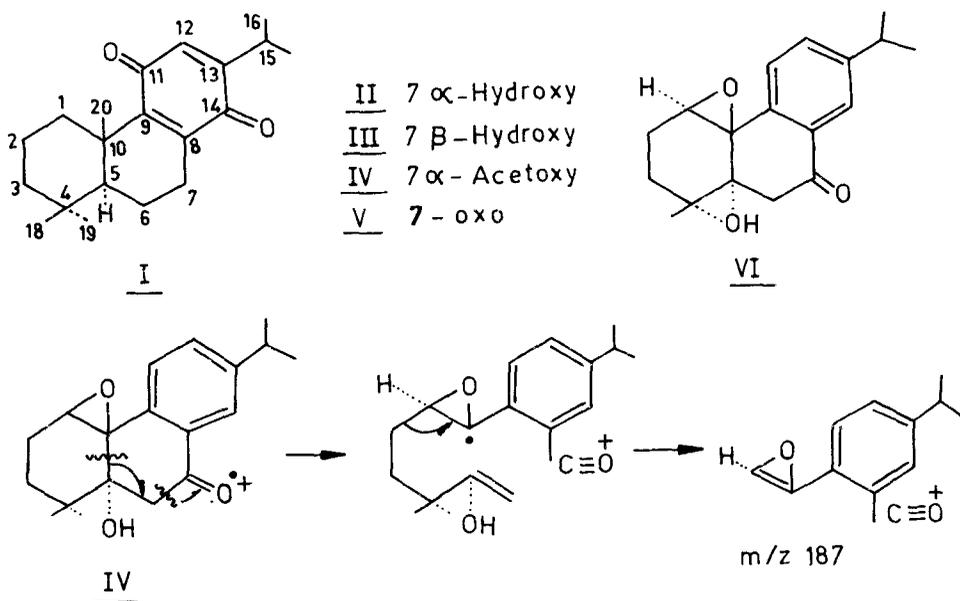
Compound (*VI*), C<sub>19</sub>H<sub>24</sub>O<sub>3</sub>, m.p. 78°, [ $\alpha$ ]<sub>D</sub><sup>23</sup> + 356° showed UV absorption at 244 nm (log  $\epsilon$  4.01), 250 (3.99) and 336 (3.84), characteristic of an acetophenone chromophoric system. In its IR spectrum, absorptions were found at 3600 (hydroxyl), 3030, 1270 (epoxy), 1389 (gem-dimethyl) and 1685 (conjugated

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carbonyl)  $\text{cm}^{-1}$ . In its NMR spectrum, a six-proton singlet seen at  $\delta$  0.78 was attributed to gem dimethyl. A double doublet integrating for six protons centred at  $\delta$  1.22 was assigned to isopropyl methyl protons. The presence of isopropyl group was further inferred from the appearance of one C(15)-methine proton septet at  $\delta$  3.12 (Brieskorn and Buchberger 1973). This was finally confirmed by the appearance of a fragment ion in its mass spectrum at  $m/z$  257 (due to the loss of the isopropyl group) (Parker and Johnson 1968). Angular methyl at C(10) which is commonly found in many of the abietane diterpenes was found to be absent in this compound.

The position of the epoxide moiety was fixed between C(1) and C(10) from the NMR and MS spectral analyses of the compound. In NMR a triplet integrating for one proton was seen at  $\delta$  3.59, which could only be due to the proton at C(1), because if the epoxide was linked to C(2) and C(3), then one would expect two doublets, integrating for one proton each, appearing at two different positions (Silva *et al* 1973). Moreover, in its MS a fragment ion at  $m/z$  187 (scheme 1) clearly indicated that the epoxide is linked between C(1) and C(10). Also a one-proton singlet,  $\text{D}_2\text{O}$  exchangeable, seen at  $\delta$  4.51 could only be attributed to the tertiary hydroxyl at C(5). This finding was further supported by its resistance to acetylation. Besides, the presence of a two-proton singlet at  $\delta$  2.31 attributed to the C(6)-H confirmed the presence of a hydroxyl at C(5). In the low field region a singlet due to C(14)-H was seen at  $\delta$  6.95. Two doublets at  $\delta$  6.88 and 7.05, integrating for one aromatic proton each, were assigned to C(11)-H and C(12)-H. In the MS of this epoxide, the molecular ion peak was seen at  $m/z$  300. The base peak was observed at  $m/z$  231. The other fragment ion ( $M^+ - 15$ ) appeared at  $m/z$  285.

Thus on the basis of the above observations the compound (VI) was identified as 5 $\alpha$ -hydroxyabieta-8,11,13-triene-7-one-1,10-epoxide.



Scheme 1.

### 3. Experimental

UV spectra were measured on a Shimadzu-240 spectrophotometer using methanol (spectroscopic grade) as the solvent. IR spectra were taken on a Perkin-Elmer Infracord 137-B as KBr pellets. The optical rotations were measured in chloroform (c.0.1% or 0.2%) on a Perkin-Elmer model 141 polarimeter.  $^1\text{H}$  NMR spectra were recorded on Varian model XL-100 A or Bruker WII 270 machines in  $\text{CDCl}_3/\text{CD}_3\text{OD}$  using tetramethylsilane as the internal standard. M.P. are uncorrected. Column chromatography was carried out using silica gel (Acme India). Thin layer chromatograms were examined under a UV lamp for detection of spots. These were also detected by exposure to  $\text{I}_2$  vapour,  $\text{NH}_3$  vapour or by spraying with sulphuric acid (10%) or 2,4-dinitrophenylhydrazine as required and subsequently heating the plate at  $100^\circ$  in an oven.

Air dried finely powdered roots (1.5 kg) of the plants were extracted with  $\text{C}_6\text{H}_6$  in a Soxhlet apparatus for 48 hr. The extract was concentrated under vacuum and the concentrate so obtained was subjected to column chromatography over silica gel. A total number of 350 fractions (50 ml each) were collected and monitored on TLC. Like fractions were pooled together and concentrated under vacuum. Five such concentrates were found to contain diterpenes. The concentrate A (2.5 g) contained a mixture of three compounds. The major component was separated by repeated crystallisation from MeOH: rectangular prisms, 100 mg, m.p.  $169\text{--}71^\circ$  TLC, silica gel, ( $\text{C}_6\text{H}_6$ : EtOAc, 95:5, Rf 0.65). This compound was identified as 6,7-dehydroroyleanone (Bakshi *et al* 1984). It was converted into its 6,7-dihydro (royleanone) and 12-methoxy derivatives.

Two compounds present in the mother liquor were separated by reverse phase TLC, (MeOH:  $\text{H}_2\text{O}$ , 20:80) and subsequent normal preparative TLC. The second compound was crystallised from MeOH as orange-red crystals, 30 mg, m.p.  $181^\circ$   $[\alpha]_D^{23} + 134^\circ$  ( $\text{CHCl}_3$ ). Its IR, UV, NMR, MS spectral data were similar to those reported for royleanone (I) (Edwards *et al* 1962). The third compound was a new diterpene epoxide (VI).

*5 $\alpha$ -Hydroxyabieta-8,11,13-triene-7-one-1,10-epoxide*: This was obtained as a pale yellow solid on crystallisation from petroleum ether ( $60\text{--}80^\circ$ ), 15 mg, m.p.  $78^\circ$ ,  $[\alpha]_D^{23} + 356^\circ$  ( $\text{CHCl}_3$ ), calculated for  $\text{C}_{19}\text{H}_{24}\text{O}_3$ ; C, 75.99; H, 8.05; found C, 76.02; H, 7.98%, UV  $\lambda_{\text{max}}$  (MeOH) nm (log  $\epsilon$ ): 244 (4.01), 250(3.99), 336(3.84); IR  $\nu_{\text{max}}$  (KBr)  $\text{cm}^{-1}$ : 3600, 3030, 1685, 1613, 1481, 1410, 1389, 1270, 1101, 1036, 990, 970;  $^1\text{H}$  NMR ( $\text{CDCl}_3$ )  $\delta$  0.78 [s, 6H, C(4)-methyls], 1.22 [dd, 6H, isopropyl methyls], 2.31 [s, 2H, C(6)- $\text{H}_2$ ], 3.12 [septet, 1H,  $J = 7$  Hz, isopropyl methine-H], 3.59 [t, 1H, C(1)-H], 4.51 [s, 1H, C(5)-OH,  $\text{D}_2\text{O}$  exchangeable], 6.95 [s, 1H, C(14)-H], 6.88 and 7.05 [2d, 2H, C(11)-H, C(12)-H]. MS  $m/z$  (%) 300 ( $M^+$ , 18), 285 ( $M^+$ -15), 257 ( $M^+$ -43), 233, 231 (100), 215, 211, 203, 187, 173, 167, 143, 130.

*7 $\alpha$ -Acetoxyroyleanone*: Column rechromatography of fraction 3 (2.5 g) yielded this compound as a yellow crystalline solid, 550 mg, m.p.  $211.5^\circ$   $[\alpha]_D^{23} - 14^\circ$  (c.0.2). Its spectral data (UV, TR, NMR, MS) were found to be the same as that reported in the literature (Edwards *et al* 1962; Brieskorn *et al* 1973).

*7 $\alpha$ -Hydroxyroyleanone*: It was obtained as one of the components by the column rechromatography of fraction 4 and subsequent reverse phase preparative TLC as a

yellow crystalline product, 55 mg, m.p. 172–73°,  $[\alpha]_D^{23} - 131^\circ$ . Spectral data (UV, IR, NMR) were in total agreement with the literature values (Brieskorn and Buchberger 1973; Janot and Potier 1964).

*7 $\beta$ -Hydroxyroyleanone*: It was obtained as the second compound from fraction 4, 42 mg, m.p. 215°,  $[\alpha]_D^{23} + 215^\circ$ . Its spectral data (UV, IR, NMR) were in accordance with values reported in the lit. (Hensch *et al* 1975).

*7-Oxoroyleanone*: This was obtained as orange-red needles on column rechromatography of fraction 5, 12 mg, m.p. 196–97°,  $[\alpha]_D^{23} - 268^\circ$ . The compound was characterised on the basis of UV, IR, NMR, MS spectral data (Hensch *et al* 1975).

## References

- Bakshi B, Hassarajani S A, Mulchandani N B and Shankar J 1984 *Planta Med.* **50** 355  
Bakshi B, Mulchandani N B and Shankar J 1986 *Planta Med.* (in press)  
Baojin Y, Mingkun Q, Guowei Q and Zhenxiong C 1981 *Yaoxue Xuebao* **16** 837  
Bredenberg B, McChesney J D and Wenkert E 1964 *J. Org. Chem.* **29** 2293  
Brieskorn C H and Buchberger L 1973 *Planta Med.* **24** 190  
Edwards O E, Feniak G and Los M 1962 *Can. J. Chem.* **40** 1540  
Hensch M, Ruedi P and Eugster C H 1975 *Helv. Chim. Acta* **58** 1921  
Janot M and Potier P 1964 *Ann. Pharm.* **22** 387  
Kakisawa H, Hayashi T and Yamazaki T 1969 *Tetrahedron Lett.* 301  
Nadkarni K M 1976 in *Indian Materia Medica* (ed.) (Bombay: Popular Prakashan) **1** p. 1094  
Parker W L and Johnson F J 1968 *J. Am. Chem. Soc.* **90** 4716  
Silva M, Bittner M and Sammes P G 1973 *Phytochemistry* **12** 883  
Vlasova G F, Romanova A S, Perelson M E and Bankovskii A I 1969 *Khim. Prir. Soedin* **5** 317  
Vlasova G F, Romanova A S and Bankovskii A I 1971 *Rast. Resu* **7** 74  
Watson W M and Taira J 1976 *Tetrahedron Lett.* 2051