Revised Structure and Synthesis of the Sesquiterpene Calameon (Calamendiol)

By M. Iguchi, A. Nishiyama, M. Niwa, and S. Yamamura*
(*Faculty of Pharmacy, Meijo University, Showa-ku, Nagoya, Japan*)
and Y. Hirata
(*Chemical Institute, Nagoya University, Chikusa, Nagoya, Japan*)

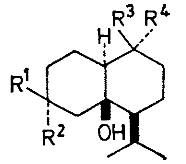
Summary The structure of calameon has been revised.

We have reported[1,2] the isolation and structure of isocalamendiol (I), and now describe the revised structure and synthesis of calameon (calamendiol).

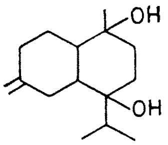
Calameon (II), m.p. 170·5—171·5° (lit. 169°), $C_{15}H_{26}O_2$, has i.r. and n.m.r. spectra similar to those of isocalamendiol (I).[1] From these spectral properties, however, the structure (III) given by Treibs[3] cannot be ruled out.

Hydrogenation of calameon over platinum in ethyl acetate afforded a mixture of two dihydro-compounds, (IV), m.p. 123—124° and (V), m.p. 133—134° in 27 and 59% yields, respectively. The former was identical with an authentic sample of dihydrocalameon (m.p. and i.r. spectrum),[4] whereas the latter showed the same melting point as reported by Böhme.[5] The configuration of the secondary methyl group in the two isomers has been determined by the comparison of their n.m.r. spectra (in $CDCl_3$): (IV) has a methyl doublet at δ 1·18 (J 7·0 Hz), whereas that in (V) appears at δ 0·89 (J 6·0 Hz).[6]

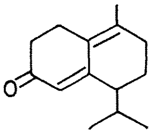
Ozonolysis of isocalamendiol (I) followed by dehydration with 100% formic acid (under reflux, 30 min.) gave an oily conjugated ketone (VI), m/e 204 (M^+); ν_{max} (film) 1660, 1630, and 1580 cm^{-1}; λ_{max} (MeOH) 209, 237, and 302 nm (log ϵ 3·76, 3·66, and 4·16, respectively), which was also obtained in good yield from calameon (II) by a similar procedure. Finally, the structure of calameon (II) was established by the following experiments using the dienol (VII),[2] which had been obtained from isocalamendiol (I), as well as shyobunone already synthesized from (—)-santonin.[7] Oxidation of (VII) with *m*-chloroperbenzoic acid (1·2 equiv.) in diethyl ether (under reflux, 15 hr.) followed by reduction with lithium aluminium hydride afforded, in 44% yield (relative ratio 1 : 1), a mixture of two diols.[8] One of them was identical with calameon (m.p. and i.r. spectrum). Accordingly, the structure of calameon should be represented by (II). Another diol, m.p. 168·5—170°, is not isocalamendiol (I), but a new isomer (VIII), m/e 238 (M^+); ν_{max} (KBr) 3370 br., 3080, 1650 cm^{-1}; δ 0·93 (6H, d, J 6·5 Hz), 1·12 (3H, s), and 4·68—5·0 (2H, br.m) (in $CDCl_3$). Finally, preisocalamendiol (IX) was converted into isocalamendiol (I) in *ca.* 45% yield when treated with 80% aqueous acetic acid (room temp., 5 min.). However, calameon (II) has not yet been obtained from (IX) under such conditions. All compounds gave satisfactory physical data. We thank Dr. V. Herout, Czechoslovak Academy of Science, for an authentic sample of dihydrocalameon.



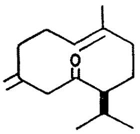
(I) $R^1,R^2 = CH_2, R^3 = Me, R^4 = OH$
(II) $R^1,R^2 = CH_2, R^3 = OH, R^4 = Me$
(IV) $R^1 = Me, R^2 = H, R^3 = OH, R^4 = Me$
(V) $R^1 = H, R^2 = Me, R^3 = OH, R^4 = Me$
(VII) $R^1,R^2 = R^3,R^4 = CH_2$
(VIII) $R^1 = OH, R^2 = Me, R^3,R^4 = CH_2$



(III)



(VI)



(IX)

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[2] M. Iguchi, A. Nishiyama, S. Yamamura, and Y. Hirata, *Tetrahedron Letters*, 1969, 4295.
[3] W. Treibs, *Chem. Ber.*, 1949, **82**, 530.
[4] F. Šorm and V. Herout, *Coll. Czech. Chem. Comm.*, 1948, **13**, 177.
[5] H. Böhme, *Chem. Zentr.*, 1940, (I), 2795.
[6] Y. Kawazoe, Y. Sato, M. Natsume, H. Hasegawa, T. Okamoto, and K. Tsuda, *Chem. and Pharm. Bull.* (*Japan*), 1962, **10**, 338; R. F. Zürcher, *Helv. Chim. Acta*, 1963, **46**, 2054.
[7] K. Kato, Y. Hirata, and S. Yamamura, to be published.
[8] H. B. Henbest, *Proc. Chem. Soc.*, 1963, **159**. The peroxy-acid can attack the exocyclic double bond at C-3 as well as at C-9 from the same side as that of the tertiary hydroxy-group.