Total Synthesis of the Sesquiterpenes (+)-Daucene, (+)-Carotol, and (−)-Daucol

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Summary From the ketol (2), previously synthesised from (−)-dihydrocarvone, (+)-daucene, (+)-carotol, and (−)-daucol have been prepared.

The recent publication[1] of total synthesis of racemic and of partly racemized (−)-daucene prompts us to disclose our own work in this field.[2]

The synthesis of the ketol (2) from (+)-carvone (1) has been described.[3] Treatment of this ketol with diazomethane (*in situ*)[4] gave a 2:1 mixture of ketols (3a) and (4a) [as deduced from the c.d. curve of the mixture of the corresponding acetates (3b) and (4b)]. These ketols could not be separated, but their acetates could, and the structures of the latter were deduced by comparison of their c.d. curves with those of A-homo-5α-cholestan-3-one (5) and -4-one (6),[5] taking into account the quasiantipodal relationship of the two series (Table).

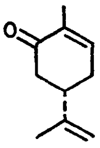
C.d. of ketones (3b), (4b), (5), and (6) *in dioxan*

Ketone:	(3b)	(4b)	(5)	(6)
$\Delta\epsilon_{max}$	+1·32	−0·65	−1·43	+2·56
λ_{max}/nm	293	293	296	294

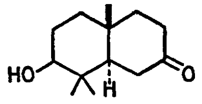
Hydrolysis of the acetate (3b) afforded the ketol (3a), treatment of which with phosphorus pentachloride[6] gave the keto-olefins (7) and (8). Isomerization of the keto-olefin (7) [to (9a)] and treatment of the product with methylmagnesium iodide gave the hydroxy-olefin (9b), which could be dehydrated with thionyl chloride–pyridine to (+)-daucene (10), $[\alpha]_D$ + 39°, identical (i.r. and n.m.r. spectra[7]) with natural daucene.

Daucene (10) was oxidised by *p*-nitroperbenzoic acid to the monoepoxide (11), the stereochemistry of which was proved by chemical means. Reduction of the epoxide (11) with lithium–ethylamine at 0 °C gave back some daucene (10) and a mixture of five alcohols from which (+)-carotol (12) was separated in 5% yield. This was identified by its i.r. and n.m.r. spectra and by oxidation to (−)-daucol (13a), m.p. 116 °C, $[\alpha]_D$ −19° (*cf.* refs. 8 and 9). The latter was fully characterised by its i.r. spectrum and its transformation into daucol acetate (13b)[9,10] and daucone (14),[9,11] both of which were identical with material from natural sources.

In view of the total synthesis of racemic carvone (1),[12] the work reported here almost amounts to a total synthesis of daucene, carotol, and daucol.



(1)



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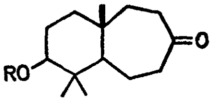
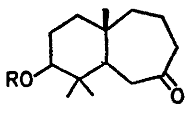


(3) a; R = H
b; R = Ac



(4) a; R = H
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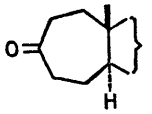

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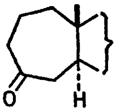
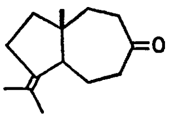
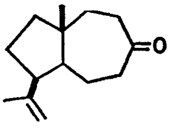


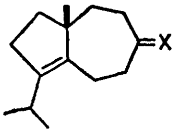
(6)



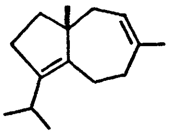
(7)



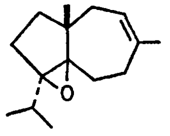
(8)



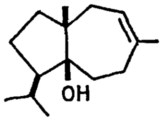
(9) a; X = O
b; X = Me,OH



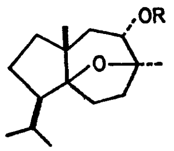
(10)



(11)

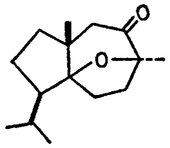


(12)



a; R = H
b; R = Ac

(13)



(14)

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[1] M. Yamasaki, *Chem. Comm.*, 1972, 606; P. Naegeli and R. Kaiser, *Tetrahedron Letters*, 1972, 2013.

[2] H. De Broissia, Thesis, Nancy, 1970.

[3] J. Levisalles and H. Rudler, *Bull. Soc. chim. France*, 1968, 299.

[4] N. A. Nelson and R. N. Shut, *J. Amer. Chem. Soc.*, 1959, **81**, 6486.

[5] J. Levisalles, G. Teutsch, and I. Tkatchenko, *Bull. Soc. chim. France*, 1969, 3194.

[6] J. F. Biellmann and G. Ourisson, *Bull. Soc. chim. France*, 1962, 331.

[7] G. V. Pigulevskii, V. I. Kovaleva, and D. V. Motskos, *Chem. Abs.*, 1961, **55**, 15842g.

[8] F. Šorm and L. Urbanek, *Coll. Czech. Chem. Comm.*, 1948, **13**, 45, 420.

[9] J. Levisalles and H. Rudler, *Bull. Soc. chim. France*, 1967, 2059.

[10] L. H. Zalkow, E. J. Eisenbraun, and J. N. Shoolery, *J. Org. Chem.*, 1961, **26**, 981.

[11] V. Sykora, L. Novotny, M. Holub, V. Herout, and F. Šorm, *Coll. Czech. Chem. Comm.*, 1961, **26**, 788.

[12] J. L. Simonsen and L. N. Owen, 'The Terpenes,' Cambridge Univ. Press, 1953, vol. 1, p. 395.