Simple Synthesis of β-Damascenone and Related Compounds

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Summary β-Damascenone (I; R = Me) is obtained in overall yields of 30—40% by a sequence involving aluminium chloride-catalysed Diels–Alder addition of penta-1,3-diene to 3-bromo-4-methylpent-3-en-2-one, followed by dehydrobromination, base-catalysed condensation with acetaldehyde, and elimination of water.

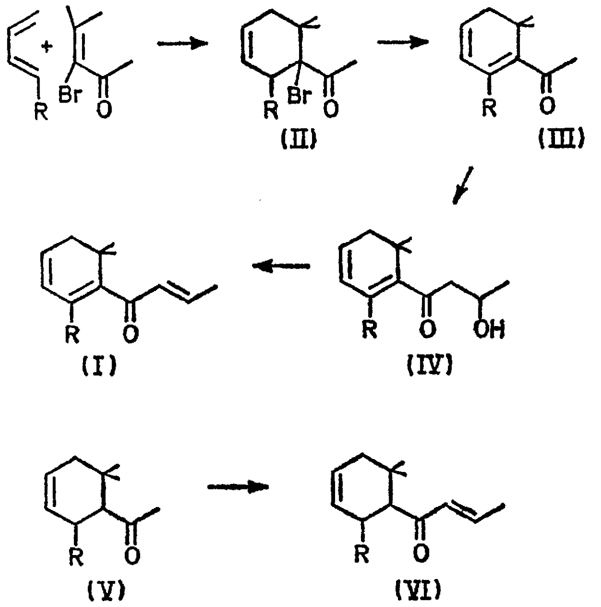
β-Damascenone (I; R = Me), first isolated from Bulgarian rose oil[1] (*Rosa damascena* Mill.) and later identified in other plant materials,[2] is expected to become important in perfumery. Existing syntheses proceed from β-cyclocitral[1,3] or from ethyl β-safranate.[4] We now describe an efficient, direct synthesis from readily available chemicals.

Addition of penta-1,3-diene (mixture of isomers) (1·20 mol) to 3-bromo-4-methylpent-3-en-2-one (0·30 mol), in methylene chloride containing aluminium chloride (0·07 mol) at 40°, gave the Diels–Alder adduct (II; R = Me) in 63% yield† as a mixture of *trans*- and *cis*-isomers (*ca.* 20:80). Treatment of the adduct (II; R = Me) with lithium fluoride and lithium carbonate in dimethylformamide at 120° formed the dienone (III; R = Me) (85%).‡ An alternative conversion of (II; R = Me) into (III; R = Me) in 67% yield involved bromination with *N*-bromosuccinimide in carbon tetrachloride followed by reduction with zinc and acetic acid in ether. The methyl ketone (III; R = Me) was treated with *N*-methylanilinomagnesium bromide[5] and then condensed with acetaldehyde in ether–benzene to give the aldol (IV; R = Me). Water was eliminated from the aldol (IV; R = Me) with toluene-*p*-sulphonic acid in methylene chloride, or with sodium acetate in acetic anhydride, yielding β-damascenone (I; R = Me) [70% from (III; R = Me)].

Addition of penta-1,3-diene to mesityl oxide produced the adduct (V; R = Me) as a mixture of stereoisomers in the ratio *ca.* 13:87. Reduction of the bromo-ketone (II; R = Me) with zinc gave the same isomers in the ratio *ca.* 10:90. The adduct (V; R = Me) was converted into δ-damascone (VI; R = Me) which had a pleasant odour similar to that of β-damascenone.

Application of the same reaction sequence to buta-1,3-diene gave the dienone (VI; R = H) and the trienone (I; R = H) both of which had characteristic odours resembling mango.

The catalysed Diels–Alder reactions proceed with accompanying polymerisation of the diene and usually it is convenient to separate the adduct from polymer by steam distillation.



Catalysed Diels–Alder reactions similar to those described above occur between mesityl oxide or its bromo-derivative and other dienes, and can involve other ββ-disubstituted dienophiles.

Satisfactory spectral data have been obtained for all new compounds.

(*Received*, 18*th December* 1972; *Com.* 2113.)

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† Dr. P. Lombardi has since obtained yields of 87% (g.l.c.) using 2 mol of pentadiene to 1 of bromomesityl oxide.

‡ Small amounts of double bond isomers are formed also.

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