

CLAISEN REARRANGEMENTS OF ALLYLIC α -PHENYLTHIOACETATES:
APPLICATIONS IN SYNTHESIS

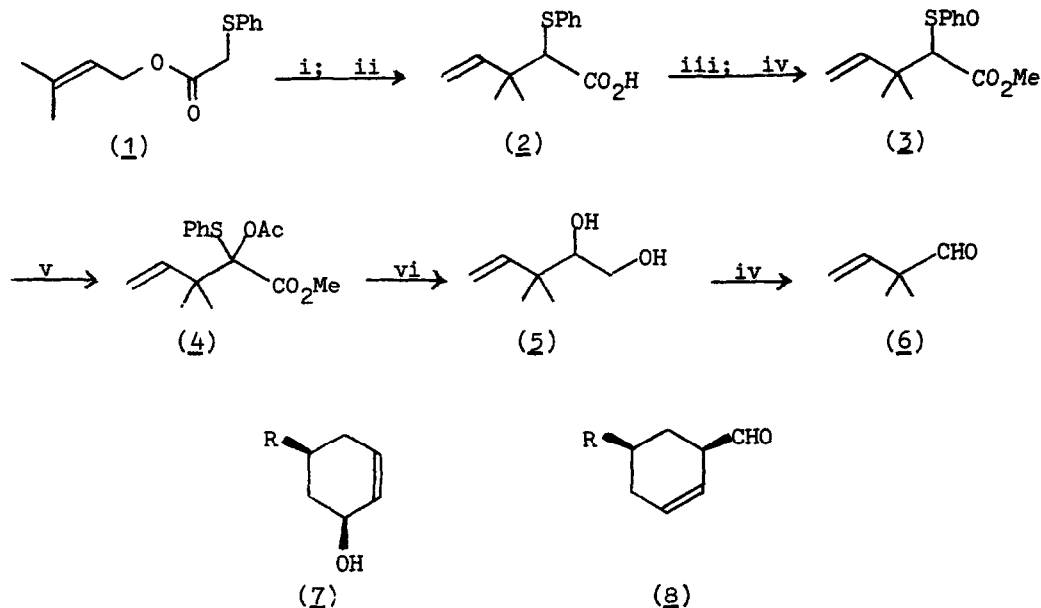
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Recent publications¹⁻⁴ have shown the value in synthetic work of the α -phenylsulphinyl derivatives of esters and lactones, which can be obtained by carboalkoxylation of alkyl phenyl sulphoxides¹, by alkylation of methyl sulphinyllacetate², and by the oxidation of the α -phenylthio derivatives of esters and lactones. Methods at present available for preparing the α -phenylthio derivatives include the α -phenylsulphenylation⁴ of esters or lactones, and the interaction⁵ of 1,2-epoxides with the di-lithio derivative of phenylthioacetic acid. We here describe a new route to α -phenylthio acids, which provide the starting-point for new routes via the corresponding α -phenylsulphinyl compounds to (a) $\beta\gamma$ -unsaturated aldehydes, and (b) (Z)-2-dienoic acids, of types which would otherwise be difficult to obtain.

When silyl enolates derived from allylic α -phenylthioacetates are kept at 50-60° they undergo Claisen rearrangement⁶ to give, after hydrolysis, α -phenylthio acids. Thus the ester (1) gave (ca. 80%) 3,3-dimethyl-2-phenylthiopent-4-enoic acid (2)⁷ (S-benzylthiuronium salt, m.p. 126°); and the ester (9) gave similarly (ca. 70%) the mixed diastereoisomeric $\gamma\delta$ -unsaturated α -phenylthio acids (10)⁷.

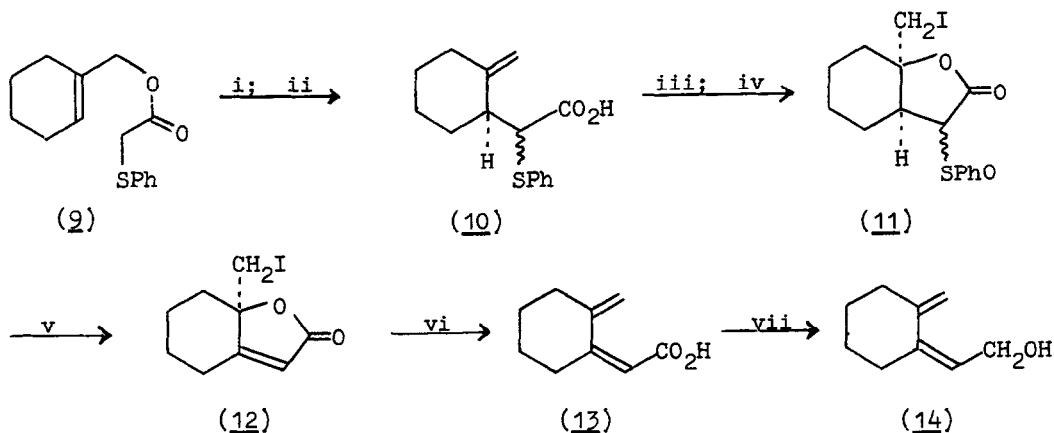


Reagents: i, LiNPr_2^1 ; ii, Me_3SiCl ; 55° ; 2N-HCl aq. ; iii, CH_2N_2 ; iv, NaIO_4 ; v, NaOAc , Ac_2O ; vi, LiAlH_4 .

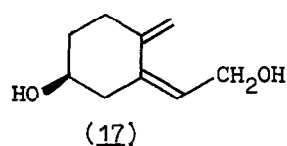
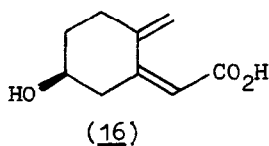
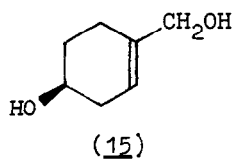
The route from such α -phenylthio acids to $\beta\gamma$ -unsaturated aldehydes is illustrated by the sequence $(2) \longrightarrow (6)$. The α -phenylsulphonyl ester (3) underwent Pummerer rearrangement⁸ to give the ester (4) which was reduced with lithium aluminium hydride to the 1,2-diol (5) [ca. 40% from the acid (2)] (bis-*p*-nitrobenzoate, m.p. 144°). Periodate cleavage then gave the aldehyde (6) (semicarbazone⁹, m.p. 161 - 162°). This sequence should permit the stereospecific conversion of secondary allylic alcohols such as (7) into the $\beta\gamma$ -unsaturated aldehydes (8) ; whereas recently described routes¹⁰ to $\beta\gamma$ -unsaturated aldehydes are not well-suited to use with secondary alcohols.

The route from α -phenylthio acids to (Z) -2-dienoic acids is exemplified by the sequence $(10) \longrightarrow (13)$. Iodolactonisation of the mixed acids (10) and oxidation with periodate gave the mixed α -sulphonyl lactones (11) . Above

100° both isomers were converted [ca. 45% from (10)] into the $\alpha\beta$ -unsaturated iodomethyl- γ -lactone (12)¹¹, m.p. 83°, from which the dienoic acid (13) and the dienol (14)¹² have been prepared. This sequence should be applicable to a conversion of the optically active diol (15) into the dienoic acid (16), and thence into the dienediol (17), which is an important degradation product of vitamin D₂. The acid (16) can not conveniently be obtained by the extension of existing methods¹² of preparing the parent acid (13).



Reagents: i, LiNPr_2^1 ; ii, Me_3SiCl ; 55°; H_2O ; iii, Na_2CO_3 aq. $-\text{I}_2$; iv, NaIO_4 ; v, 100-120°; vi, Zn-MeOH ; vii, LiAlH_4 .



References

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6. cf. R. E. Ireland and R. H. Mueller, J. Amer. Chem. Soc., 1972, 94, 5897
7. Structures (1) - (14) in this paper denote racemates; structures (15) - (17) represent absolute configurations.
8. cf. S. Iriuchijima, K. Maniwa, and G. Tsuchihashi, J. Amer. Chem. Soc., 1974, 96, 4280.
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11. This step does not succeed with analogues of (11) in which the iodine atom is attached to secondary, instead of to primary carbon, since at the temperatures necessary for the elimination of the sulphinyl group hydrogen iodide is also lost. For success in such cases, use of the corresponding selenium (instead of sulphur) compounds will probably be necessary.
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