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GENERATION AND REACTIONS OF 1-(ARYLSULFINYL)ALKENYLLITHIUM REAGENTS. TERMINAL ALLENES FROM 2-ALKENYL ARYL SULFOXIDES.

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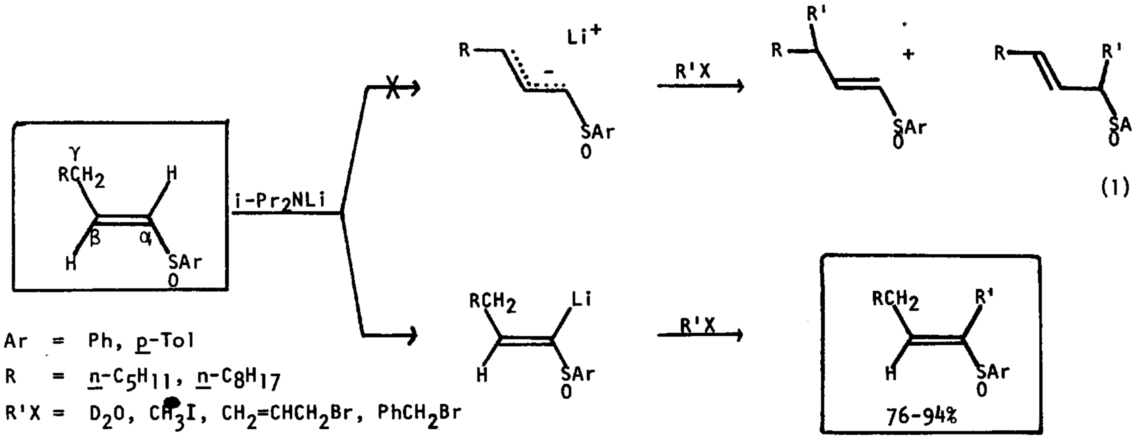
α-Metalation of alkyl aryl sulfoxides has been used to study how a sulfinyl group stabilizes an adjacent carbanion and to form carbon-carbon bonds α to the sulfinyl group.[1] α-Metalation of 1-alkenyl aryl sulfoxides, however, has received virtually no attention despite the availability of vinylic sulfoxides and their increasing use in organic synthesis.[2,3] We report here our results on α-lithiation of 1-alkenyl aryl sulfoxides, on reaction of these α-sulfinylalkenyl anions with various electrophiles, and on a significant new method for allene formation via sulfoxide elimination. We have discovered that 1-alkenyl aryl sulfoxides can be α-lithiated effectively by treatment at -78° for 20 min with a slight excess of lithium diisopropylamide in tetrahydrofuran (THF). The 1-(arylsulfinyl)alkenyllithium reagents so generated react cleanly and rapidly with a variety of electrophiles to give α-substituted 1-alkenyl sulfoxides in 76-94% yields, as shown in eq 1.[4] The absence of any α-alkylated allylic sulfoxides (or the corresponding 2,3-sigmatropically rearranged allylic alcohols) and the absence of any γ-alkylated vinylic sulfoxides supports the intermediacy of a vinylic lithium species rather than an allylic one (eq. 1)[5,6]



(1)

Ar = Ph, p-Tol

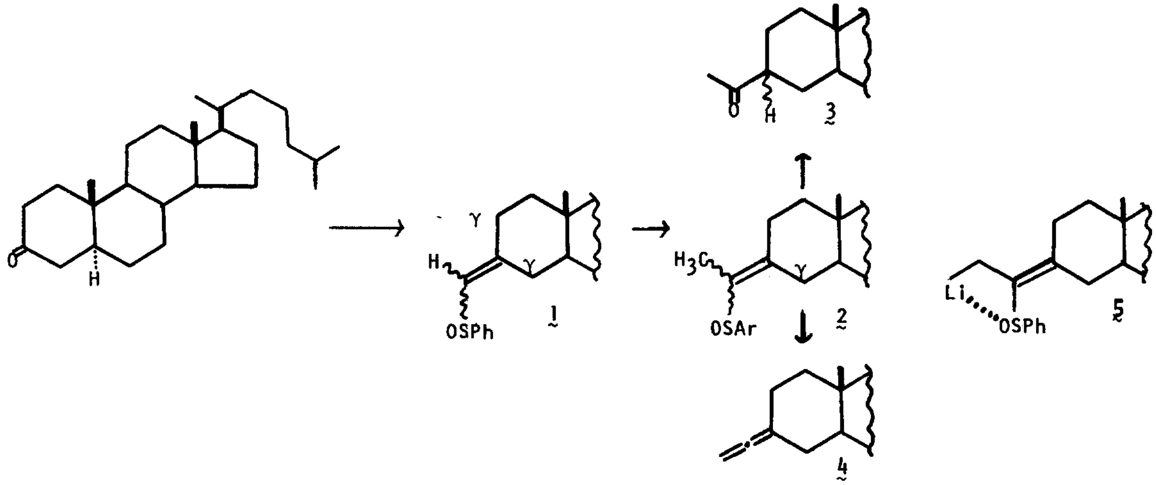
R = n-C_5H_{11}, n-C_8H_{17}

R'X = D_2O, CH_3I, $CH_2{=}CHCH_2Br$, $PhCH_2Br$

In separate experiments, isomeric Z- and E-1-alkenyl sulfoxides underwent α-lithiation and α-methylation to give almost entirely the corresponding E-2-alkenylsulfoxides; this configurational instability of α-sulfinylalkenyl anions is in sharp contrast to the configurational stability of most alkenyl carbanions[7] and may be due to the sulfinyl group lowering the alkenyl anion isomerization barrier.[8] Acylation of the vinylic lithium reagents was achieved in 40-50% yields using methyl chloroformate and pivaloyl chloride. The relatively high basicity of the vinylic lithium species was indicated by its deprotonation (rather than alkylation) of methyl α-bromoacetate.

Steroidal 1-alkenyl sulfoxide **1**, prepared from 3-cholestanone and lithium diethyl phenylsulfinylmethylphosphonate,[2a] was converted in 79% yield into 2-alkenyl sulfoxide **2** by treatment at low temperature with LDA and then with methyl iodide in THF. Despite the availability of protons on the γ (or γ') carbon atom geometrically cis to the sulfinyl group, we have no evidence for γ-deprotonation (i.e., allylic rather than vinylic anion formation); methylation occurred exclusively α to sulfur and no β, γ-unsaturated (i.e., allylic) sulfoxide was detected. Hydrolysis[9] of 2-alkenyl sulfoxide **2** would lead to 3-acetylcholestane **3** in what would amount overall to a reductive nucleophilic acylation[10] of 3-cholestanone by means of an acyl anion equivalent. Potentially, other acyl groups besides acetyl could be introduced.

The mass spectra (70 eV) of the E-2-alkenyl aryl sulfoxides prepared via eq 1 and the mass spectrum of steroidal 2-alkenyl sulfoxide **2** indicated a facile fragmentation to form the corresponding allenes. Exposing E-2-dodecenyl phenyl sulfoxide to lithium 2,2,6,6-tetramethylpiperidide[11] (LTMP) in THF at -100° followed after 45 minutes by adding solid ammonium chloride gave 1,2-dodecadiene in good yield. Likewise, steroidal 2-alkenyl sulfoxide **2** was converted into allene **4** in 60% yield after preparative tlc; no steroidal acetylene was detected. This result is particularly striking when compared with the poor yields of allenes obtained from non-aromatic ketones by other methods.[12] When LDA was used instead of the very hindered LTMP for deprotonation of 2-alkenyl sulfoxide **2**, some γ-deprotonation occurred. A tentative mechanistic rationale for this base-promoted allene formation involves formation of 2-sulfinylallyllithium **5** as a labile intermediate.



Conversion of 2-alkenyl sulfoxides into the corresponding terminal allenes is a new and important synthetic transformation which extends the already broad use of sulfinyl groups in forming carbon-carbon double bonds. Because transformation of aldehydes and especially non-aromatic ketones into the corresponding terminal allenes generally has been difficult and indirect, and because allenes are important in nature, we are pursuing these exciting observations

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