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# REACTION OF SULFINIC ESTERS WITH METHYLSULFINYLCARBANION

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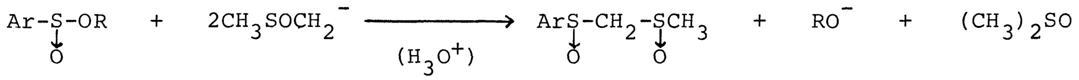
Sulfinic esters react with methylsulfinylcarbanion to give the corresponding α-methylsulfinylmethyl sulfoxides(I) in good yields. The per cent ratio of meso form to dl form of the product obtained is about 60 : 40. When (-)-menthyl (-)-(S)-p-toluenesulfinate is treated with methylsulfinylcarbanion, dextrorotatory α-methylsulfinylmethyl p-tolyl sulfoxide(IIa) is obtained. Recrystallization of (IIa) yields the diastereomerically pure (+)-(S)-α-methylsulfinyl-(R)-methyl p-tolyl sulfoxide(IIb). Based on these observations, the stereochemistry of the reaction is discussed.

Methylsulfinylcarbanion can be readily obtained by the reaction of dimethyl sulfoxide with strong base such as sodium hydride, potassium t-butoxide or sodium amide, and the chemical properties and the synthetic applications of this reagent have been studied extensively. Previously, Russell et al.[1)] and Corey et al.[2)] have reported independently that carboxylic esters react with 2 equivalents of this reagent to form the corresponding β-keto sulfoxides which are valuable synthetic intermediates. In this communication, we wish to report the stereochemistry of the reaction of sulfinic esters with this reagent.

We have found that the methylsulfinylcarbanion(2 equivalents) also reacts with arenesulfinic esters to form the corresponding aryl α-methylsulfinylmethyl sulfoxides (I) in good yields without undergoing a facile proton-transfer reaction, in a similar fashion in the case of the reaction with carboxylic esters.



$$\mathrm{Ar\text{-}\underset{\underset{O}{\downarrow}}{S}\text{-}OR} + 2CH_3SOCH_2^- \xrightarrow[(H_3O^+)]{} \mathrm{Ar\underset{\underset{O}{\downarrow}}{S}\text{-}CH_2\text{-}\underset{\underset{O}{\downarrow}}{S}CH_3} + RO^- + (CH_3)_2SO$$

(I)

Ar; p-$CH_3C_6H_4$- or $C_6H_5$-

In a typical reaction, methylsulfinylcarbanion(in 15 ml of tetrahydrofuran) prepared by the reaction of 12 ml of dry dimethyl sulfoxide and 0.021 mol of sodium hydride[1b,3)] was treated dropwise with a solution of an arenesulfinic ester(0.01 mol) in tetrahydrofuran at -5 - 0°C. After completion of the addition(ca. 10 min), the mixture was stirred for 1 hr at 0°C. And then water(50 ml) was added, and the solution was acidified with aqueous hydrochloric acid to a pH of about 3 and extracted with chloroform. The extract was washed well with water and dried. When the oil obtained from the chloroform-layer was poured into a large amount of n-hexane, n-hexane insoluble aryl α-methylsulfinylmethyl sulfoxide (I) precipitated. (The column chromatography packed with 100 mesh silica gel using benzene as eluent also affords (I).) The results of the reaction are summarized in Table 1. This reaction is stereoselective, and the predominant diastereomer of (I) is meso form. Namely, the per cent ratio of meso form to dl form of (I) obtained was 60 : 40 (see Table 1). The ratio can be evaluated from the NMR spectra of the methylene protons or the methyl protons of methylsulfinyl group of (I) by integration of the respective signals, since the difference in chemical shift between the diastereotopic methyl or methylene groups is large enough(see Fig. 1).

Table 1. Results of the reactions of arenesulfinic esters with methylsulfinylcarbanion

| Sulfinic esters | Yields(%) of the corresponding α-methylsulfinylmethyl sulfoxides | meso(%) : dl(%) |
|---|---|---|
| $C_6H_5SOOCH_3$ | 77 | 62 : 38 |
| $C_6H_5SOOC_2H_5$ | 75 | 60 : 40 |
| p-$CH_3C_6H_4SOOCH_3$ | 85 | 58 : 42 |
| p-$CH_3C_6H_4SOOC_2H_5$ | 80 | 59 : 41 |
| p-$CH_3C_6H_4SOOC_3H_7$-iso | 70 | 60 : 40 |

When (-)-menthyl (-)-(S)-p-toluenesulfinate, mp 107-107.5°C, $[\alpha]_D^{20}$-201.5° (acetone)(lit;[4] mp 106-107°C, $[\alpha]_D$-199.2°(acetone)), was treated with methylsulfinylcarbanion(2 equivalents) in a manner similar to the reaction for dl-sulfinic esters above mentioned, dextrorotatory α-methylsulfinylmethyl p-tolyl sulfoxide(IIa), $[\alpha]_D^{19}$ +223.2°(c=0.207, l=1, acetone)(meso : dl = 59.3% : 40.7%), was obtained(85% yield.) The diastereomerically pure dl form,(IIb), was isolated by careful recrystallization of (IIa) from benzene. The colorless needles (IIb) had mp 147°C, $[\alpha]_D^{19}$+345.8° (c=0.113, l=1, acetone). Anal. Calcd. for $C_9H_{12}O_2S_2$: C, 49.97; H, 5.59; Found: C, 49.85; H, 5.50. The structural assignment of (IIb) was supported by the NMR spectrum which exhibited resonances at 2.76 ppm(s) and 4.00 ppm(s) due to the methyl protons of methylsulfinyl group and methylene protons, respectively(see Fig. 1). Though we have not isolated the pure meso diastereomer, recrystallization of (IIa) from benzene-n-hexane also led to enrichment in the meso form, (IIc). The mixture consisting of 90.2% (IIc) and 9.8% (IIb) has $[\alpha]_D^{19}$+170°(c=0.299, l=1, acetone).[5]

α-Methylsulfinylmethyl sulfoxides can also be prepared by the oxidation of the corresponding α-methylthiomethyl sulfoxides.[6] Oxidation, with hydrogen peroxide in acetic acid, of (+)-(R)-α-methylthiomethyl p-tolyl sulfoxide(V), mp 44°C, $[\alpha]_D^{19}$+190.2° (acetone)(lit;[7] mp 42-44°C, $[\alpha]_D$+193.3°(benzene)), prepared by the reaction of (+)-(R)-α-bromomethyl p-tolyl sulfoxide(IV)[8], mp 89°C, $[\alpha]_D^{19}$+175.0°(acetone)(lit;[7] mp 88-89°C, $[\alpha]_D$+176.7°(benzene)), and sodium methyl sulfide yielded dextrorotatory α-methylsulfinylmethyl p-tolyl sulfoxide(IIIa), $[\alpha]_D^{19}$+195.0° (c=0.325, l=1, acetone), meso : dl = 55% : 45%.[9]

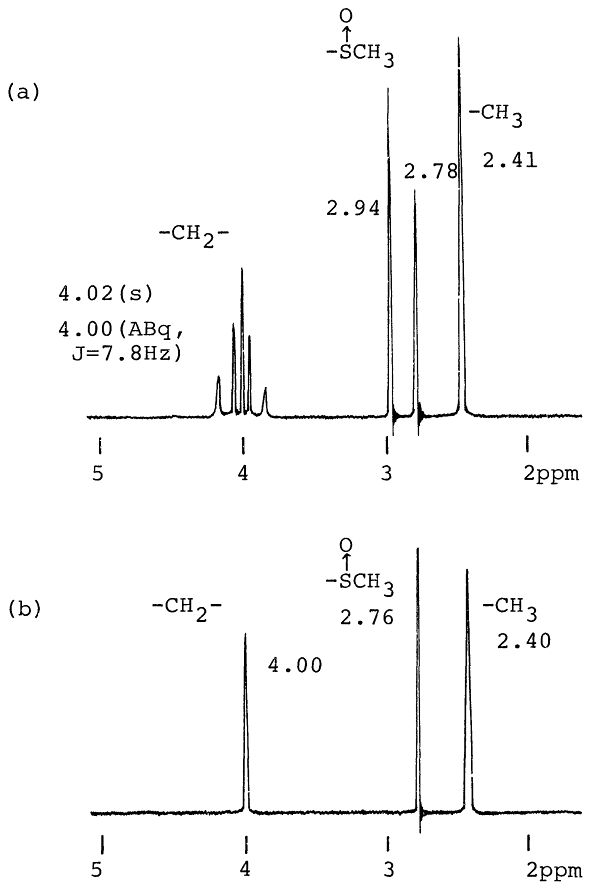


Fig. 1. NMR spectra(100MHz) of methyl and methylene protons of (+) $p\text{-}CH_3C_6H_4\text{-}SO\text{-}CH_2\text{-}SO\text{-}CH_3$ in $CDCl_3$:

(a) Mixture of meso and dl forms (59.3% : 40.7%)(IIa), $[\alpha]_D^{20}$+223.2°(acetone).

(b) dl Form(IIb), $[\alpha]_D^{19}$+345.8°(acetone).

This oxidation is considered to take place with retention of configuration at the sulfur atom of (R)-(V), and from (IIIa) dl diastereomer (+)-(S)-methylsulfinyl-(R)-methyl p-tolyl sulfoxide(IIIb), $[\alpha]_D^{19}$+305.5°(c=0.250, l=1, acetone), was isolated by recrystallization from benzene.

These observations suggest that (IIb) and (IIc) have RS and RR configurations, respectively, and the initial nucleophilic substitution of methylsulfinylcarbanion at the sulfur atom of sulfinic esters in the reaction proceeds through an $S_N2$ process with complete inversion of configuration at the sulfur atom.

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5) From the ratio of the diastereomers and their rotations the specific rotation of the diastereomerically pure meso form is readily calculated: The meso form has $[\alpha]_D$+152°(acetone).

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8) (IV) was prepared by the bromination, using $Br_2$-NBS, of (+)-(R)-methyl p-tolyl sulfoxide, $[\alpha]_D^{19}$+146°(acetone), by the published method.[7,10] Optical purity of (IV) calculated on the basis of the data reported by Montanari et al.[11] is about 90%.

9) The ratio, meso/dl, is much the same as that reported by Tsuchihashi et al.[6a]

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