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REACTION OF DIMETHYL SULFOXIDE WITH SOME ORGANIC COMPOUNDS IN THE PRESENCE OF PHOSPHORUS PENTOXIDE

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There have been several reports on the reaction of dimethyl sulfoxide (DMSO), in which $-SCH_3$ (1), $-CH_2SCH_3$ (2,3,5, 6), or $-CH_2-$ (1,3,4) group in the DMSO molecule is introduced into the reactant. The reaction of sulfoxides with acid anhydride (Pummerer reaction (7)) has also been developed: Oae, et al. (8) obtained α-acetoxymethyl methyl sulfide in the reaction of acetylphenyl phosphate with DMSO, Morihara (9) isolated α-acetoxy methionine hydantoin sulfide in the reaction of methionine hydantoin sulfoxide with acetic anhydride, and Parham, et al. (10, 11) and Schroeder, et al. (12) studied the reaction of cyclic sulfoxides.

In the course of our recent works on the syntheses of nucleosides and polysaccharides in the presence of phosphorus pentoxide (P_4O_{10}) as dehydrating agent (13) and on the oxidation of carbohydrates with the DMSO-P_4O_{10} reagent (14), we have observed that some organic acids and heterocyclic compounds react with DMSO in the presence of P_4O_{10} to give α-substituted dimethyl sulfides and related substances. We wish to report some results of the reactions.

A mixture of p-nitro benzoic acid (6 mmole) and DMSO (50 ml.) was heated at 65-70° for 1 hr. in the presence of P_4O_{10} (3 mmole). The product obtained by extracting the reaction mixture with chloroform followed by concentration was dissolved in hot aqueous ethanol. After allowing the solution to stand in a refrigerator, α-(p-nitro benzoyloxy)methyl methyl sulfide* crystallized; yield 51%, m.p. 54-55°; ν_{max}^{Nujol} 1715 (C=O), 1270 (C-O) $cm.^{-1}$; n.m.r.** δ 8.27 (aromatic H, 4 H), 5.46 (CH_2-S, 2 H), and 2.33 (CH_3-S, 3 H). Oxidation of the sulfide with hydrogen peroxide in acetic acid gave α-(p-nitro benzoyloxy)-methyl methyl sulfone; m.p. 142-143°; ν_{max}^{Nujol} 1320 and 1150 (S=O), 1720 (C=O), and 1260 (C-O) $cm.^{-1}$.

The reaction of benzoic acid with DMSO produced an oily product in 60% yield, which was converted with hydrogen peroxide into α-benzoyloxymethyl methyl sulfone; m.p. 106-107° (lit. (5) m.p. 105-106°); ν_{max}^{Nujol} 1320 and 1150 (S=O), 1730 (C=O), and 1265 (C-O) $cm.^{-1}$; n.m.r. δ 7.3-8.3 (aromatic H, 5 H), 5.32 (CH_2-S, 2 H), and 3.05 (CH_3-S, 3 H).

α-Stearoyloxymethyl methyl sulfide was similarly obtained in the reaction of stearic acid with DMSO in 40% yield; m.p. 42-44°; ν_{max}^{Nujol} 1740 (C=O) and 1150 (C-O) $cm.^{-1}$; n.m.r. δ 5.17

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* Satisfactory elemental analyses were obtained for all compounds described in the text.

** N.m.r. spectra were measured at 60 Mc. in $CDCl_3$, and chemical shifts were expressed as p.p.m. downfield from tetramethylsilane as internal standard.

(CH_2-S, 2 H), 2.37 (α-CH_2, 2 H), 2.26 (CH_3-S, 3 H), 1.28 (CH_2-C, 30 H), and 0.89 (CH_3-C, 3 H): sulfone; m.p. 68-70°; ν_{max}^{Nujol} 1325 and 1160 (S=O) $cm.^{-1}$; n.m.r. δ 5.08 (CH_2-S, 2 H), 2.95 (CH_3-S, 3 H), 2.37 (α-CH_2, 2 H), 1.28 (CH_2-C, 30 H), and 0.89 (CH_3-S, 3 H).

These results show that the reaction of carboxylic acids with DMSO in the presence of P_4O_{10} produce α-acyloxymethyl methyl sulfides.

The reaction of 1,3-dimethylxanthine (5 mmole) with DMSO at 70-75° with stirring for 15 hr. in the presence of P_4O_{10} (3 mmole) gave α-[7-(1,3-dimethylxanthinyl)]methyl methyl sulfide in 62% yield; m.p. 130-131°; λ_{max}^{EtOH} 277 mμ, λ_{min}^{EtOH} 245 mμ; ν_{max}^{KBr} 1700, 1660, 1550, 1370, 1220, 875, and 750 $cm.^{-1}$, no NH absorption; n.m.r. δ 3.40 and 3.60 (CH_3-N, 6 H), 7.80 (C_8-H, 1 H), 5.40 (CH_2-S, 2 H), and 2.20 (CH_3-S, 3 H). The corresponding sulfone was obtained according to the method as described above; m.p. 243°; ν_{max}^{Nujol} 1320 and 1165 (S=O) $cm.^{-1}$.

The reaction of p-nitro phenol with DMSO.under the same conditions as mentioned above produced a sulfur-containing compound; m.p. 136-137°; ν_{max}^{Nujol} 1510 and 1340 (NO_2), 865 (w), 830 (m), 820 (m), 780 (w), and 750 (m) $cm.^{-1}$, no OH absorption; n.m.r. δ 7.98-8.17 (aromatic H, multiplet, 2 H), 6.97 (aromatic H, doublet, 1 H), 5.35 (O-CH_2-S, singlet, 2 H), 3.95 (S-CH_2-C=, singlet, 2 H). Anal. Calcd. for $C_8H_7NO_3S$: C, 48.74; H, 3.58; N, 7.11; S, 16.26%. Found: C, 48.69; H, 3.73; N, 7.14; S, 17.67%. This compound was treated with hydrogen peroxide in acetic acid at 70° for 3 hr.- The sulfone derivative obtained showed following physical constants; m.p. 154-155°; ν_{max}^{Nujol}

1620, 1580, 1530, 1490, 1350, 1330, 1160, 1130, 880, 840, 820, and 750 cm^{-1}. The chemical structure of the former was tentatively determined as 6-nitrobenzo-1,3-oxathien, mainly from the analysis of coupling constants of aromatic protons in the n.m.r. spectrum.

The application of these reactions to other types of compounds and the study of reaction mechanism, especially in connection with methylation (14), are in progress, and the details will be reported elsewhere.

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