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HETEROCYCLES. II. NITRATION OF 3-ARYLSYDNONES

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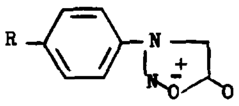
Reactions of sydnones with electrophilic reagents are among the most extensively studied reactions in the chemistry of mesoionic systems (1). That 3-alkyl and 3-aryl substituted sydnones undergo electrophilic substitution exclusively at the 4-position (1) supported the premise that the sydnone ring is a reactive aromatic system. For example, nitration of I, under a variety of conditions, led to formation of 4-nitro-3-phenylsydnone, II (2,3). Repeating Baker's work (2), we were unable, by TLC analysis, to find any phenyl nitrated material in the crude reaction product. The lack of activity shown by the benzene ring is in accord with its attachment to a nitrogen atom carrying a fractional positive charge (4). We now report the first examples of electrophilic substitution on the phenyl group of 3-arylsydnones (5).

When 3-p-tolylsydnone, III, was treated with nitric acid (concd. sulfuric acid at -20°) and the mixture worked up in typical fashion, compound IV, mp 119-119.5° (73%), was obtained. The structural assignment is based on elemental analyses and the following spectroscopic data (7): infrared bands at 3.26 (sydnone H), 5.69 (sydnone C=O) (8), 6.51, 7.33 μ (NO_2); ultraviolet maxima at 230, 240, 311 mμ (log ε 4.341, 4.264, 3.740) (9); PMR at δ 2.65 (s, 3, CH_3), 7.89 (s, 1, sydnone H) (11), 7.86 (d, 1, J=8 cps, C_5-H), 8.23 (q, 1, $J_{2,6}$=2 and $J_{5,6}$ =8cps, C_6-H), 8.59 (d, 1, J=2 cps, C_2-H).

Unambiguous confirmation of the structure was supplied by synthesis of IV from 4-methyl-3-nitroaniline (alkylation with chloroacetic acid, nitrosation, and dehydration) in the usual manner (1). The nitration and synthetic products were identical in all respects.

Similarly, 3-p-methoxyphenylsydnone, V, was nitrated to give 3-(4-methoxy-3-nitrophenyl)sydnone, VI, mp 155-156° (70%). The structure follows from the elemental analyses and the following spectroscopic data: infrared bands at 3.26 (sydnone H), 5.71 (sydnone C=O) (8), 6.28 (aromatic C=C), 6.51, 7.39 μ (NO_2); ultraviolet maxima at 251, 267, 315 mμ (log ε 4.068, 4.048, 3.935) (9); PMR at δ 4.14 (s, 3, CH_3), 7.68 (d, 1, J=9 cps), 7.79 (s, 1, sydnone H) (10), 8.25 (q, 0.8, $J_{2,6}$ =3 and $J_{5,6}$ =9 cps, C_5-H), 8.53 (d, 0.8, J=3 cps, C_2-H).

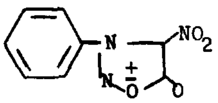
Preliminary experiments with 3-(4-chlorophenyl)-and 3-benzylsydnone gave no crystalline products, which might indicate sydnone ring nitration. These reactions are being studied in more detail.



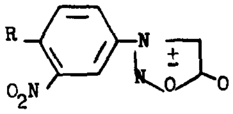
I R = H

III R = CH_3

V R = CH_3O



II



IV R = CH_3

VI R = CH_3O

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2. W. Baker, W. D. Ollis, and V. D. Poole, *J. Chem. Soc.*, 1542 (1950); M. Hashimoto and M. Ohta, *Nippon Kagaku Zasshi*, **78**, 181 (1957); Crane, *Org. Chem. Bull.*, **22**, (2), (1950). See also H. Kato and M. Ohta, *Bull. Chem. Soc. Japan*, **35**, 1418 (1962); F. H. C. Stewart, *Chem. Ind. (London)*, 1718 (1962).

3. In the analogous reaction V. G. Yashunskii, V. F. Vasil'eva, and Y. N. Sheinker (*J. Gen. Chem. USSR*, **29**, 2680 (1959), reported sulfonation of 3-phenyl-, 3-(m-chlorophenyl)-, 3-(p-ethoxyphenyl)-, and 3-(p-methoxyphenyl)-sydnones gave the corresponding 4-sulfonic acids.

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5. 3-(o-Tolyl)-4-nitrosydnone is cited in the literature in a biological screen of several sydnones (P. Oehme, E. Göres, K. Schwarz, G. Petsch, H. D. Faulhaber, and P. Lange), *Acta Biol. Med. Germany*, **14**, 369 (1965). The preparation of this compound, kindly supplied to us by Drs. Rückert and Keilert of the Research Division of VEB Berlin-Chemie, gave in our hands a nitro compound mp 152-153° (reported (6) 150-151°). We found this compound is not 3-(o-tolyl)-4-nitrosydnone, but rather 3-(2-methyl-5-nitrophenyl)sydnone on the following basis: infrared bands at 3.22 (sydnone H), 5.69 (sydnone C=O), 6.20 (C=C), 6.57, 7.39 μ (NO_2); PMR at δ 2.48 (s, 3, CH_3), 7.58 (s, 1, sydnone H), 7.88 (d, 1, $J_{3,4}$ = 8 cps), 8.50 (q, 1, $J_{3,4}$ = 8 cps, $J_{4,6}$ = 2.5 cps), 8.68 (d, 1, $J_{3,4}$ = 2.5 cps).

6. H. Rückert and M. Keilert, Private communication.

7. All melting points are uncorrected. Satisfactory analyses were obtained for all new compounds reported. Infrared spectra were determined as KBr pellets, ultraviolet spectra in 95% ethanol, and NMR spectra in DMSO-D_6.

8. Sydnones have very strong carbonyl stretching band in the range 5.6-5.8 μ (1). This is shifted to smaller wave numbers when electron withdrawing groups are substituted in the C_4-position. For example, II absorbs at 5.49 μ.

9. 3-arylsydnones generally absorb about 310 mμ (1).

10. The sydnone proton can be detected by its sensitivity to solvent changes (11). Addition of a few drops of D_2O was sufficient to shift the peak to 7.78 δ for IV and to 7.47 δ for XI. This sensitivity is more dramatically demonstrated by the induced solvent shifts of III and V. The sydnone proton of III shifts from 6.87 δ in $CDCl_3$ to 6.27 δ in C_6D_6 and to 7.72 δ in DMSO-D_6. VI likewise shifts from 6.82 δ in $CDCl_3$ to 6.25 δ in C_6D_6 and to 7.70 δ in DMSO-D_6.

11. K. D. Lawson, W. S. Brey, Jr. and L. B. Kier, *J. Am. Chem. Soc.*, **86**, 463 (1964).