Tetrahedron Letters No. 32, pp.3057-3060, 1971. Pergamon Press. Printed in Great Britain.

ALKYLATION OF 3-BENZYLSYDNONE

C. V. Greco and B. P. O'Reilly

Department of Chemistry, St. John's University
Jamaica, New York 11432

(Received in USA 1 June 1971; received in UK for publication 12 July 1971)

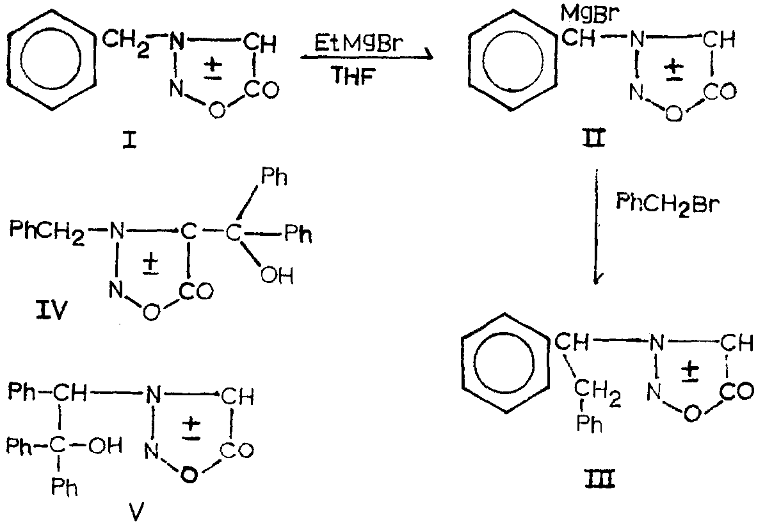
The mesoionic structure proposed for sydnone[1] and supported by molecular orbital calculations[2,3] would lead to the expectation of enhanced acidity by hydrogens contained in alkyl or aralkyl substituents attached to the annular nitrogen at position three carrying a fractional positive charge. Among the preparations and reactions of organometallic derivatives of sydnone, there has been no report[4] of involvement by such substituents. We now describe the first of such reactions of sydnone.

When 3-benzylsydnone (I)[5] (0.01 mole) in tetrahydrofuran at 3° with a three-fold molar excess of ethylmagnesium bromide for 4 hrs was subsequently treated with a four-fold molar excess of benzyl bromide for 18 hrs and the mixture worked up in the usual manner,[6] 1,2-diphenyl-1-sydnonylethane (III), mp 120-122° (benzene-hexane, 59.4% yield) was isolated. The structural assignment followed from elemental analysis[7] and spectral data:[8] infrared bands at 3.20 (sydnone H) and 5.73μ (sydnone C=O); ultraviolet maxima at 213 (logϵ 4.11) and 295 nm (3.90); nmr ($CDCl_3$) at δ 3.54 (d, 1, J = 8Hz, methylene), 3.60 (d, 1, J = 8 Hz, methylene), 5.58 (t, 1, J = 8 Hz, methine), 6.24 (s, 1, sydnone H)[9], 7.15 (s, 5, C_6H_5), 7.35 (s, 5, C_6H_5).

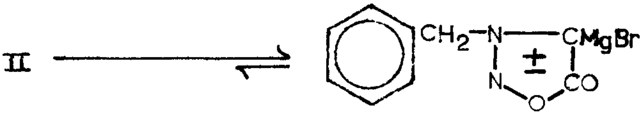
The structure of III was unambiguously confirmed by an alternate synthesis from 1,2-diphenylethylamine by alkylation with chloroacetic acid, then nitrosation and dehydration in acetic anhydride as usually described,[1] mp 120-122° (benzene-hexane, 50.3% yield based on precursor nitrosoacid). This product was identical to the alkylation product in both physical and spectroscopic properties.

Reaction of the new phenyl-(3-sydnonyl)methylmagnesium bromide (II) with benzophenone was subsequently examined. Following the usual procedure,[6] compound I after reaction with ethylmagnesium bromide was treated with benzophenone to afford two products, namely, diphenyl-4-(3-benzylsydnonyl)carbinol (IV), mp 172-174° (EtOH, 48% yield) and 1,1,2-triphenyl-2-(3-sydnonyl)ethanol (V), mp 180-182° (iso-PrOH-hexane, 6% yield). Both structures were supported by elemental analysis[7] and spectroscopic data:[8] for IV; ir 3.03 (sharp OH) and 5.89μ (sydnone C=O); uv maxima 213 (log ϵ 4.21) and 305 nm (3.95); nmr(Me$_2$SO-d$_6$) showed δ 7.28 (s, 10, two C$_6$H$_5$), 7.19 (s, 1, OH), 5.73 (s, 2, methylene)[9] and for V: ir 2.95 (sharp OH) and 5.75μ (sydnone C=O); uv maxima 215 (log ϵ 4.34) and 298 nm (3.98); nmr (Me$_2$SO-d$_6$) showed δ 7.63 (broad s, 5, C$_6$H$_5$), 7.30 (broad s, 10, C$_6$H$_5$), 7.12 (s, 1, OH) and 6.98 (s, 1, sydnone H).

Extension of these reactions to 3-methylsydnone in some preliminary studies indicated a lack of acidity by the methyl substituent. No reaction products were isolated using benzyl bromide and with benzophenone, only diphenyl-4-(3-methylsydnonyl)carbinol, mp 160-162° was isolated (MeOH,24% yield).



The results with benzylsydnone (I) probably can be explained if on reaction with ethylmagnesium bromide an equilibrium mixture of the Grignard II and 3-benzylsydnonylmagnesium bromide (VI) resulted. The ratio of the carbinol products on reaction with benzophenone indicates the 4-methine proton on the sydnone ring was more acidic than the benzylic protons, this contention being supported by the chemical shifts observed for these protons in the nmr spectra.[9] Hence, a higher equilibrium concentration of VI over V resulted in a higher yield of carbinol IV over carbinol V. However, the Grignard VI would then be less nucleophilic than II to the extent it was insufficiently basic to react with benzyl bromide. The small equilibrium concentration of II was gradually replenished by a shift in the equilibrium from VI to II, the latter Grignard possessing sufficient nucleophilicity to undergo alkylation by benzyl bromide.



VI

A related explanation[10] is that reaction with benzyl bromide is irreversible and the formation of III was kinetically controlled with the benzylic carbon more nucleophilic than the sydnone 4-methine carbon. The condensation with benzophenone, however, may be reversible and the product ratio thermodynamically controlled indicating the 4-position of the sydnone ring to be more acidic than the benzylic carbon.

Futher experiments designed to increase the acidity of the benzyl protons relative to the 4-methine proton may support these explanations.

REFERENCES

1. W. Baker and W. D. Ollis, Quart. Revs., 11, 15 (1957).
2. E. B. Roche and L. B. Kier, Tetrahedron, 24, 1673 (1968).
3. K. Sundaram and W. P. Purcell, Internat. J. Quantum Chem., 2, 145 (1968).
4. M. Ohta and H. Kato, "Nonbenzenoid Aromatics", J. P. Snyder, Ed., Vol 1, Academic Press, Inc., N. Y. 1969, pp 154-157.
5. W. Baker, W. D. Ollis and V. D. Poole, J. Chem. Soc., 307 (1949).
6. C. V. Greco and B. P. O'Reilly, J. Heterocycl. Chem., 7, 1433 (1970).
7. All new compounds gave satisfactory elemental analyses.
8. Infrared spectra were determined by the KBr pellet technique, ultraviolet spectra were run in methanol and the nmr spectra were obtained in the stated solvent on a Varian A60A using Me_4Si as an internal standard.
9. This proton was sensitive to solvent changes. Consult, K. D. Lawson, W. S. Bray and L. B. Kier, J. Amer. Chem. Soc., 86, 463 (1964). The 4-methine proton of I shifted from 7.16 δ in Me_2SO-d_6 to 6.25 δ in $CDCl_3$. The benzylic hydrogens in I were also solvent sensitive shifting from 5.67 δ in Me_2SO-d_6 to 5.35 in $CDCl_3$ while in IV the shift in the respective solvents was from 5.73 to 5.30 δ.
10. This explanation was suggested by one of the referees.