

NOVEL SYNTHESIS AND 1,3-DIPOLAR CYCLOADDITION REACTION OF
PYRIDINIUM N-METHYLIDE

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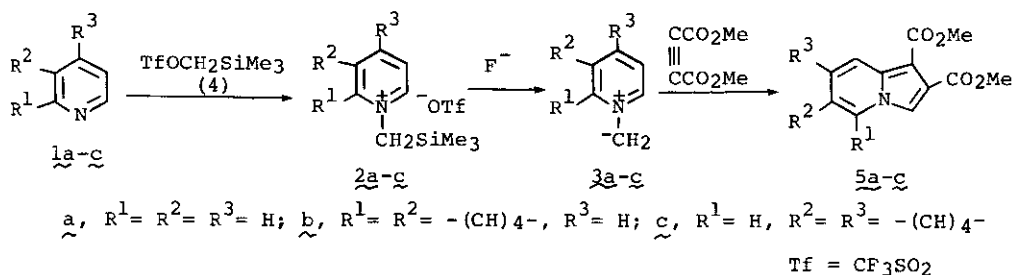
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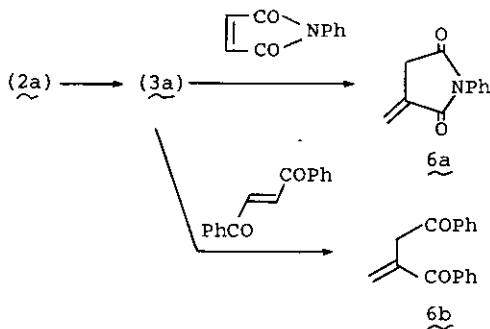
Abstract — Pyridinium N-methylide, generated *in situ* by treating N-(trimethylsilylmethyl)pyridinium triflate with fluoride ion, was found to react with dimethyl acetylenedicarboxylate to give dimethyl indolizine-1,2-dicarboxylate. Similarly, the N-methylides derived from quinoline and isoquinoline gave the corresponding indolizine derivatives. With N-phenylmaleimide and (E)-1,2-dibenzoylethylene, however, pyridinium N-methylide afforded N-phenylitaconimide and 2,3-dibenzoylpropene, respectively.

Although there are a number of reports on the syntheses and reactions of pyridinium N-acylmethylides,¹ little work has appeared on the chemistry of pyridinium N-methylide (3a) itself.^{2,3} The N-methylide (3a) has been prepared either by deprotonation of N-methylpyridinium salts^{2,3} or decarboxylation of pyridinium N-acetate.³ The most direct and versatile route to (3a), however, appears to be *via* desilylation of N-(trimethylsilylmethyl)pyridinium salt. In this communication we wish to report a new synthesis and 1,3-dipolar reactivity of (3a) and its benzologs. Reaction of pyridine (1a) with an equimolar quantity of trimethylsilylmethyl triflate (4)⁴ in 1,2-dimethoxyethane (DME) at room temperature for 2 h gave N-(trimethylsilylmethyl)pyridinium triflate (2a) which, without isolation,⁵ was treated with dimethyl acetylenedicarboxylate (DMAD) in the presence of cesium fluoride at 0°C for 3 h to give dimethyl indolizine-1,2-dicarboxylate (5a)⁷ in 31.2% yield. Alternatively, the solution of (2a) in DME was treated with a 1M solution of tetra-n-butylammonium fluoride (TBAF) in tetrahydrofuran (THF) at -70°C for 1.5 h to give the same indolizine (5a) in 37.7% yield.

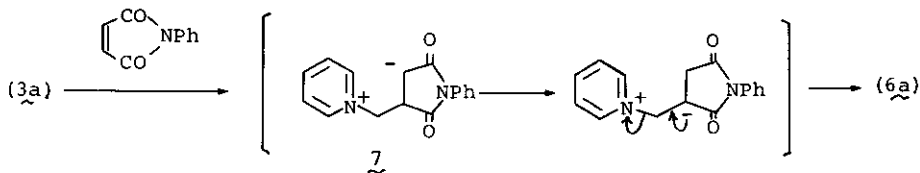
Similar reaction of quinoline (1b) and isoquinoline (1c) with (4) in DME followed by treatment of the resulting (2b,c)⁵ with DMAD in the presence of TBAF at 0°C for 3-4 h afforded dimethyl pyrrolo[1,2-a]quinoline-2,3-dicarboxylate (5b)⁷ and dimethyl pyrrolo[2,1-a]isoquinoline-1,2-dicarboxylate (5c) in 36.5 and 22.9% yields, respectively.



In contrast to the reaction of (2a) with DMAD, reaction of (2a) with N-phenylmaleimide in DME in the presence of TBAF at 0°C for 2 h gave N-phenylitaconimide (6a)^{6,7} in 11.7% yield instead of the expected tetrahydroindolizine derivative. Similarly the reaction of (2a) with (E)-1,2-dibenzoyl ethylene gave 2,3-dibenzoylpropene (6b)⁷ in 23.9% yield.



A possible mechanism for the formation of (6) would involve an initial Michael addition of (3a) to the olefin (e.g., N-phenylmaleimide) to form an intermediate (7) which undergoes 1,2-proton migration followed by elimination of pyridine leading to (6).



Further studies on the chemistry of these ylides are in progress.

REFERENCES AND NOTES

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4. E. Vedejs and G. R. Martinez, J. Am. Chem. Soc., 1979, 101, 6452; ibid., 1980, 102, 7993; Y. Terao, N. Imai, K. Achiwa, and M. Sekiya, Chem. Pharm. Bull., 1982, 30, 3167; A. Padwa, G. Haffmanns, and M. Tomas, Tetrahedron Letters, 1983, 4303.
5. The triflates (2a-c) could be isolated after reacting (1a-c) with (4) in dichloromethane at room temperature for 2 h: (2a) (91.9%), mp 108-109°C (from ethyl acetate); (2b) (99.1%), mp 95-96°C (from ethyl acetate); (2c) (92.2%), mp 84-85°C.
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7. (5a): mp 90-91°C (from methanol); IR (nujol) 1690 and 1735 cm^{-1} ; NMR (CDCl_3) δ 3.89 and 3.90 (6H, s, COOCH_3), 6.73 (1H, dt, H-6, $J = 7, 1.5$ Hz), 7.04 (1H, ddd, H-7, $J = 9.5, 7, 1$ Hz), 7.61 (1H, s, H-3), 7.92 (1H, dt, H-5, $J = 7, 1$ Hz), and 8.10 (1H, brd, H-8, $J = 9$ Hz).
 (5b): mp 132-134°C (from methanol); IR (nujol) 1690 and 1725 cm^{-1} ; NMR (CDCl_3) δ 3.93 (6H, s, COOCH_3), 7.33 (1H, d, H-5, $J = 10$ Hz), 7.44 (1H, dt, H-7, $J = 7.5, 1$ Hz), 7.60 (1H, ddd, H-8, $J = 8, 7.5, 1.5$ Hz), 7.71 (1H, dd, H-6, $J = 7.5, 1.5$ Hz), 7.91 (1H, br d, H-9, $J = 8$ Hz), 7.99 (1H, d, H-4, $J = 10$ Hz), and 8.24 (1H, s, H-1).
 (5c): mp 134-135°C (from methanol); IR (nujol) 1710 and 1730 cm^{-1} ; NMR (CDCl_3) δ 3.83 and 4.03 (6H, s, COOCH_3), 6.86 (1H, d, H-5, $J = 7.5$ Hz), 7.4-7.6 (3H, m, H-6, H-7, and H-8), 7.64 (1H, d, H-4, $J = 7.5$ Hz), 7.69 (1H, s, H-3), and 8.24 (1H, br d, H-9, $J = 7$ Hz).
- (6a): mp 116-117°C (lit.⁶ mp 108-110.5°C) (from n-hexane-benzene); IR (nujol) 1705 and 1770 cm^{-1} ; NMR (CDCl_3) δ 3.50 (2H, dd, CH_2CO , $J = 2.5, 2$ Hz), 5.74 (1H, d, $\text{H}_2\text{C}=\text{}$, $J = 2$ Hz), 6.46 (1H, d, $\text{H}_2\text{C}=\text{}$, $J = 2.5$ Hz), and 7.2-7.6 (5H, m, aromatics).
- (6b): mp 59-60°C (from n-hexane); IR (nujol) 1660 and 1680 cm^{-1} ; NMR (CDCl_3) δ 4.23 (2H, s, CH_2), 5.81, 5.95 (1H each, s, $\text{H}_2\text{C}=\text{}$), and 7.4-7.6, 7.8-8.1 (10H, m, aromatics).

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