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1,3-DIPOLAR CYCLOADDITION OF 5-METHOXY-1-METHYL-3-OXIDOPYRIDINIUM

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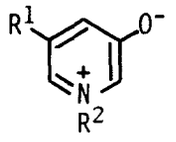
1,3-Dipolar cycloaddition of 1-methyl-3-oxidopyridinium 1a has been the subject of much synthetical interest[1]. However, the application is quite limited because of insufficient 1,3-dipolar reactivity of the betaine 1a; the reaction succeeds with olefinic dipolarophiles containing a strongly electron-withdrawing group, but fails with other olefins. In order to increase the reactivity of the betaine several attempts have been made, and replacement of the methyl group on the nitrogen of 1a by electron-withdrawing substituent as in the betaine 1b was reported to be effective[1]. We now report that the introduction of the methoxy group into the 5-position of 1a greatly enhances the 1,3-dipolar reactivity, giving widely the cycloadducts.



a, R^1=H, R^2=Me
b, R^1=H, R^2=5-nitro-2-pyridyl
c, R^1=OMe, R^2=Me

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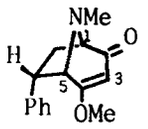
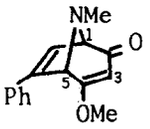
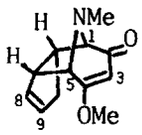
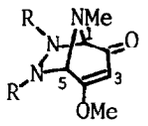
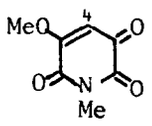
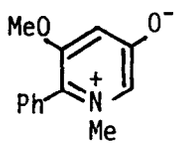
5-Methoxy-1-methyl-3-oxidopyridinium 1c[2] reacted with styrene, phenyl acetylene, cyclopentadiene, and diethyl azodicarboxylate to give the cycloadducts 2 (oil, picrate mp 165-166°), 3(oil, picrate mp 229-230°), 4(mp 72-73.5°), and 5 (oil, picrate mp 172-173°), respectively. Reaction conditions, yields, and spectral data for the adducts are given in Table. These structures were confirmed by ir and uv spectra, which show the characteristic bands due to the β-keto enol ether system, and nmr spectra. The betaine 1c also reacted with singlet oxygen to give the trione 6(mp 178-179°) as shown in Table. We believe from the following evidence given by the same photooxidation of the betaine 7 that the compound 6 was obtained through the 1,3-dipolar cycloadduct 8a. The betaine 7 with singlet oxygen gave the unstable cycloadduct 8b [δ 2.18 (s, NMe), 3.58(s, OMe), 5.13(d, H-1, J=1.5 Hz), 5.38(d, H-3, J=1.5 Hz), and 7.38(s, arom)], which was gradually converted to the dione 9(mp 184-185°) on standing in the air.

Table. 1,3-Dipolar cycloaddition of 1c

Dipolarophile \ Product	Structure	Reaction condition	Yield (%)	Spectral data	ir cm^{-1} uv nm (log ε) nmr δ (J=Hz)
$PhCH=CH_2$	 2	CH_3CN reflux 8 hr	94		ir 1655,1605 uv 203(3.97),250(4.01) nmr 2.38 (s,NMe),3.18(s,OMe),3.36(d, H-1,J=8),3.52(d,H-5,J=6),5.12(bs,H-3)
PhC≡CH	 3	PhMe reflux 5 hr	25		ir 1660,1600 uv 206(4.14),251(4.32) nmr 2.50(s,NMe),3.66(s,OMe),3.95(d, H-1,J=3),4.32(bs,H-5),4.76(bs,H-3)
	 4	CH_3CN r.t. 72 hr	54		ir 1645,1605 uv 251(3.94) nmr 2.44 (s,NMe),3.46(d,H-1,J=8),3.60(s,OMe), 3.64(d,H-5,J=7),5.18(s,H-3),5.45(dq, H-8,J=6,2)5.63(dq,H-9,J=6,2)
$R-N=N-R$ ($R=CO_2Et$)	 5	THF r.t. 10 min	71		ir 1725,1680,1615 uv 238(3.79) nmr 2.35(s,NMe),3.75(s,OMe),4.90(bs,H-1), 5.10(bs,H-5),5.40(bs,H-3)
$^1O_2$	 6	EtOH hν/dye, r.t. 3 hr	49		ir 1685,1620 uv 256(3.09) nmr 3.40 (NMe),4.00(OMe),6.25(H-4)



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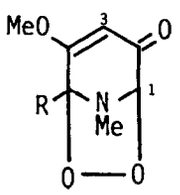
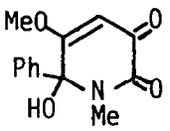


8a, R=H
8b, R=Ph



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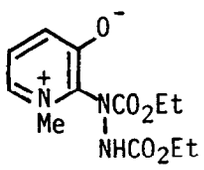

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It is noteworthy that the attitude of the betain 1c to the reaction with dipolarophiles is in marked contrast to that of the betaine 1a, which gives the betaine 10 with diethyl azodicarboxylate[3], 3-hydroxy-1-methyl-2-pyridone with singlet oxygen[4], and no cycloadducts with other dipolarophiles mentioned above. Further, the cycloadducts 2, 3, and 4 are expected to become useful intermediates for phenyl tropone and azulenic compounds[1,2].

References and Note

1 A.R. Katritzky and Y. Takeuchi, *J. Am. Chem. Soc.*, 92, 4134 (1970); N. Dennis, A.R. Katritzky, and Y. Takeuchi, *Angew. Chem. Int. Ed. Engl.*, 15, 1 (1976).

2 Y. Tamura, T. Saito, H. Kiyokawa, L.-C. Chen, and H. Ishibashi, *Tetrahedron Letters*, 1977, 4075.

3 Unpublished result

4 H. Takeshita, A. Mori, and S. Ohta, *Bull. Chem. Soc. Japan*, 47, 2437 (1974).