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YLIDE-INDUCED YLIDE FORMATION: A NOVEL DOUBLE CYCLOADDITION REACTION OF A [1,2,4]TRIAZOLO[1,5-a]PYRIMIDINIUM YLIDES

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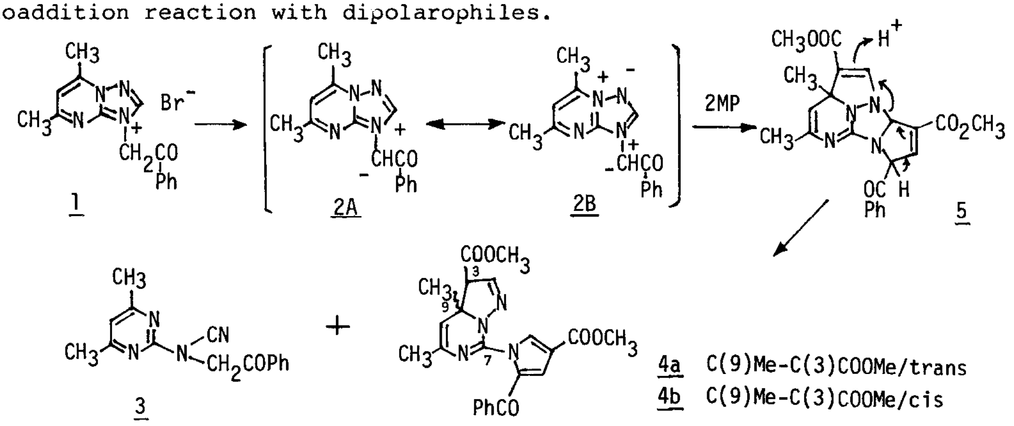
Abstract: Treatment of 5,7-dimethyl-3-phenacyl[1,2,4]triazolo[1,5-a]pyrimidinium ylide (2) with methyl propiolate leads to a novel double cycloaddition and resulted in the formation of 3,9-dihydropyrazolo[1,5-c]pyrimidine derivative (4).

We recently reported the generation of 5,7-dimethyl-3-phenacyl[1,2,4]triazolo[1,5-a]pyrimidinium ylides and their thermal reactions[1] as a part of a systematic investigation of [1,2,4]triazolo[1,5-a]pyrimidinium ylides. We now report the double 1,3-dipolar cycloaddition reaction of the ylides with methyl propiolate (MP). This reaction is the first example of the double 1,3-dipolar cycloaddition reaction with dipolarophiles.



Iminium salt (1)[1] was treated with triethylamine in the presence of MP in dry acetonitrile at 0°C for 1.5 h. We isolated two products; pyrimidine derivative (3) (18,5 %) and pyrazolo[1,5-c]pyrimidine (4) (26.6 %).

The product 3 was identical with authentic sample.[1] The new product 4 was 1:2 adduct of the ylide 2 and MP from mass spectrum. No 1:1 adduct was obtained from the reaction. ^{1}H-NMR spectrum of 4 showed a mixture of the two diastereoisomers (4a,b) in the ratio of 5:4. The major isomer (4a) was separated by fractional recrystallization from ether as colorless needles (mp 150-152°C). The ^{13}C-NMR of 4a showed a singlet for C(9) and a quartet for C(9)-Me at δ 63.8 and 22.2, respectively. The ^{1}H-NMR of 4a[2] indicated the existence of allylic protons [δ 5.13 (1H, q, J=1.4 Hz), 6.56 (1H, d, J=1.4 Hz)] and a shielded methyl group [δ 1.37 (s, 3H)]. Moreover, when the C(9)-Me (δ 1.37) was irradiated, 20 % of nuclear Overhauser effect (NOE) was observed at C(3)-H (δ 3.65). These results are in good accordance with the structure of 4a, and the structure was further confirmed by X-ray analysis.[3]

The plausible formation mechanism of 4 involves the addition of the ylide (2B), which is one of resonance structures of azomethine ylide (2A), with 2 eq. of MP to give tetracyclic compound (5). The intermediate (5) readily affords ring-opened product (4). This novel reaction provides a new synthetic route to 3,9-dihydropyrazolo[1,5-c]pyrimidine derivatives.

Cycloaddition reaction of [1,2,4]triazolo[1,5-a]pyrimidine itself did not proceed, indicating no ylidic nature of the triazolopyrimidine ring. However, the ylidic nature was induced by construction of the exo-ylide (2A). We would like to name such ylide (2B) the "ylide-induced ylide" and further investigation in this area is under way.

References and Notes

[1] M. Hori, K. Tanaka, T. Kataoka, H. Shimizu, E. Imai, K. Kimura, and Y. Hashimoto, Tetrahedron Lett., 1985, 26, 1320; J. Chem. Soc. Perkin Trans 1, in the press.

[2] ^{1}H-NMR data of 4a ($CDCl_3$, 400 MHz). δ 7.98 (1H, d, J=1.9 Hz), 7.89-7.45 (m, 5H), 7.12 (1H, d, J=1.9 Hz), 6.56 (1H, d, J=1.4 Hz), 5.13 (1H, q, J=1.4 Hz), 3.82 (s, 3H), 3.72 (s, 3H), 3.65 (1H, d, J=1.4 Hz), 1.96 (3H, d, J=1.4 Hz), 1.37 (s, 3H).

[3] The details of the X-ray structure analysis will be published in a full paper.

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