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A NEW CARBON-CARBON BOND FORMATION AT THE β-POSITION OF 3,4-DIMETHOXY-*E*-β-NITROSTYRENE

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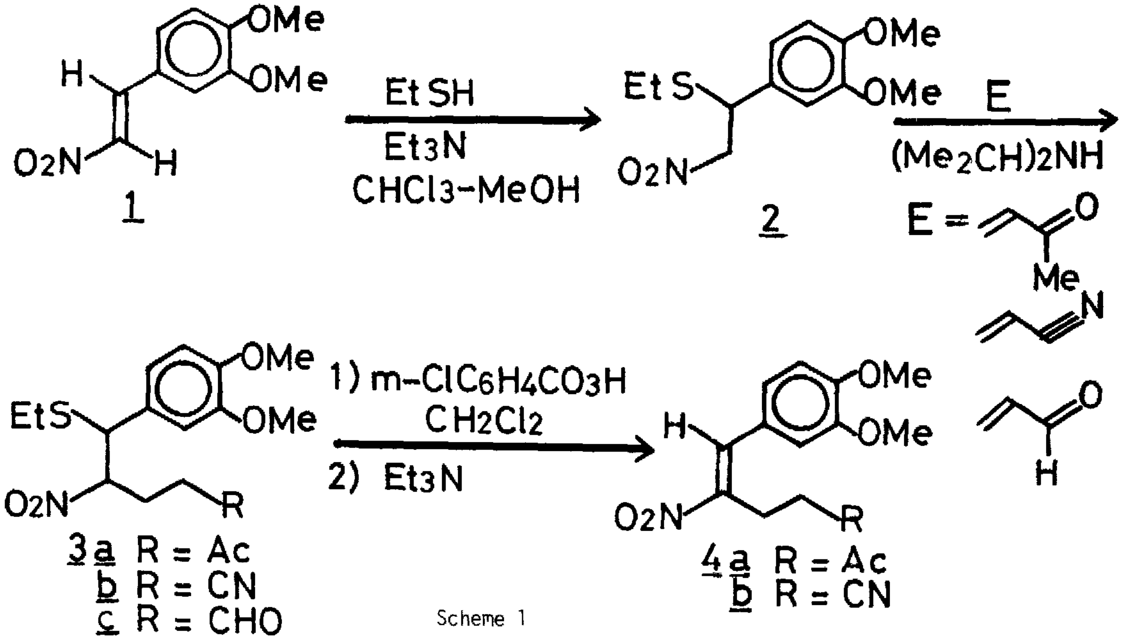
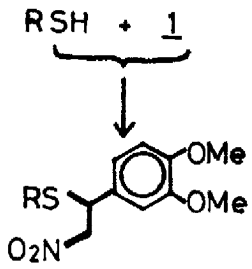
Recently, we published the chemical conversions of thioether 2 into ethers.[1] Now, we succeeded in a selective synthesis of a sole geometric *E*-isomer 4 of 3,4-dimethoxy-β-substituted -β-nitrostyrene starting from 3,4-dimethoxy-*E*-β-nitrostyrene 1 *via* a Michael-type reaction with compound 2 and subsequent stereoselective elimination. (See Scheme 1.)



Scheme 1

It has been well known that the α,β-unsaturated nitro compounds are the excellent Michael acceptors[2,3,4] and, on the other hand, the nitroalkanes are the excellent Michael donors.[2] In order to modify to the Michael donor tentatively, the original Michael acceptor 1 was transformed into the ethylthio ether 2. Thus, the compound 1 was allowed to react with ethane thiol under the presence of triethylamine as catalyst in chloroform-methanol (4:1) at room temperature to give the adduct 2 in quantitative yield[5] The reaction also took place similarly, when several thiols were used instead of ethane thiol, and the yield of the product was quantitative in every case These reactions are summarized in Table 1

Table 1 Addition of thiols to compound 1



R	Reaction time (hr)	Product m p (°C)
Me	2	57
Et	2	71-72
Pr	2	oil
Bu	2	oil
sec Bu	2	oil
tert Bu	16	65-66
Ph	1	71-73

Ethylthio ether 2 was adopted as the most desirable Michael donor, because it was crystalline and convenient for handling and elimination of the ethylthio group was relatively hard The addition of 2 to methyl vinyl ketone, acrylonitril and acrolein took place under diisopropyl amine catalysis[3] and gave the 70∿80% yield of the adducts, 3a, 3b, and 3c, as the mixture of *dl*-threo and *dl*-erythro isomers, respectively. The products, 3a, and 3c, were obtained as crystals, and recrystallization resulted in isolation of one *dl*-diastereomer These Michael additions are summarized in Table 2

Table 2 Michael Type Reactions of 2 with Acceptors

Michael Acceptor (Mol equiv)	Reaction Time (hr)	Reaction Temperature (°C)	Product m.p [a]	Yield (%)	Ratio[b] of diastereomers
CH_2=CHCOMe[c] (excess)	13	25	3a (98)	70	2 1
CH_2=CHCN[c] (excess)	2	0	3b (oil)	80	1 1
CH_2=CHCHO[d] (1 5)	2	0	3c (126-128)	75	3 5 1
	6	25	3c	83	3 1

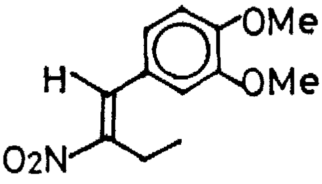
[a] M p of the major *dl*-diastereomer

[b] Checked by the NMR spectrum

[c] Without other solvent

[d] Chloroform was used as the solvent

The thioether 3a (a mixture of *dl*-diastereomers) was treated with *m*-chloroperbenzoic acid in dichloromethane under ice-cooling and subsequently with triethylamine to afford a sole geometric isomer 4a (m.p. 78-79°) in 82% yield *via* sulfoxide (not separated). A similar treatment of 3b (a mixture of *dl*-diastereomers) also gave only 4b (m.p. 92-93°) in 86% yield selectively. Aldehyde 3c, however, on similar treatment or several other trials for preparing the desired olefin did not give the satisfactory result. On the other hand, the compounds 2 and 6 which was derived from olefin 5[6] (m.p. 80-81°) and was shown to be a mixture of the *dl*-diastereomers in a ratio of 1.3 to 1 on treatment with *m*-chloroperbenzoic acid and triethylamine as described above gave the sole product 1 and 5 in 99% and 92% yields *via* a stereoselective elimination, respectively.



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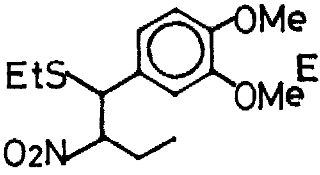

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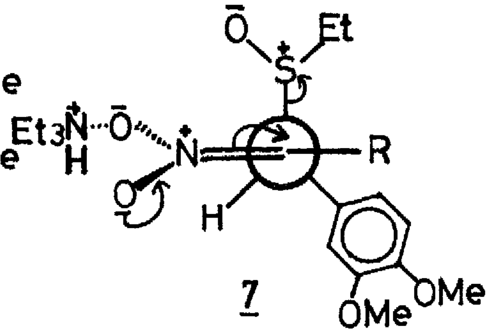

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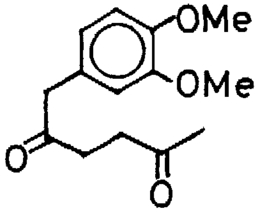
The *E*-geometry for 1, 4a, 4b, and 5 was assigned on the basis of their NMR spectral data. Previously, Yamamura *et al.*[7] reported that the α-vinyl proton in the β-substituted β-nitrostyrenes was less shielded in the *cis* than in the *trans* geometry with respect to the nitro group, regardless of the other β-substituent, and pointed out that the vinyl proton of *trans*-β-nitrostyrene systems may experience a large paramagnetic anisotropy effect from the nitro group in the *cis* position. According to their observations, the chemical shifts of the α-vinyl protons of β-substituted *E*-β-nitrostyrenes range between δ 8.02 and δ 8.36, while those of *Z*-isomers range between δ 6.13 and δ ca. 7.56. Now, the α-vinyl proton of 1, 4a, 4b, and 5 was observed at δ 7.93 (the lower field proton of the AB type), 8.03, 8.24, and 7.97, respectively, in their NMR spectra. Thus, the selective formation of the *E*-geometric isomer in these cases suggests that the eliminations proceed through a common transition state 7.

Finally, the nitro olefin system in 4a was transformed into a ketone on its treatment with zinc dust in acetic acid, resulting in the formation of a 1,4-diketone 8 in 50% yield



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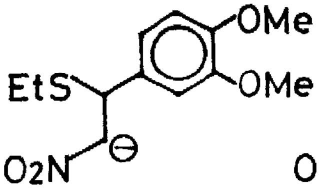

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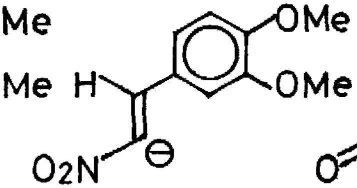

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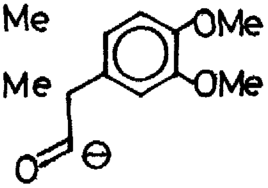

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As the result, we demonstrate that the anion 9 can be regarded as a synthon which is synthetically equivalent to the hypothetical anions 10 and 11

References

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[2] H H Baer and L Urbas, "*The Chemistry of the nitro and nitroso group.* Part 2" (Edited by H Feuer), pp 130∿148, Interscience Publishers (1970), and references cited therein

[3] J E McMurry and J Melton, *J Amer Chem Soc* , 93, 5309 (1971)

[4] S B Bowlus, *Tetrahedron Lett* , 3591 (1975)

[5] Satisfactory elemental analytical, mass spectral, and proton NMR data have been obtained for all new compounds

[6] Compound 5 was synthesized by heating veratral aldehyde with 1-nitropropane under catalysis with n-butylamine in toluene *Cf* R V Heinzelman, *Org Synth* , Coll Vol 4, 573 (1963).

[7] K Yamamura, S Watarai, and T Kinugasa, *Tetrahedron Lett* , 2829 (1972)