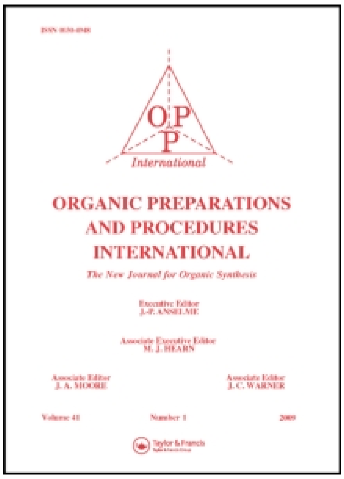


Organic Preparations and Procedures International
Publication details, including instructions for authors and subscription information:
http://www.informaworld.com/smpp/title~content=t902189982

THE REGIOSELECTIVE NITRATION OF α,β-UNSATURATED NITRILES WITH NITROGEN OXIDES

Arturo Navarro-Ocaña[a]; Eduardo Barzana[a]; Daniel López-González[b]; Manuel Jiménez-Estrada[b]
[a] Dept. Alimentos y Biotecnología, Facultad de Química, Universidad Nacional Autónoma de México, México, D.F. [b] Instituto de Química,

To cite this Article Navarro-Ocaña, Arturo , Barzana, Eduardo , López-González, Daniel and Jiménez-Estrada, Manuel(1999) 'THE REGIOSELECTIVE NITRATION OF α,β-UNSATURATED NITRILES WITH NITROGEN OXIDES', Organic Preparations and Procedures International, 31: 1, 117 — 119

To link to this Article: DOI: 10.1080/00304949909355681

URL: http://dx.doi.org/10.1080/00304949909355681

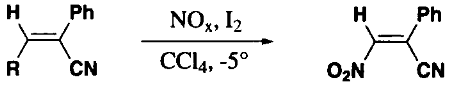
THE REGIOSELECTIVE NITRATION OF α,β-UNSATURATED NITRILES WITH NITROGEN OXIDES

Submitted by
(04/06/98)

Arturo Navarro-Ocaña*[†], Eduardo Barzana[†], Daniel López-González[††]
and Manuel Jiménez-Estrada[††]

† *Dept. Alimentos y Biotecnología, Facultad de Química*
Universidad Nacional Autónoma de México
Cd Universitaria, D. F. 04510, Coyoacán, MÉXICO, D.F.
†† *Instituto de Química*

The understanding of the chemistry of nitroalkenes has evolved rapidly since the 1980's based on their wide use for the synthesis of a variety of compounds; they are readily available, facilitate the formation of C-C bonds, and efficient methods are known for their transformation into other functional groups.[1] It is also well known that nitration of alkenes (and aromatic compounds) can be performed with nitrogen monoxide or nitrogen dioxide.[2] However, a mixture of NO/NO_2 (NOx) has not been investigated as a nitrating agent. This mixture would have the advantage of being easily generated[3] without the need for further purification or handling of costly cylinders which are subject to stringent import regulation in some countries. Herein we report an alternative and convenient procedure for the nitration at low temperatures of (Z)-3-R-alkyl-2-phenylpropenenitriles **1**.[4] When such compounds were treated with NOx in the presence of iodine,[5] the corresponding nitroalkenes were obtained; some of these nitro compounds are available by nitration with NO_2.[6] The NOx mixture was easily prepared by the procedure of Schmid (THF and HNO_3).[3] Substituted 3-nitropropenenitriles are the starting material for a new synthesis of 5-aminoisoxazoles,[7] which are interesting heterocyclic compounds with important biological properties.[8]



(Z)-**1** (Z)-**2**
R = Alkyl, aryl

When the 3-alkyl-2-phenylpropenenitrile **1a** was treated with NOx in the presence of iodine in carbon tetrachloride at -5°, the (Z)-3-nitro-2-phenylpropenenitrile **2a** was obtained in 90% yield. Application of this nitration procedure to other alkenenitriles **1b-h** resulted in the formation of the corresponding conjugated nitro olefins listed in Table 1.

The products were obtained exclusively with (Z)-geometry of double bond and no contamination with the corresponding (E)-isomers was detected. Yields were comparable to those reported for NO_2. In addition, for compounds **2e** and **2f** this is the first example of synthesis with nitrogen oxides and in particular with NOx.

In conclusion, the use of mixed oxides as a nitrating agent for the synthesis of conjugated nitroolefins from olefins is a comparable alternative to the existing procedures with the advantage of a facile implementation.

TABLE 1. Nitration of Alkenenitriles by Mixed Oxides of Nitrogen in the Presence of Iodine

Product[a]	R	mp. (°C)[b] [Lit. mp.]	Yield (%) [Lit.][6]
2a	Phenyl	95-96[95.5]	90[89]
2b	4-Chlorophenyl	116[116]	85[85]
2c	4-Methoxyphenyl	92[92]	90[90]
2d	4-Nitrophenyl	92[92]	75[70]
2e	2-Thienyl	90[c]	75
2f	Styryl	oil[d]	80
2g	H	72[72]	75[80]
2h	Methyl	115[115]	80[75]

a) Only the (Z) products were obtained, identified spectroscopically and mixture mps with known compounds. b) Uncorrected. c) Unstable solid; HRMS m/z (M + 1) 256.0296 (Calcd for $C_{13}H_8N_2O_2S$, 256.0306). d) Unstable oil; HRMS m/z (M + 1) 276.0891 (Calcd for $C_{17}H_{12}N_2O_2$, 276.0899).

TABLE. Spectral Data of Compounds **2**

Prod.	IR (cm^{-1})	EM m/z (Relative intensity)	^{1}H NMR (δ, ppm; *J*, Hz)
2a	3061, 2931, 2220, 1592, 1543, 1332	250 (M$^+$, 18), 204 (100), 203 (84), 176 (60);	7.40 (br, s 10H)
2b	3061, 2931, 2220, 1592, 1543, 1332	284 (M$^+$, 22), 254 (25), 238 (95), 203 (100), 77 (20)	7.34 (d, J = 8.9, 2H), 7.33 (m, 5H), 7.19 (d, J = 8.9, 2H)
2c	3119, 2862, 2223, 1603, 1540, 1352	280 (M$^+$, 50), 234 (100), 238 (95), 219 (40), 190 (62), 77 (17)	d 8.19 (d, J = 8.9, 2H), 7.45 (d, J = 8.9, 2H), 7.28 (m, 5H)
2d	2935, 2219, 1604, 1538, 1333, 1260	280 (M$^+$, 50), 234 (100), 238 (95), 219 (40), 190 (62), 77 (17)	7.31 (m, 5H), 7.14 (d, J = 9.0, 2H), 6.80 (d, J = 9.0, 2H), 3.79 (s, 3H)
2e	3040, 2932, 2255, 1602, 1545, 1331	256 (M$^+$, 50), 210 (100), 177 (35), 164 (55), 77 (37)	7.03 (t, J = 5.9, 3.8, 1H), 7.17 (dd, J = 3.8, 1.1, 1H), 7.50 (br, s, 5H), 7.63 (dd, *J* = 5.9, 1.1, 1H)
2f	3100, 2225, 1638, 1517, 1346, 1317	276 (M$^+$, 20), 230 (100), 203 (98), 101 (30), 77 (45)	7.45 (m, 8H) 7.56 (br, s, 1H), 7.68 (m, 2H), 8.35 (br, s, 1H)
2g	3030, 2925, 2239, 1529, 1448, 1348	174 (M$^+$, 30), 126 (100), 99 (65), 77 (50)	7.40 (br, s, 5H), 7.85 (s, 1H)
2h	2885, 2220, 1630, 1536, 1333	280 (M$^+$, 1), 115 (100), 140 (59), 103 (52)	7.51 (m, 5H), 2.41 (s, 3H)

Compounds **2e**, **2f** and **2g** were characterized by spectroscopic means (IR, mass and NMR).

EXPERIMENTAL SECTION

Melting points were determined using a Fisher-Johns apparatus and are uncorrected. Infrared spectra were measured with a Nicolet FT-IR 55X instrument. Proton NMR spectra were obtained on a Varian

VXR-300S, 200MHz spectrometer using TMS as an internal standard. Low-resolution mass spectra were recorded on a Hewlett-Packard 5985-B (70 ev) mass spectrometer.

Typical Procedure.- A stirred solution of 2.05 g. (10 mmol) of **1a** and 0.10g of iodine in 100 mL of carbon tetrachloride was cooled in an ice-bath (-5°). The mixed oxides (NOx)[3] gas was passed into the solution over 2 hours. After gas addition, stirring was continued for one hour in the cold at -5°. The reaction mixture was extracted with 10% sodium thiosulfate solution until disappearance of the iodine color, washed with a saturated sodium hydrogen carbonate solution and water, and dried over sodium sulfate. The residue obtained on evaporation of the organic solvent was recrystallized from ethanol to give 2.24 g (90%) of **2a**, mp. 95-96°. The progress of the reaction was monitored by TLC.

Acknowledgment.- We acknowledge partial financial support from CONACYT and DGAPA-UNAM No. IN214996. We also thank L. Velasco Ibarra and F. Javier Pérez Flores for technical support.

REFERENCES

1. For reviews on the preparation and use of nitroalkenes in organic synthesis, see: D. Seebach, E.W. Colvin and T. Weller, *Chimia*, **33**, 1, (1979); A. G. M. Barret and G. G. Graboski, *Chem. Rev.*, **86**, 751, (1986); K. Fuji and M. Node, *Synlett*, 603, (**1991**); A.G.M. Barret, *Chem. Soc. Rev.*, **20**, 95, (1991); R. Tamura, A. Kamimura and N. Ono, *Synthesis*, 423, (**1991**); R. A. Karakhanov, V. I. Kelarev and Y. N. Polivin, *Russ. Chem. Rev.*, **993**, 725, (1993); V. F. Rudchenko, *Chem. Rev.*, **62**, 169, (1993); K. Bott, *"Methoden der Organischen Chemie"*, Vol E15/1, pp 1129-1200, (Houben-Weyl)), Georg Thieme Verlag, Stuttgart, 1993.

2. E. S. Perekalin, E. S. Lipina. V. M. Berestovitskaya and D. A. Efremov, *"Nitroalkenes: Conjugated Nitro Compounds"*, Wiley, Chichester, UK. 1994.

   E. Hata, T. Yamada and T. Mukaiyama, *Bull. Chem. Soc. Jpn*, **68**, 3629, (1995) and references cited therein.

3. H. Schmid, A. Maschka and H. Frauenschill, *Monatsh. Chem.*, **80**, 671, (1949).

4. S. S. Kulp and C. B. Caldwell, *J. Org. Chem.*, **45**, 171, (1980).

5. V. Jäger and H. J. Günther, *Angew. Chem., Int. Ed. Engl.*, **16**, 246, (1977).

6. J. C. Doré and C. Viel, *Eur. J. Med. Chem.*, **9**, 673, (1974). C. Bellec, D. Bertin, R. Colau, S. Deswarte, P. Maitte and C. Viel, *J. Heterocyclic Chem.*, **16**, 1611, (1979).

7. A. Navarro-Ocaña, M. Jiménez-Estrada, M. B. Gonzólez-Paredes and E. Barzana, *Synlett*, 695, (**1996**).

8. J. Rouchaud, F. Gustin and C. Moulard, *Bull. Soc. Chim. Belg.*, **102**, 543, (1993).

****