Tetrahedron Letters, Vol.32, No.26, pp 3075-3078, 1991
Printed in Great Britain

0040-4039/91 $3.00 + .00
Pergamon Press plc

HYDROXYNITRILIUM IONS AS INTERMEDIATES IN THE REACTION OF NITRODERIVATIVES WITH AROMATICS

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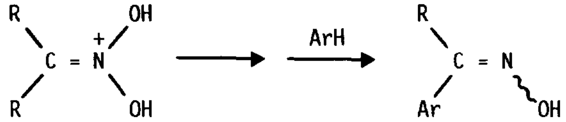
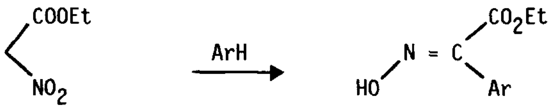
Key Words: Aromatics; Nitroderivatives; Oximes; Nitronic acid; Hydroxynitrilium ion.

Abstract - *In acids reaction of ethyl nitroacetate **1** and of α-nitroacetophenone **14** with aromatics yields E-oximes **2** and **15**, respectively, addition occurring on the corresponding hydroxynitrilium ion.*

It has been reported that α,ß-unsaturated nitroderivatives[1-4], nitronates of nitroalkanes[5,6], and α-carbonylnitromethanes[7] react with aromatics in acids to give arylated oximes, *via* the corresponding protonated nitronic acid :



We would like to report that reaction of ethyl nitroacetate **1** with aromatics yields specifically the E-oximes **2** by addition of the aromatic to an hydroxynitrilium ion.



1 **2**

Results obtained using trifluoromethanesulfonic acid (TSFA), sulfuric acid or hydrogen fluoride are reported in the table.

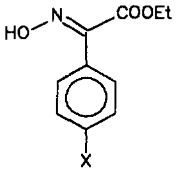
The best yields are observed using TSFA as the acid, reaction in HF giving, besides the oxime, furoxan **6**[8,9].

Stereochemistry of the oximes is based on ^1H[10] and on ^{13}C NMR spectra which have been compared with those of the Z-isomers prepared when the corresponding ketones Ar-CO-CO_2Et are reacting with NH_2OH-HCl. The main differences between the E and Z-isomers are observed in the chemical shifts of the methylene protons of the ester groups, and of the carbon atom of the oximino group and the next aromatic carbon atom.

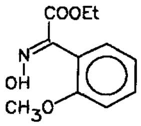
ArH	Acid	Acid/Ester 1[a]	Ester 1/ArH[a]	T°C	Reaction time (h)	Product[b] (%)
C_6H_6	TSFA	7.5	0.2	0 to +5	7	**3a**(70)
	H_2SO_4	20	0.25	+3°C	1.3	**3a**(60)
	HF	80	0.33	0 to +15	7	**3a**(52)
C_6H_5F	TSFA	7.5	0.33	-10 to +15	7	**3b**(75)
	HF	80	0.33	0 to +15	15	**3b**(21)+ **6**(38)
$C_6H_5\text{-}OCH_3$	TSFA	7.5	0.5	0 to +15	4	**3c**(30)+ **4**(58)
5-methoxy indane	TSFA	7.5	1	0 to +10	0.5	**5**(74)

a: Molar ratio; b :Yield based on ester **1**.

Both isomers are stable in the reaction conditions implying that the E-isomers are primary products.



3 a X=H
b X=F
c $X=OCH_3$



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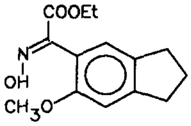

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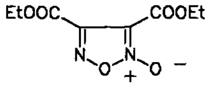

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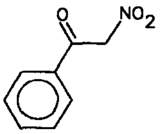

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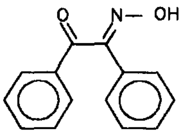

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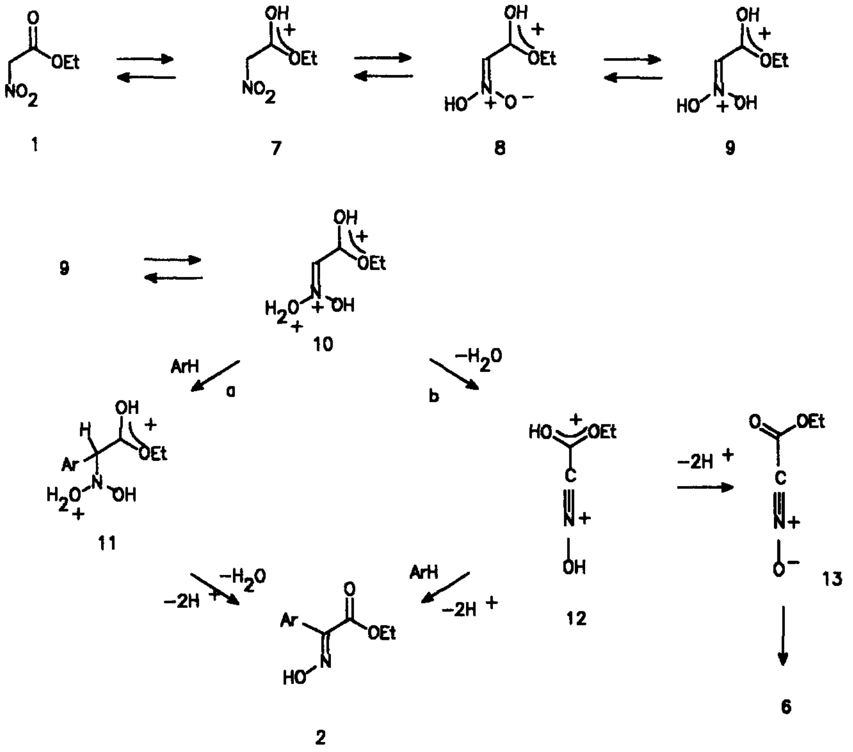
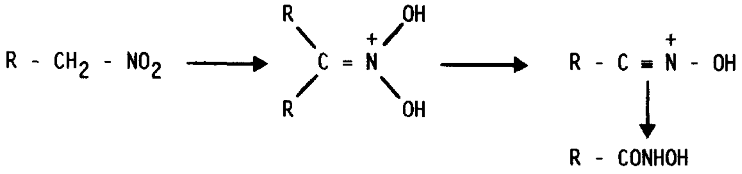
Reactivity of ester **1** with aromatics shows that the ester group favors enolization to the *aci*-nitro species, making unnecessary to use the corresponding nitronate as the starting material[5,6].

Diprotonated ion **9**, whose formation is outlined in the scheme, should not be reactive enough to add aromatics since trifluoroacetic which monoprotonates nitronic acids is unable to catalyze the reaction. This implies that a third protonation is necessary to activate the substrate. At this step is has been assumed[7] that the resulting ion **10** reacts with the aromatic to give the oxime **2**, through the intermediacy of ion **11** (route a).



*On the contrary we propose that the reaction proceeds via the hydroxynitrilium ion **12** (route b), this mechanism being supported by the following data:*

- in strong acid solution, in contrast to dilute acid used in the Nef reaction, nitroalkanes are converted to hydroxamic acids, *via* a protonated nitrile oxide[11].



$$R-CH_2-NO_2 \longrightarrow \underset{R}{\overset{R}{}}C=\overset{+}{N}\underset{OH}{\overset{OH}{}} \longrightarrow R-C\equiv\overset{+}{N}-OH \longrightarrow R-CONHOH$$

- in concentrated sulfuric acid at -5°C, nitroester **1** yields furoxan **6** after dimerization of nitrile oxide **13**[8]. In the same conditions in the presence of benzene, oxime **3a** is obtained in 60% yield (see Table).

When the reaction is carried out with HF, which is less acidic than H_2SO_4 and TSFA, deprotonation of ion **12** into neutral nitrile oxide **13** might account for the formation of furoxan **6**[8,9].

- finally nucleophilic addition to nitrilium ions has been shown to lead to a single isomer in which the entering nucleophile and the forming lone pair on nitrogen are trans, the reaction being kinetically controlled[12].

This is in agreement with our results, the alternative mechanism proposed by Shudo[7] not accounting for the specific formation of a single stereoisomer.

We observed a similar stereochemistry in the arylation of nitronates of nitroalkanes [6] and in oxime **15**, which is obtained when nitroacetophenone **14** is reacting with benzene in TSFA. The exclusive formation of one stereoisomeric oxime in which the aryl and OH groups are cis appears to be a general process, involving reaction of hydroxynitrilium ions with the aromatics.

REFERENCES

1. Ohwada, T.; Ohta, T.; Shudo, K. *Tetrahedron*, 1987, **43**, 279.
2. Ohwada, T.; Itai, A.; Shudo, K. *J. Am. Chem. Soc.* 1987, **109**, 7036.
3. Ohwada, T.; Ohta, T.; Shudo, K. *J. Am. Chem. Soc.* 1986, **108**, 3029.
4. Okabe, K.; Ohwada, T.; Ohta, T.; Shudo, K. *J. Org. Chem.* 1989, **54**, 733.
5. Berrier, C.; Brahmi, R.; Carreyre, H.; Coustard, J.M.; Jacquesy, J.C. *Tetrahedron Lett.* 1989, **30**, 5763.
6. Berrier, C.; Brahmi, R.; Carreyre, H.; Coustard, J.M.; Jacquesy, J.C.; Violeau B. *Bull. Soc. Chim. Fr.* submitted for publication.
7. Ohwada, T.; Yamagata, N.; Shudo, K. *J. Am. Chem. Soc.* 1991, **113**, 1364.
8. Vigalok, I.V.; Moisak, I.E.; Svetlakov, N.V. *Khim. Geterotsikl. Soedin.* 1969, **1**, 175; *Chem. Abstr.* 1969, **71**, 3330 j.
9. Hirai, K.; Matsuda, H.; Kishida, Y. *Chem. Pharm. Bull.* 1971, **20**, 97.
10. Armand, J.; Guetté, J.P. *Bull. Soc. Chim. Fr.* 1969, 2894.
11. a) - Noland, W.E.; Cooley, J.H.; McVeigh, P.A. *J. Am. Chem. Soc.* 1959, 81, 1209.)b Kornblum, N; Brown, R.A. *J. Am. Chem. Soc.* 1965, **87**, 1742.
12. a) - McCormack, M.T.; Hegarty, A.F. *J. Chem. Soc.*, Perkin II, 1976, **14**, 1701.
    b) - Hegarty, A.F. *Acc. Chem. Res.*, 1980, **13**, 448. c) - Nguyen, M-T., Hegarty, A.F. *J. Am. Chem. Soc.* 1983, **105**, 3811.

(Received in France 7 March 1991)