

NITRONES II. DUALISTIC BEHAVIOUR IN THE REACTION OF PHOSPHONATES WITH NITRONES. ALTERNATIVE FORMATION OF AZIRIDINES AND ENAMINES.

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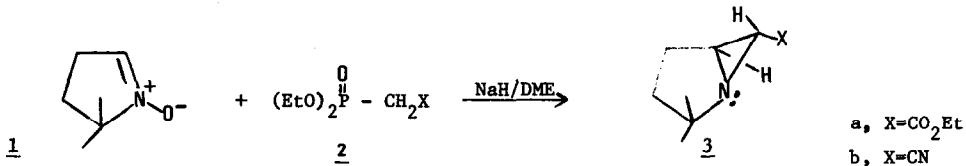
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Previously we have reported that the reaction of C-phenyl-N-methyl nitrone with sodium triethyl phosphonoacetate leads to the formation of two isomeric aziridines.¹

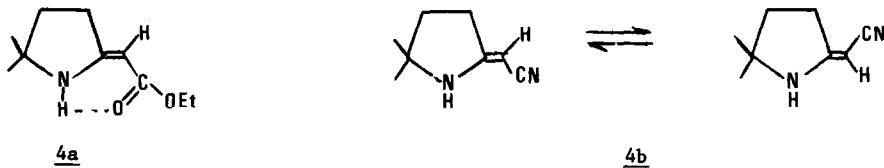
In this communication we wish to describe results obtained in our study of the reactions of 5,5-dimethyl- Δ^1 -pyrroline N-oxide (1) with two phosphonates: $(EtO)_2P(O)CH_2CO_2Et$ (2a) and $(EtO)_2P(O)CH_2CN$ (2b).

Reactions of nitrone **1** with the phosphono ylids generated from **2a** and **2b** with sodium hydride in 1,2-dimethoxyethane (DME) gave the *trans*-aziridines **3a** and **3b**.^{2,3}

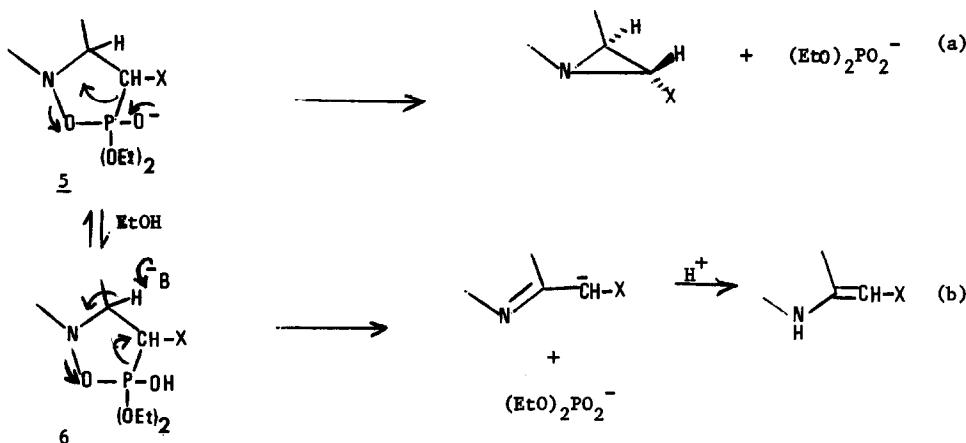


The structural assignment of products 3a and 3b is based on their pmr spectra. The angular hydrogens appear in 3a and 3b at δ 2.70 and 2.80 ppm as broad signals, whereas the hydrogens ~~of~~ to the functional groups X appear at higher field (being *trans* to the lone pair⁴) as sharp doublets, δ 2.11 and 1.94 ($J=2.5$ Hz in both compounds) for 3a and 3b respectively.⁵

In contrast reaction of 1 with the ylid generated from 2a by sodium ethoxide in ethanol gave a mixture of the enaminic ester 4a^{3,6} (32%) and the aziridine 3a (15%), whereas reaction of 1 with 2b in the same conditions gave enaminonitrile 4b^{3,7} as the sole product (55%).⁸



These results show that the reaction between nitrones and phosphonates may proceed by two pathways. Our results may be rationalized by assuming the initial formation of an oxazaphospholidine intermediate⁹ (5) which may decompose by two different mechanisms, as indicated by (a) and (b).



We have assumed previously¹ that the decomposition of 5 to aziridines is facilitated by the backdonation of electrons from the exocyclic, negatively charged oxygen to the phosphorus. Therefore, it seems reasonable that protonation of 5 (in EtOH) may inhibit its fragmentation according to equation (a). The protonated oxazaphospholidine (6) may undergo a different fragmentation indicated by equation (b) to yield the corresponding enamino derivatives. This mechanism is also in accordance with the greater selectivity observed in the formation of the enamine when X=CN. The cyano group, being a stronger electron withdrawing substituent than the carbethoxy group, can stabilize better the negative charge developing on the α -carbon, therefore making the P-C bond cleavage by mechanism (b) easier.

ACKNOWLEDGEMENT. This work was supported in part by a grant from the Joint Research Fund of the Hebrew University and Hadassah.

References and Footnotes

1. E. Breuer and I. Ronen-Braunstein, J.C.S. Chem. Comm., 949 (1974).
2. 3a: yield: 35%, b.p. 80°/0.2 mm, IR(neat): 1725 cm^{-1} ; NMR (CDCl_3) 60 MHz: δ 4.16 2H q ($J=7.25$ Hz), 2.70 1H m, 2.32-1.90 2H m, 2.11 1H d ($J=2.5$ Hz), 1.50-1.13 11 H m. 3b: yield 32%, m.p. 77-78°, IR(nujol): 2240 cm^{-1} , NMR (CDCl_3) 60 MHz: δ 2.80 1H m, 2.33-2.03 2H m, 1.94 1H d ($J=2.5$ Hz), 1.45-1.00 2H m, 1.26 3H s, 1.17 3H s.
3. Satisfactory analytical and mass spectral results were obtained for all new compounds described.
4. E. Breuer and D. Melumad, J.Org.Chem., 38, 1601 (1973).
5. This assignment was confirmed by synthesizing mono deutero 3b using $(EtO)_2P(O)CD_2CN$ with NaH in DME.
6. B.p. 80°/0.1 mm, UV (EtOH) 279 nm (18700), IR (neat): 3320, 1710, 1600 cm^{-1} , NMR (CDCl_3) 60 MHz: δ 7.70 1H b.s (NH), 4.36 1H b.s., 4.25 2H q ($J=6.75$ Hz), 2.62 2H t ($J=7.5$ Hz), 1.77 2H t ($J=7.5$ Hz), 1.25 3H t ($J=6.75$ Hz) 1.27 6H s.
7. M.p. 85-87°, UV (EtOH): 267 nm (23200), IR(nujol): 3230, 2180, 1600 cm^{-1} , NMR (CDCl_3) 60 MHz: δ 5.80 1H bs (NH), 3.85 and 3.55, total 1H b-singlets, 2.69 2H m, 1.82 2H t ($J=7.5$ Hz), 1.26 3H s 1.24 3H s.
8. In separate control experiments we have shown that: (a) nitrone 1 can be recovered unchanged from a solution of NaOEt in EtOH, (b) aziridine 3a can be recovered unchanged from a solution of NaOEt in EtOH, whereas aziridine 3b is converted partly to 3a but not to 4a or 4b by NaOEt in EtOH, (c) added enaminonitrile 4b can be recovered from reaction of 1 and 2b with NaH in DME.
9. R. Huisgen and J. Wulff, Chem.Ber., 102, 746 (1969).