

REDUCTION OF NITRO GROUPS BY YNAMINES; SYNTHESIS AND X-RAY CRYSTAL STRUCTURE
OF N,N-DIETHYL-3,3a-DIHYDRO-3-METHYLBENZOFURO[3,2-c]ISOXAZOLE-3-CARBOXAMIDE

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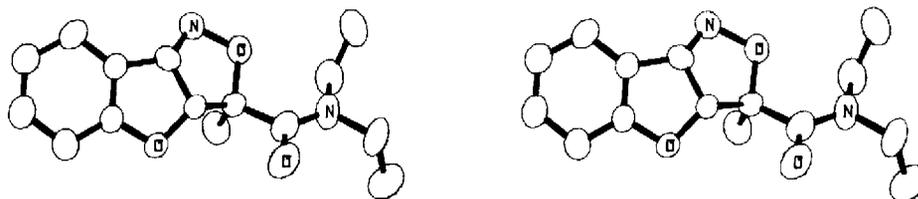
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Abstract: 3-Nitrobenzo[b]furan and 1-diethylaminopropyne react thermally at 5-10°C to give a 1:1 addition product (5) in which one of the oxygen atoms of the nitro group is transferred to C-1 of the acetylene. The structure of the benzofuro[3,2-c]isoxazole (5) has been determined by X-ray crystallography.

Nitroalkenes¹, 3-nitrobenzo[b]thiophen², and 4-nitroisothiazole² react with ynamines (1-aminoacetylenes) to give cyclobutene and nitrono derivatives. (2+2)-Cycloaddition of the electron-rich acetylenes with the electron-deficient nitro compounds gives the cyclobutenes, and (4+2)-cycloaddition followed by rearrangement of the resulting nitronic esters accounts for the formation of the nitrones. This rearrangement involves non-catalytic oxygen transfer from the nitro group to an acetylenic C-atom³.

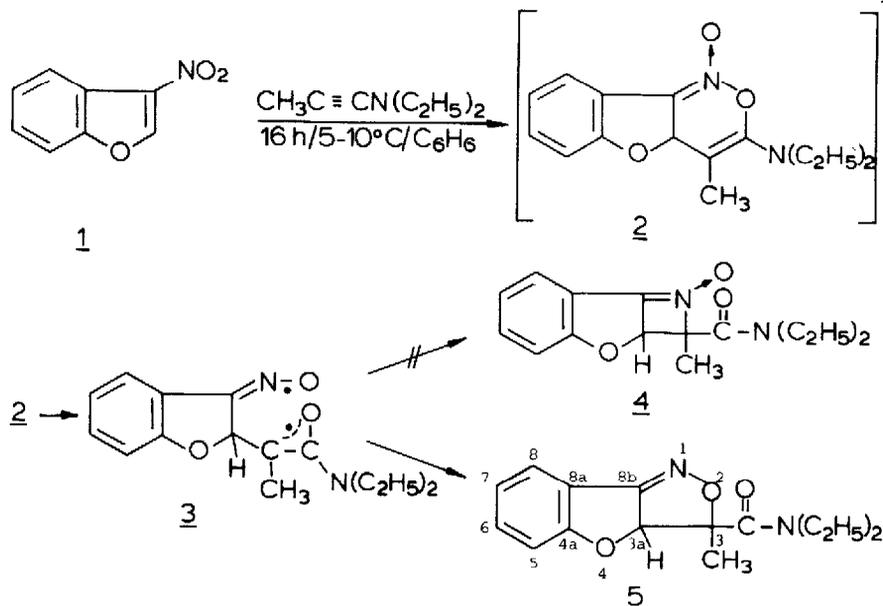
We now wish to report the reaction of an ynamine with 3-nitrobenzo[b]furan which gives a novel heterocycle by an alternative rearrangement pathway of the (4+2)-cycloadduct. 3-Nitrobenzo[b]furan and 1-diethylaminopropyne (1:1, benzene, 5-10°C, 16h) gave after chromatography (SiO₂, CHCl₃) a crystalline 1:1 reaction product in 41% yield, m.p. 118.5-119.5°C^{4,5}. MS: M⁺ 274.13 (C₁₅H₁₈N₂O₃). IR(KBr): 1645 cm⁻¹ (C=O) and 1610 cm⁻¹ (C=N). ¹H NMR δ(CDCl₃): 1.20 and 1.38 (t, 3H, CH₂CH₃), 1.52 (t, 3H, CH₃), 3.1-3.9 (m, 4H, CH₂-CH₃), 6.32 (s, 1H, H-3a), 6.9-7.8 (m, 4H, H_{arom}) ppm. ¹³C NMR δ(CDCl₃): 12.6, 14.7 and 16.6 (q, CH₃), 41.1 and 42.5 (t, CH₂), 94.6 (s, C-3), 96.6 (d, C-3a), 113.2 (d, C-5), 115.4 (s, C-8a), 122.7, 123.8 and 133.8 (d, C-6, C-7) and C-8), 167.3, 168.4 and 169.9 (s, C-4a, C-8b and C=O) ppm. The structure of the N,N-diethyl-3,3a-dihydro-3-methylbenzofuro[3,2-c]isoxazole-3-carboxamide (5) was determined by X-ray crystallography.

Crystal data⁶: C₁₅H₁₈N₂O₃; monoclinic; space group P2₁/c, a=9.1946(2), b=21.3392(8), c=14.6348(6) Å, β=90.101(3)°, Z=8; d_{calc}=1.27 g cm⁻³. The crystal structure determination is based on 3362 reflections, with an intensity greater than the



figure

standard deviation from counting statistics. Intensities have been measured on a Philips PW1100 diffractometer (CuK_α radiation, graphite monochromator, $\omega/2\theta$ scan mode, $3 < \omega < 60^\circ$). The structure was solved by direct methods⁷ and refined with anisotropic temperature factors (hydrogen atoms have not been located yet) to a final weighted R-factor of 11.3%. The asymmetric unit contains two different molecules which have the same conformation. One of them is shown in the figure.



The formation of the 3,3a-dihydrobenzofuro[3,2-c]isoxazole (5) can be explained by a (4+2)-cycloaddition followed by rearrangement of the cyclic nitronic ester (2) via the diradical 3. With nitroalkenes¹, the analogous reaction gives nitrones cf. 4 by formation of N-C bonds rather than O-C bonds. The steric strain involved in the formation of a fused 2,3-dihydroazete 1-oxide (4) must explain the alternative pathway with 3-nitrobenzo[*b*]furan⁸. The formation of 5 is a further example of the reduction of a nitrogroup by an ynamine^{4,2}.

Compound 5 represents a novel class of heterocycles, to our knowledge, and the parent benzofuro[3,2-*c*]isoxazole has hitherto not been reported⁹.

References and notes

1. A.D. de Wit, M.L.M. Pennings, W.P. Trompenaars, D.N. Reinhoudt, S. Harkema and O. Nevestveit, *J. Chem. Soc. Chem. Commun.*, 1979, 993.
2. D.N. Reinhoudt and C.G. Kouwenhoven, *Recl. Trav. Chim. Pays Bas*, **95**, 67 (1976).
3. V. Jäger and H.G. Viehe, *Angew. Chem.*, **82**, 836 (1970).
4. The yield of 1 is almost independent of the solvent in which the reaction is carried out (e.g. acetonitrile 38%).
5. Satisfactory elemental analysis of 5 was obtained.
6. All relevant crystallographic data are deposited at the Cambridge Crystallographic Data Centre (C.C.D.C.)
7. G. Germain, P. Main and M.M. Woolfson, *Acta Crystallogr. Sect. A*, **27**, 368 (1971).
8. See also accompanying paper.
9. A 1,3,3a,8b-tetrahydrobenzofuro[3,2-*c*]isoxazole has been reported by Oppolzer and Keller¹⁰.
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