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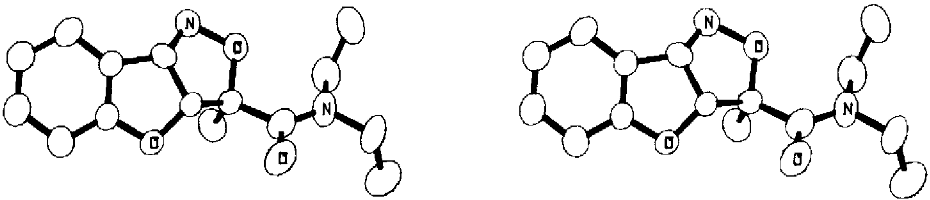
Abstract: 3-Nitrobenzo[b]furan and 1-diethylaminopropyne react thermally at 5-10°C to give a 1:1 addition product (5) in which one of the oxygen atoms of the nitro group is transferred to C-1 of the acetylene. The structure of the benzofuro[3,2-c]isoxazole (5) has been determined by X-ray crystallography.

Nitroalkenes[1], 3-nitrobenzo[*b*]thiophen[2], and 4-nitroisothiazole[2] react with ynamines (1-aminoacetylenes) to give cyclobutene and nitrone 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-atom[3].

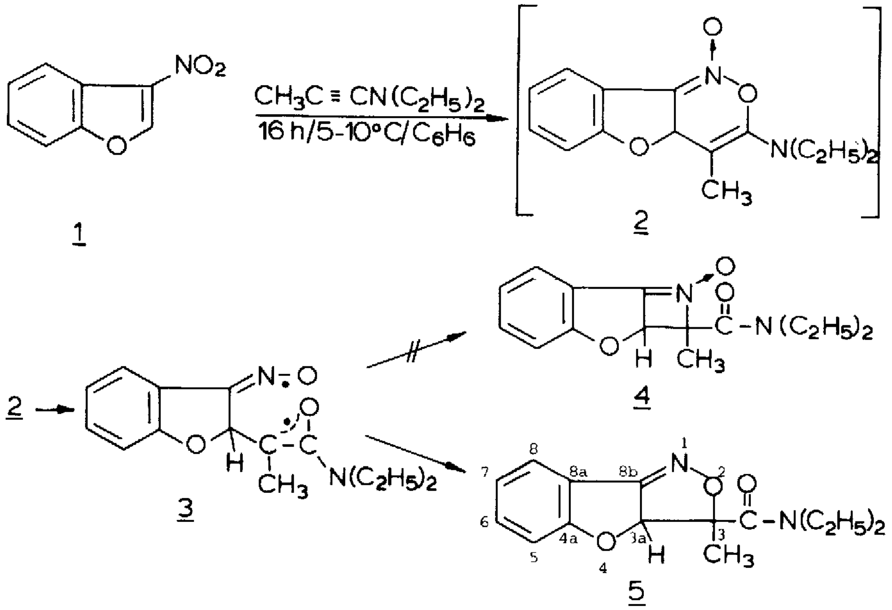
We now wish to report the reaction of an ynamine with 3-nitrobenzo[*b*]furan which gives a novel heterocycle by an alternative rearrangement pathway of the (4+2)-cycloadduct. 3-Nitrobenzo[*b*]furan and 1-diethylaminopropyne (1:1, benzene, 5-10°C, 16h) gave after chromatography (SiO_2, $CHCl_3$) a crystalline 1:1 reaction product in 41% yield, m.p. 118.5-119.5°C [4,5]. MS: M^+ 274.13 ($C_{15}H_{18}N_2O_3$). IR(KBr): 1645 cm^{-1} (C=O) and 1610 cm^{-1} (C=N). ^1H NMR $\delta(CDCl_3)$: 1.20 and 1.38 (t,3H,$CH_2\underline{CH_3}$), 1.52 (t,3H,CH_3) 3.1-3.9 (m,4H,$\underline{CH_2}$-CH_3), 6.32 (s,1H,H-3a), 6.9-7.8 (m,4H,H_{arom}) ppm. ^{13}C NMR $\delta(CDCl_3)$: 12.6,14.7 and 16.6 (q,CH_3), 41.1 and 42.5 (t,CH_2), 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=0) 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 data[6]: $C_{15}H_{18}N_2O_3$; monoclinic; space group $P2_1/c$, 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, $3<\omega<60^{o}$). The structure was solved by direct methods[7] 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 nitroalkenes[1], 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*]furan[8]. The formation of 5 is a further example of the reduction of a nitrogroup by an ynamine[1,2].

Compound 5 represents a novel class of heterocycles, to our knowledge, and the parent benzofuro[3,2-*c*]isoxazole has hitherto not been reported[9].

References and notes

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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.)
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8. See also accompanying paper.
9. A 1,3,3a,8b-tetrahydrobenzofuro[3,2-*c*]isoxazole has been reported by Oppolzer and Keller[10].
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