

Novel Nucleophile-dependent *cine*-Substitution in α -Nitrofurans

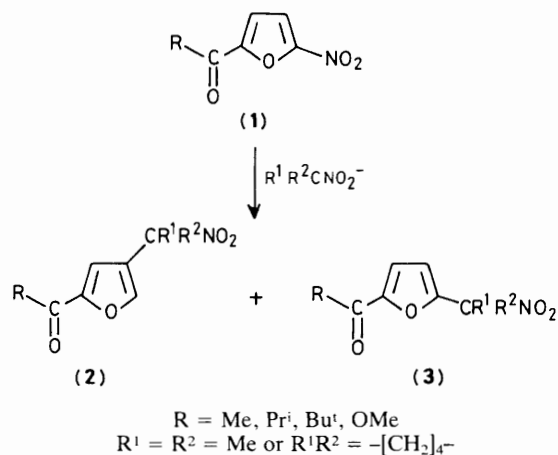
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α -Nitrofurans bearing acyl or alkoxy carbonyl groups on the α' -position undergo *cine*-substitution of the α -nitro group when treated with the anions of secondary nitroalkanes, whereas with other nucleophiles, normal substitution of the α -nitro group occurs.

As part of our studies on the substitution reactions of nitroheteroaromatic compounds,¹ the reaction of the α -nitrofurans (**1**) with a variety of nucleophiles was examined. When the compounds (**1**) were treated in dimethyl sulphoxide at room temperature for 0.5–3 h with the salts of secondary nitroalkanes, such as 2-nitropropane and nitrocyclopentane,

the *cine*-substitution products (**2**) were the major products and could be isolated in 40–87% yields whereas the expected substitution products (**3**) were detected (by g.l.c. and ¹H n.m.r. spectroscopy) in the crude reaction production in less than 8% yields. The overall yields were improved to 70–90% and the proportion of products (**3**) was reduced to less than



3% when equimolar amounts of the nitroalkane and the corresponding salt were used. The proportion of products (2) and (3) did not vary significantly when the counterion in the *aci*-nitronate salts was varied from lithium to sodium to tetrabutylammonium.

The assignment of constitution to products (2) and (3) was based on ^1H n.m.r. spectroscopy. The AX spectrum for the ring protons in (2) had J_{AX} approximately 1.0 Hz, whereas in (3), and in the starting materials (1), J_{AX} was 3.5–3.9 Hz in accord with values for coupling constants in 2,4- and 2,5-disubstituted furans respectively.² Analytical and other spectroscopic data were also consistent with the assigned structures.

By way of contrast with the above results, the reaction of nitrofurans (1) with other nucleophiles such as azide, arenethiolate, arenesulphinate, cyanide, and methoxide ions, the

carbanions formed from malonic esters and malononitriles, and also piperidine, in a range of different solvents, gave only the normal substitution products in which the nitro group was replaced by the incoming nucleophile at the α -position. Secondary products were also formed in some cases (e.g. in the reaction with azide ion¹), but in none of the reactions could *cine*-substitution products be detected.

The unusual nature of this *cine*-substitution process, which appears to be the first example in the furan system, extends beyond the peculiar nucleophile dependence. Most other examples of *cine*- and *tele*-substitution of nitro groups involve attack on systems bearing two nitro groups, usually in an *ortho* relationship.^{3,4} In heteroaromatic systems all the reported examples have attack of a nucleophile at the activated α -position with subsequent loss of a nitro group from the β -position.^{4,5}

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