Formation under Kinetic Control of Aziridine Invertomers

By RENÉ GRÉE and ROBERT CARRIÉ*

(*Groupe de Recherches de Physicochimie Structurale, BP 25 A, 35031 Rennes Cedex, France*)

Summary The reaction of the stereoisomeric nitronic esters (**1**) and (**2**) with benzoylacetylene is stereoselective; each isomer leads to different aziridines, and the reaction allows the synthesis under kinetic control of *N*-methoxy-aziridine invertomers.

TARTAKOVSKII and COLL[1] have shown that nitronic esters react with activated acetylenes to give *N*-methoxy-aziridines but, to our knowledge, the stereochemistry of this reaction has not been studied. We have found that the reaction of (**1**) and (**2**) with benzoylacetylene (**3**; X = COPh) is stereoselective, each isomer leading to different aziridines. The configuration of the nitronic esters (**1**) and (**2**) has been established previously.[2]

The *Z*-compound (**1**) gives a quantitative yield (n.m.r.) of the aziridines (**4**) (96%) and (**5**) (4%) with the CN and OMe groups in *cis* positions, while the *E*-isomer (**2**) gives compounds (**6**) (19%) and (**7**) (81%) with the same groups in *trans* positions. Compounds (**4**)—(**7**) have been isolated.†

The stereoselectivity was established by using pure (**2**)[2] and mixtures of (**1**) and (**2**) of known composition; with the mixtures, ratios [(**4**) + (**5**)]:[(**6**) + (**7**)] were always equal to the ratios of (**1**):(**2**) in the starting mixture of dipoles. The reactions were carried out at room temperature and the proportions of the aziridines were obtained by integration of the n.m.r. spectra of the crude mixture (C_6D_6) (see Table). The ring proton signals were assigned unambiguously by using deuteriated nitronic esters. The more shielded proton (H_a) is on the carbon atom bearing the CN group.

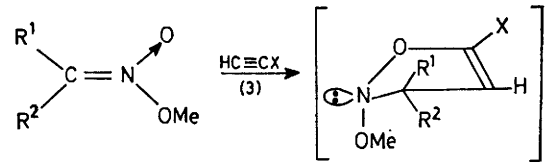
The relative configuration at the two carbon atoms was based on n.m.r. analysis: J_{ab} (*cis*) 7·4 and 8·4 Hz, J_{ab} (*trans*)

TABLE. N.m.r. data for compounds (**4**)—(**7**).

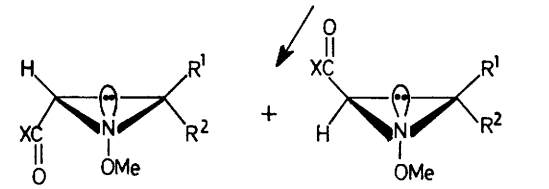
		$CDCl_3$ solvent (C_6D_6 in parentheses).			
Compound	M.p./°C	δ (H_a)	δ (H_b)	J_{ab}/Hz	δ (OMe)
(**4**)	56	3·04	3·83	7·4	3·58
		(1·88)	(3·10)	(7·4)	(3·16)
(**5**)	95	3·34	4·08	5·6	3·76
		(2·74)	(3·72)	(5·6)	(3·32)
(**6**)	90	3·47	4·00	5·6	3·47
		(2·87)	(3·25)	(5·6)	(2·87)
(**7**)	95	3·16	4·01	8·4	3·65
		(2·23)	(3·51)	(8·4)	(3·16)

† These invertomers are quite stable under the reaction conditions.

5·6 Hz. Coupling constants of the same order of magnitude have been found for *N*-chloro and *N*-aminoaziridines.[3,4]



(1) R^1 = H, R^2 = NC- (A) R^1 = H, R^2 = NC-
(2) R^1 = NC-, R^2 = H (B) R^1 = NC-, R^2 = H



(4) R^1 = H, R^2 = NC- (5) R^1 = H, R^2 = NC-
(6) R^1 = NC-, R^2 = H (7) R^1 = NC-, R^2 = H

An *X*-ray analysis of compound (**5**) by some of our colleagues[5] has determined the stereochemistry at nitrogen: OMe and CN are in *cis* positions. We can thus deduce the relative configuration of the ring atoms in (**6**).

The stereochemistry at nitrogen in both the aziridines '*cis*' (**4**) and (**7**) was established, as for the *N*-chloroaziridines,[6] by considering the relative stability of the two invertomers: (**4**) which is the more sterically hindered, leads quantitatively to a mixture of (**7**) (35%), (**6**) (16%), and (**5**) (49%) after 5 h reflux in toluene.‡ We assign it the structure with the three substituents on the same side of the aziridine ring; for (**4**) and (**7**), as for *N*-chloroaziridine invertomers,[3] the coupling constants are different, the smaller values being observed with the ring protons and nitrogen lone pair *cis*.

We suggest that the diastereoisomeric isoxazolines (A) and (B)§ are intermediates since it is known[7] that nitrones add to acetylenes to give Δ^4-isoxazolines which may isomerise easily into acylaziridines and, also, we have already observed that the 1,3 dipolar cycloaddition of nitronic esters to $\alpha\beta$ diactivated[8] and monoactivated[9] olefins gives only one invertomer under kinetic control. The assumption that (**1**) leads only to (A) (CN and OMe *cis*) and (**2**) to (B) seems reasonable. Since (A) and (B) are diastereoisomers, the two isomeric 1,3 dipoles would be expected to give different results.

This synthesis of *N*-methoxyaziridine invertomers under kinetic control is not restricted to the above example. Similar results were obtained for the addition of (**1**) and (**2**) to butynone (X = COMe) and also in the reactions of the stereoisomers of the nitronic esters $MeCO_2CH{=}N(O)OMe$ with the acetylenes (**3**; X = COPh, COMe, and CO_2Me).

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‡ It has not been possible to distinguish between nitrogen inversion and *cis–trans*-equilibration of the aziridines. Compounds (**5**)—(**7**) give the same thermodynamic equilibrium mixture when heated.

§ Even by working at low temperatures, it has not been possible to show the existence of these isoxazolines.

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