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^{1}H NMR DETECTION OF σ-ADDUCTS IN *S$_N$*H REACTIONS OF NITROQUINOLINES WITH CHLOROMETHYL PHENYL SULFONE

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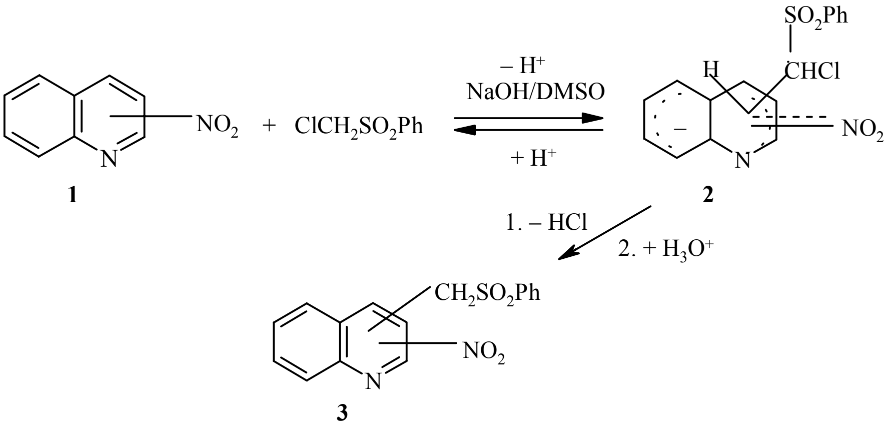
The intermediate σ-adducts of chloromethyl phenyl sulfone with 3-nitro-, 5-nitro-, 6-nitro-, 7-nitro- and 8-nitroquinoline are detected by ^{1}H NMR spectroscopy.

Keywords: nitroquinolines, anionic (phenylsulfonyl)chloromethyl-σ-adducts.

It has been reported that x-mononitroquinolines (x = 3-8) undergo vicarious nucleophilic substitution of the aromatic hydrogen when reacting with chloromethyl phenyl sulfone in basic solution [1, 2]. These *S$_N$*H reactions occur very selectively, giving product of substitution of hydrogen at the *ortho* position to the nitro group in nitroquinolines. The reaction process takes place between nitroquinoline **1** and a carbanion such as carbanion generated from chloromethyl phenyl sulfone (Scheme 1). In the first step addition of the carbanion to the nitro compound **1** results in the formation of σ-adduct **2**, which undergoes base-induced β-elimination of HCl to form a carbanion which is subsequently protonated during the workup procedure, giving product **3**.

Scheme 1



To establish whether the intermediates in the above-mentioned reactions are detectable anionic σ-adducts like **2**, we have measured the ^{1}H NMR spectra of nitroquinolines **1a-e** in a solution of NaOD in DMSO containing 1.1 equivalents of chloromethyl phenyl sulfone. As was reported in our earlier paper [2], we have measured the ^{1}H NMR spectra of 3-nitro-and 4-nitroquinoline and their 2-deutero analogues (to explain the

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TABLE 1. ^{1}H NMR Data of Mononitroquinolines and Their Anionic σ-Adducts with Chloromethyl Phenyl Sulfone

Compound	Solvent	Chemical shifts (δ values)						
		2-H	3-H	4-H	5-H	6-H	7-H	8-H
3-Nitroquinoline **1a**	DMSO-d_6	9.66	—	9.04	8.34	—		7.62*
4-ClCH SO_2Ph-σ-adduct of **1a** (**2a**)	NaOD / DMSO-d_6	8.37	—	5.59	7.84	—		7.19*
	Δδ	1.29	—	3.45				
5-Nitroquinoline **1b**	DMSO-d_6	9.10	7.82	8.85	—	8.36	8.01	8.36
6-ClCH SO_2Ph-σ-adduct of **1b** (**2b**)	NaOD / DMSO-d_6	8.26	7.23	8.04	—	5.31	7.24	6.31
	Δδ	0.84	0.59	0.81	—	3.05	0.77	2.05
6-Nitroquinoline **1c**	DMSO-d_6	9.15	7.78	8.73	9.08	—	8.50	8.23
5-ClCH SO_2Ph-σ-adduct of **1c** (**2c**)	NaOD / DMSO-d_6	8.53	7.13	—	4.97	—	7.53	6.45
	Δδ	0.62	0.65	—	4.11	—	0.97	1.78
7-Nitroquinoline **1d**	DMSO-d_6	9.13	7.78	8.59	8.31	8.33	—	8.81
8-ClCH SO_2Ph-σ-adduct of **1d** (**2d**)	NaOD / DMSO-d_6	7.47	7.21	—	6.34	6.99	—	5.30
	Δδ	1.66	0.57	—	1.97	1.34	—	3.51
8-Nitroquinoline **1e**	DMSO-d_6	9.07	7.78	8.61	8.36	7.79	8.26	—
7-ClCH SO_2Ph-σ-adduct of **1e** (**2e**)	NaOD / DMSO-d_6	9.06	6.89	8.60	7.25	7.39	5.36	—
	Δδ	0.01	0.89	0.01	1.11	0.40	2.90	—

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* The signals of these protons form a complex multiplet and cannot be exactly assigned.

position of the σ-adduct) in a solution of NaOD and DMSO containing 1.1 equivalents of methyl phenyl sulfone instead of chloromethyl phenyl sulfone but could not detect these σ-intermediates. In this case, if the first addition step takes place, the second stage of the reaction (elimination of HCl) cannot occur.

Now using suitable techniques of measurement we obtained the ^{1}H NMR spectra of σ-adducts **2a**-**e** and mononitroquinolines **1a**-**e** with chloromethyl phenyl sulfone under the same conditions. It was observed that in the spectra nearly all signals are shifted upfield, particularly considerably the signals of the protons at the carbon atoms which form σ-adducts. Addition of the carbanion of chloromethyl phenyl sulfone to the sp^2 carbon atom of nitroquinolines induces the change of its hybridization from sp^2 to sp^3 (tetrahedral center of σ-adduct), which is reflected in a considerable upfield shift signal of the hydrogen atom attached to the particular carbon atom. This rehybridization (sp^2 to sp^3) is due to the σ-adduct formation. The corresponding ^{1}H NMR data of nitroquinolines **1a**-**e** and their (phenylsulfonyl)chloromethyl-σ-adducts are compiled in Table 1. The upfield shift $\Delta\delta$ of the signal of the hydrogen atom at the tetrahedral center of (phenylsulfonyl)chloromethyl-σ-adducts **2a**-**e** is usually in the range of 2.9-4.11 ppm.

These values are in excellent agreement with previous studies on σ-adduct formation in the amination of nitroquinolines [3-5]. This result makes the intermediate existence of anionic adducts **2** in the (phenylsulfonyl)chloromethylation of **1a**-**e** very likely. Summing up, ^{1}H NMR is a very good method to detect and to establish the structure of the covalent σ-adduct between chloromethyl phenyl sulfone and some of the nitroquinolines and in many cases to explain the course of the S_NH reactions.

The structures of the compounds **1a**-**e** have been determined on the basis of their ^{1}H NMR spectra by comparison with the spectral data (chemical shifts and coupling constants) published in [1, 6] .

The ^{1}H NMR spectra were recorded on Tesla BS-587A (80 MHz) spectrometer. TMS was used as internal standard ($\delta = 0.00$).

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