

SHORT
COMMUNICATIONS

Reaction of 3,5-Dibromo-1,2,4-triazole with 2-Chloromethylthiirane

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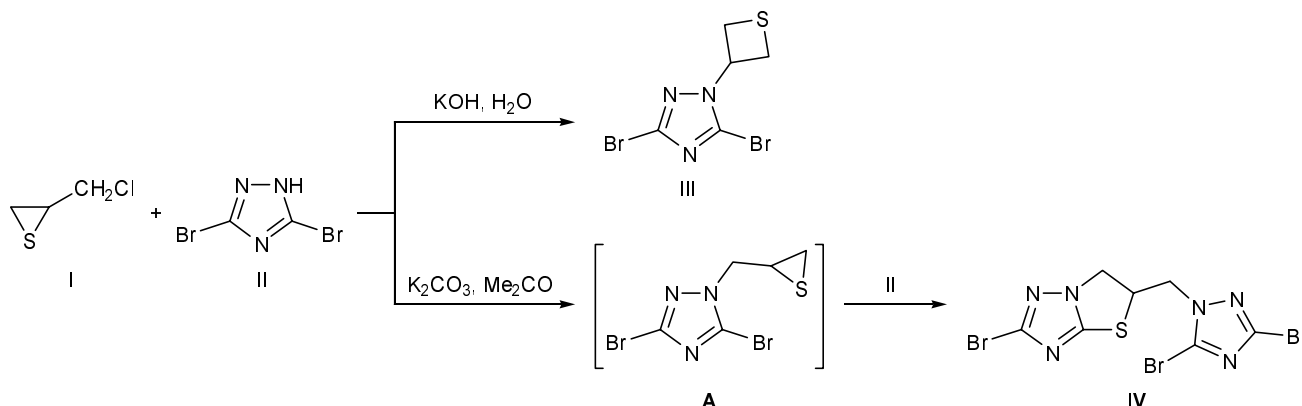
Reactions of 2-chloromethylthiirane (**I**) with various nucleophiles, such as alcohols, phenols, and amines, have been extensively studied [1–3]. Among nitrogen-containing heterocycles, reactions of **I** only with xanthenes and benzimidazoles have been reported (**I**) [4]. The present communication describes the reaction of compound **I** with 3,5-dibromo-1,2,4-triazole.

Taking into account that 2-chloromethylthiirane is a difunctional electrophile capable of undergoing thiirane–thietane rearrangement, alkylation of 1,2,4-triazoles could produce derivatives of thiirane and thietane or products formed via opening of the thiirane ring, depending on the nucleophile and solvent nature [1]. Moreover, alkylation of 3,5-disubstituted 1,2,4-triazoles with 2-chloromethylthiirane may give rise to three isomeric *N*-alkyltriazoles whose ratio should depend on the substituents on C³ and C⁵ in the triazole ring. As substrate we selected symmetric 3,5-dibromo-1,2,4-triazole (**II**) with a view to reduce the number of possible *N*-alkyl isomers.

The reaction of 3,5-dibromo-1,2,4-triazole (**II**) with an equimolar amount of 2-chloromethylthiirane (**I**) in aqueous medium in the presence of potassium hy-

droxide was accompanied by thiirane–thietane rearrangement, and the product was 3,5-dibromo-1-(thietan-3-yl)-1,2,4-triazole (**III**). The ¹H NMR spectrum of **III** contained multiplet signals in the regions δ 3.29–3.48, 4.00–4.20, and 5.62–5.81 ppm, indicating formation of a thietane ring [5]. Compound **III** showed in the ¹³C NMR spectrum signals from carbon atoms in the thietane ring and signals at δ_C 127.61 and 140.46 ppm due to nonequivalent carbon atoms in the triazole ring. These data suggest that just the N¹-alkyl isomer was obtained.

The alkylation of triazole **II** with an equimolar amount of 2-chloromethylthiirane (**I**) on heating in acetone in the presence of potassium carbonate gave dihydrothiazolotriazole **IV** as the only product, in keeping with our previous data [4]. Presumably, compound **IV** is formed through intermediate 3,5-dibromo-1-(2,3-epithiopropyl)-1,2,4-triazole **A** which readily reacts with the second molecule of **II**. However, we failed to isolate intermediate compound **A** by carrying out the reaction with excess 2-chloromethylthiirane (**I**). No reaction occurred in benzene, and initial triazole **II** was recovered from the reaction mixture.



The ^1H NMR spectrum of **IV** confirms the formation of a fused system: it contained signals from protons of the NCH_2 and SCH groups in the dihydrothiazole ring as multiplets at δ 4.25–4.46 and 4.75–4.91 ppm, respectively [4]. The presence in molecule **IV** of two triazole rings followed from the number of signals in the downfield region of the ^{13}C NMR spectrum, δ_{C} , ppm: 130.81, 141.52, 143.40, and 157.50; magnetic nonequivalence of the triazole carbon atoms indicates that the alkylation occurred at the N^1 atom of the substrate.

2-Chloromethylthiirane (**I**) was synthesized by the procedure described in [1], and 3,5-dibromo-1,2,4-triazole (**II**) was prepared as reported in [6].

3,5-Dibromo-1-(thietan-3-yl)-1,2,4-triazole (III). Triazole **II**, 22.7 g (100 mmol), was added to a solution of 6.7 g (120 mmol) of potassium hydroxide in 200 ml of water, the mixture was heated to 55°C , 13.20 g (120 mmol) of 2-chloromethylthiirane (**I**) was added, and the mixture was stirred for 1 h at $55\text{--}60^\circ\text{C}$. The mixture was cooled, and the precipitate was filtered off, washed with a 5% solution of KOH and with water until neutral washings. Yield 15.0 g (50%), mp $161\text{--}163^\circ\text{C}$ (from EtOH), R_f 0.40. ^1H NMR spectrum, δ , ppm: 3.29–3.48 m (2H, SCH_2), 4.00–4.20 m (2H, SCH_2), 5.62–5.81 m (1H, NCH). ^{13}C NMR spectrum, δ_{C} , ppm: 33.53 (SCH_2), 54.32 (NCH), 127.61 (C^5), 140.46 (C^3). Found, %: C 20.11; H 1.67; N 14.10. $\text{C}_5\text{H}_5\text{Br}_2\text{N}_3\text{S}$. Calculated, %: C 20.09; H 1.69; N 14.05.

2-Bromo-5-(3,5-dibromo-1H-1,2,4-triazol-1-yl-methyl)-5,6-dihydro-1,3-thiazolo[3,2-b][1,2,4]triazole (IV). Triazole **II**, 6.8 g (30 mmol), was dissolved on heating in 150 ml of acetone, 4.14 g (30 mmol) of potassium carbonate and 3.25 g (30 mmol) of thiirane **I**

were added, and the mixture was heated for 3 h under reflux (on a water bath). The mixture was cooled to room temperature and filtered, the solvent was distilled off from the filtrate under reduced pressure, and the residue was washed with water and diethyl ether. Yield 4.75 g (71%), mp $153\text{--}156^\circ\text{C}$ (from 1-butanol), R_f 0.19. ^1H NMR spectrum, δ , ppm: 4.25–4.46 m (2H, NCH_2), 4.51 d (2H, $5\text{-CH}_2\text{N}$, $J = 9.0$ Hz), 4.75–4.91 m (1H, SCH). ^{13}C NMR spectrum, δ_{C} , ppm: 49.13 (SCH), 49.86 (NCH_2), 52.26 ($5\text{-CH}_2\text{N}$), 130.8 (C^3), 141.5 (C^3), 143.4 (C^5), 157.5 (C^5). Found, %: C 18.75; H 1.06; N 18.94. $\text{C}_7\text{H}_5\text{Br}_3\text{N}_6\text{S}$. Calculated, %: C 18.90; H 1.13; N 18.89.

The ^1H and ^{13}C NMR spectra were recorded on a Bruker AM-300 spectrometer at 300 and 75 MHz, respectively, using chloroform-*d* as solvent and reference. The purity of the products was checked by TLC on Silufol plates using hexane–ethanol (8:2) as eluent (development with iodine vapor).

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