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ALKYNYLAMINES WITH SULFENES

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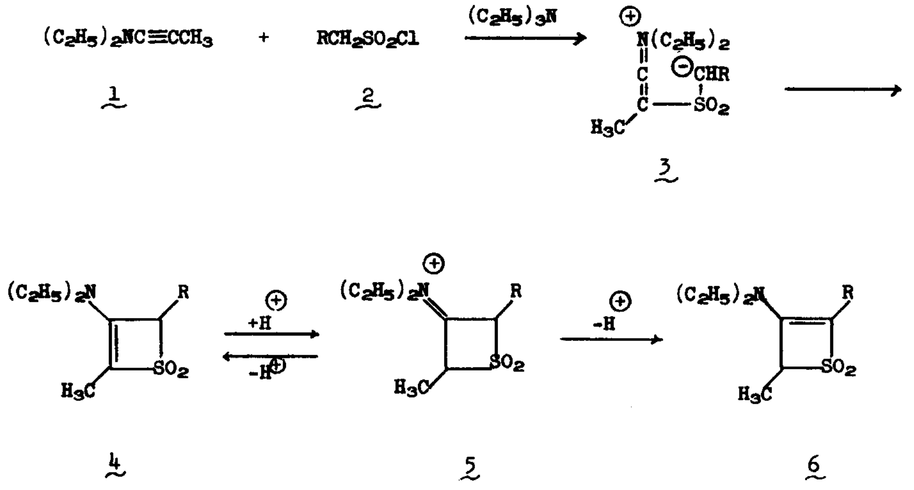
Alkynylamines (ynamines) and enamines have multiple bonds in conjugation with an amino group; as a consequence, the nitrogen atom and the β-carbon atom can behave as nucleophilic sites. Reaction of sulfenes ($RCH{=}SO_2$) with enamines is well documented (1, 2). Recent chemical advances (3) and commercial availability (4) of alkynylamines enabled us to examine their reaction with sulfenes. A stirred mixture of equimolar quantities of triethylamine and 1-diethylamino-1-propyne (1) in dry tetrahydrofuran (-10°) was treated dropwise under nitrogen with a solution of the alkanesulfonyl chloride (2) in the same solvent. Filtration of the triethylamine hydrochloride followed by solvent removal gave 3-(dialkylamino)thiete 1,1-dioxides (4). This tranformation is postulated as occurring through dipolar intermediate 3 in accordance with the electrocyclic rules (5) and recent data available on the enamine-sulfene reaction (6).

For example, with phenylmethanesulfonyl chloride ($R{=}C_6H_5$), analytically pure 4a was isolated. However, recrystallization afforded a mixture of 4a and 6a (seq 1) (7). The sensitivity of the material was evidenced by a bathochromic shift in its ultraviolet spectrum upon addition of acid. Undoubtedly, trace amounts of the hydrochloride salt provide a proton source during recrystallization yielding charged species 5a which preferentially gives 6a. Further examples are listed in Table I.

Cycloaddition of ketene O,N-acetals and ketene N,N-acetals to sulfenes is followed by spontaneous elimination of alcohol or dialkylamine, leading to the formation of similar products (9). However, in the unsymmetrical cases, these four-membered rings are a mixture of isomers while acyclic products can be obtained in either instance. The alkynylamine-sulfene reaction does not suffer from these disadvantages; a single isomer is isolated.



(1)

Table I (8)

Experimental Results and Physical and Spectral Properties

Compound	R	mp°C	Yield %	4:6	Tertiary H 4	 6	CH_3(4) (J=1.5 Hz)	CH_3(6) (J=6.7-6.9)
4a	C_6H_5	123-5	76.0	100:0	5.6-q	-	2.0-d	-
4a, 6a[6]	C_6H_5	106-8[1]	-	15:85	5.8-q	4.8-q	2.1-d	1.7-d
4b	pCl-C_6H_4	115-6	64.0	100:0	5.6-q	-	2.0-d	-
4b, 6b[6]	pCl-C_6H_4	87-90[1]	-	15:85	5.8-q	4.8-q	2.1-d	1.7-d
4c, 6c[6]	H	57-8[2]	79.6	75:25	-[3]	5.0-q	2.4-t	2.0-d
4d=6d	CH_3	-[4]	66.2	-	4.5-m		1.9-d	1.5-d
4e[6]	Cl	79-80[5]	39.6	100:0	6.1-q	-	1.9-d	-

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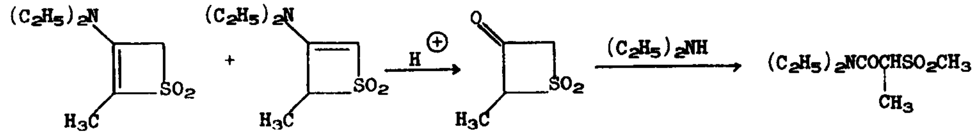
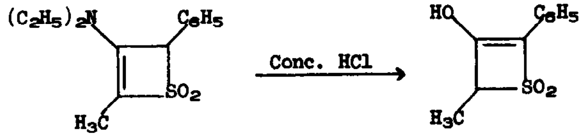
1 = CH_3CN-Et_2O or EtOAc-hexane; 2 = Et_2O, bp *ca.* 200° (1 mm); 3 = in CCl_4 with -SO_2CH_2 at 4.6 (q, J=1.5) and vinyl proton at 5.5-s; 4 = bp 162-4° (0.3 mm); 5 = EtOH-Et_2O; 6 = after purification.

Preliminary observations concerning reaction modifications indicate that adduct 4a is formed in the absence of triethylamine (33.7%) and that analogous thiete 1,1-dioxides result with 1-dimethylaminophenylacetylene as the ynamine. Solvent effects and any evidence for mesylsulfene (10) will be reported.

Hydrolysis of a mixture of 4c and 6c with acidic ion-exchange resin yielded (71.0%) ketone 7 (seq 2), mp 110-11° (benzene); $\delta^{CDCl_3}_{TMS}$ 4.75-5.3 (m, 3H, α-sulfonyl protons) and 1.6 (d, 3H, J=7.0Hz, methyl group) (8a). No evidence of the enolic form was noticed in the spectral determinations. Analogous treatment of 4a had no effect; but, exposure to concentrated hydrochloric acid afforded a quantitative yield of analytically pure enol 8 (eq 3), mp 139-40° (benzene); ν^{nujol}_{max} 1666 and 3130 cm^{-1}; $\lambda^{CH_3OH}_{max}$ 264 mμ (ε 15,390), λ_{min} 226 (3,140), and, with 1 N potassium hydroxide, λ_{max} 280 (18,370), λ_{min} 226 (3,140); $\delta^{d_6\text{-acetone}}_{TMS}$ 7.4 (m, 5H, aromatic protons), 4.7 (q, 1H, J=6.5Hz, α-sulfonyl proton), 1.6 (d, 3H, J=6.5, methyl group) and hydroxyl proton between 8-11 ppm; $\delta^{d_6\text{-acetone-}D_2O}_{TMS}$ 7.4 (no change), 4.4 (s, 2H,HOD), and 1.65 (s, 3H, methyl group). Diethylamine and 7 under mild enamine formation conditions gave amide 9 (seq 2), mp 83-5° (ether-hexane); a ring-opening somewhat analogous to other cyclic β-keto sulfones (11). Further transformations of 7, 8 and related materials are under active investigation.



4c 6c 7 9 (2)



4a 8 (3)

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References

1. (a) G. Stork and I. J. Borowitz, *J.Am.Chem.Soc.*, **84**, 313 (1962), (b) I.J.Borowitz, *ibid.*, **86**, 1146 (1964).

2. G. Opitz and H. Adolph, *Angew.Chem.*, **74**, 77 (1962).

3. H. G. Viehe, *Angew.Chem.Intern.Ed.Engl.*, **6**, 767 (1967).

4. Fluka AG., Buchs, Switzerland.

5. R. Hoffmann and R. B. Woodward, *J.Am.Chem.Soc.*, **87**, 2046 (1965).

6. L. A. Paquette and M. H. Rosen, *ibid.*, **89**, 4102 (1967).

7. The extent of this conversion is dependent on how carefully the initial solid is washed with ethanol, duration of heating during purification, and presence of water in the solvents of reaction and recrystallization.

8. (a) Acceptable elemental analyses (± 0.30%) and infrared and ultraviolet characteristics were obtained on all new compounds. (b) The nmr parameters (δ) were determined in deuterio-acetonitrile solution (unless otherwise specified) with tetramethylsilane as internal reference at 60 Mcps. Only those peaks which are necessary for the calculation of isomer composition are reported and the following abbreviations are employed: s = singlet; d = doublet; t = triplet; q = quartet; and m = multiplet.

9. (a) R. H. Hasek, R. H. Meen, and J. C. Martin, *J.Org.Chem.*, **30**, 1495 (1965), (b) W. E. Truce D. J. Abraham, and P. Son, *ibid.*, **32**, 990 (1967), (c) G. Opitz and H. Schempp, *Ann.Chem.*, **684**, 103 (1965).

10. G. Opitz, *Angew.Chem.Intern.Ed.Engl.*, **6**, 107 (1967).

11. J. J. Looker, *J.Org.Chem.*, **31**, 2714 (1966).