N-Arylsulfonylamidines; Part 1. Synthesis of Tertiary Amines *via* Lithium Aluminium Hydride Reduction of *N*-Tosylamidines

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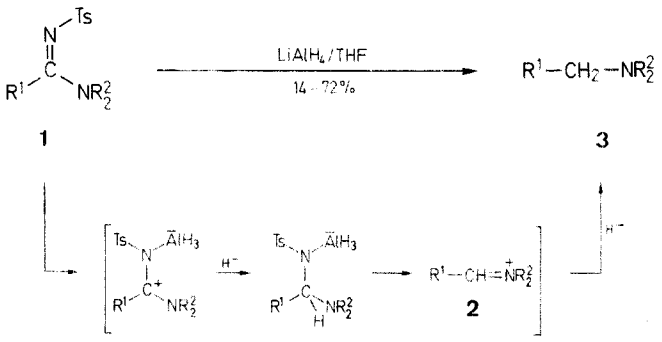
Tertiary *N*-tosylamidines are readily reduced by an equimolar amount of lithium aluminium hydride to the corresponding tertiary amines.

Tertiary *N*-tosylamidines are readily available by cycloaddition of tosylazide to enamines and spontaneous thermal rearrangement accompanied by elimination of nitrogen from the intermediate 5-amino-1-tosyl-*v*-triazolines.[1-3] A synthetically relevant feature of this rearrangement is the change of the carbon skeleton of the starting enamine. In spite of this, *N*-tosylamidines have been scarcely considered as starting materials for the preparation of other classes of compounds. As a part of a program aimed to explore the synthetic potentialities of *N*-arylsulfonylamidines we have studied the reduction of substrates **1** by lithium aluminium hydride to tertiary amines **3**. *N*-Tosylamidines **1a–j** are reacted by adding an equimolar amount (twice the stoichiometric amount) of lithium aluminium hydride to a solution of **1** in anhydrous tetrahydrofuran at room temperature. The tertiary amines **3** are easily isolated from the reaction mixture by extraction or column chromatography.



The mechanism of this reduction can be explained by analogy with the mechanism accepted for the reduction of amides to amines by lithium aluminium hydride.[4,5] As shown in the Scheme, through action of tetrahydroaluminate (i.e. aluminium hydride and hydride ion[6]) on **1** the C-NTs bond is cleaved forming the immonium intermediate **(2)** which is eventually reduced to **3**. When less than stoichiometric amount of reducing agent is used, amines **3** are produced in lower yield and unchanged **1** is recovered, thus showing that the reduction of **2** is faster than its formation from **1** and lithium aluminium hydride.

The structure of all new products **3** was confirmed by analytical and ^{1}H-NMR data (Table).

Table. Amines **3** Prepared

Product	R^1	NR_2^2	Yield[a] (%)	b.p.[b] (°C)/mbar	Molecular Formula[c] or Lit. b.p. (°C)/mbar	^{1}H-NMR ($CDCl_3$/TMS)[d] δ, J (Hz)
3a	C_6H_5	morpholyl	50	100/1.3	128–129/17.3	2.30–2.70 (m, 4H); 3.55 (s, 2H); 3.55–3.9 (m, 4H); 6.8–7.35 (m, 5H)
3b	4-$CH_3OC_6H_4$	morpholyl	72	110/0.7	136–139/1.3	2.30–2.70 (m, 4H); 3.45 (s, 2H); 3.55–3.90 (m, 4H); 3.80 (s, 3H); 6.65–7.30 (m, 4H)
3c	cyclopentyl	morpholyl	50	70/1.3	76/3.3	1.1–2.0 (m, 9H); 2.0–2.65 (m, 6H); 3.5–3.85 (m, 4H)
3d	cyclopentyl	piperidyl	67	85/1.3	98–100/20	1.0–2.3 (m, 15H); 2.30–2.70 (m, 6H)
3e	cyclohexyl	morpholyl	66	75/1.3	247[e]	1.0–2.0 (m, 11H); 2.20 (d, 2H, J = 6); 2.30–2.60 (m, 4H); 3.50–3.90 (m, 4H)
3f	C_2H_5	morpholyl	14	155/1 atm	72–82/47	0.90 (t, 3H, J = 6); 1.3–1.7 (m, 2H); 2.2 (t, 2H, J = 4.5); 2.3–2.5 (m, 4H); 3.65–3.8 (m, 4H)
3g	$CH_3CH(C_2H_5)$	morpholyl	56	85/33	176–177/993	0.8–1.0 (m, 6H); 1.0–1.8 (m, 3H); 2.0–2.3 (m, 2H); 2.3–2.5 (m, 4H); 3.6–3.8 (m, 4H)
3h	cyclopropyl	morpholyl	45	50/0.4	$C_8H_{15}NO$ (141.2)	–0.05–0.90 (m, 5H); 2.15 (d, 2H, J = 6.3); 2.35–2.55 (m, 4H); 3.55–3.80 (m, 4H)
3i	cycloheptyl	morpholyl	44	90/1.3	$C_{12}H_{23}NO$ (197.3)	1.0–2.0 (m, 13H); 2.15 (d, 2H, J = 7); 2.3–2.5 (m, 4H); 3.6–3.8 (m, 4H)
3j	cyclopentyl	4-benzyl-piperazyl	33	135–140/0.7	$C_{17}H_{26}N_2$ (258.4)	1.00–2.20 (m, 9H); 2.27 (m, 2H); 2.55 (s, 8H); 3.57 (s, 2H); 7.32 (m, 5H)

[a] Not optimized.
[b] Not corrected.
[c] Satisfactory microanalyses obtained: C ±0.35, H ±0.29, N ±0.29.
[d] Recorded on Varian 360A and EM-390 spectrometers.
[e] M.p. of hydrochloride.

Tosylamidines **1a, b,**[7] **1d, g,**[1] **1h**[3] are known compounds. Compounds **1c, e, f, i, j** are prepared analogous to the published procedure[1–3] from the corresponding enamines.

Amines 3; General Procedure:
To a stirred suspension of LAH (0.38 g, 10 mmol) in anhydrous THF (15 mL) is added dropwise a solution of the amidine **1** (10 mmol) in anhydrous THF under a nitrogen atmosphere. After stirring for 4–6 h, the mixture is hydrolysed by adding a 10% NaOH solution (1.5 mL) and water (1.5 mL). The mixture is filtered under suction and the precipitate is washed with THF (2 × 5–10 mL). It is then continously extracted with THF (15 mL) in a soxhlet apparatus. The combined extract and the filtrate are evaporated to dryness. The residue is treated with 10% HCl (10 mL) and the solution obtained is extracted with CH_2Cl_2 (20 mL). The aqueous layer is basified with solid Na_2CO_3 and extracted with CH_2Cl_2 (2 × 20 mL). The organic layer is dried (Na_2SO_4) and evaporated. The residue is purified by bulb to bulb distillation.

Received: 31 July 1986; revised: 23 January 1987

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