

A Novel, Chemoselective, 'One-pot' Procedure for the Simultaneous Denitration–Deoxygenation of 2-Nitroketones by TsNHNH₂–NaBH₄

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Chemoselective conversion of both the carbonyl group and the carbon bearing the nitro group, of 2-nitro ketones, into two methylenes is performed in one pot, under mild conditions.

The discovery, during the last decade, of new procedures^{1–3,6} to effect the denitrohydrogenation of 2-nitro ketones has hugely increased their importance in organic synthesis.^{1,4,5} However these methods have some important disadvantages because they are either effective only for aromatic 2-nitro ketones² or require strong reducing reagents,^{1,6} with obvious problems of chemoselectivity, or highly toxic compounds.²

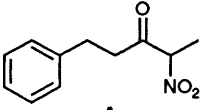
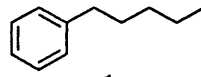
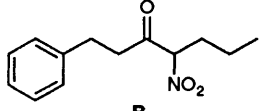
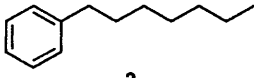
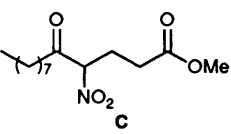
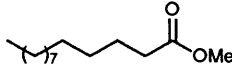
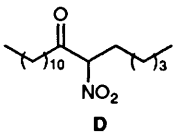
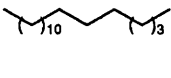
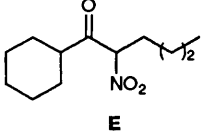
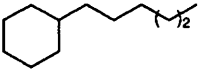
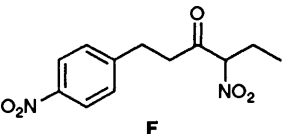
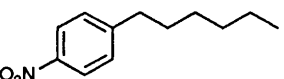
During our efforts to discover mild chemoselective reducing agents to remove the nitro group from 2-nitro ketones we found that the reduction of 2-nitrocyclohexanone tosylhydrazone **I** with NaBH₄, at room temperature, gave the *N*-cyclohexyl-*N'*-

tosylhydrazine† **II**, in 76% yield, instead of the expected⁷ cyclohexanone tosylhydrazone, whereas if the temperature was raised to 80 °C the cyclohexane **III** was obtained in 60% yield.

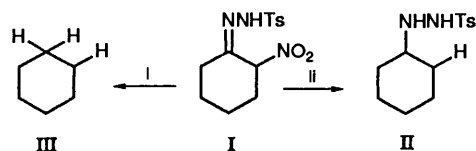
This latter result prompted us to develop a new, mild, chemoselective, 'one-pot' procedure for the simultaneous denitration–deoxygenation of 2-nitro ketones by conversion of the ketone into the corresponding tosylhydrazone in methanol

† This important result opens new perspectives in the reactivity of 2-nitro ketones and further studies will be reported in the near future.

Table 1 Products and yields for the one-pot simultaneous denitration–deoxygenation of 2-nitro ketones

Substrate	Product ^a	Yield ^b (%)
		71
		68
		54
		54
		60
		47

^a Satisfactory IR and NMR spectroscopic and elemental analyses were obtained. **1**: b.p. 115 °C (60 mmHg), *m/z* 148 (M⁺); **2**: b.p. 235 °C, *m/z* 176 (M⁺); **3**: b.p. 131 °C (4 mmHg), *m/z* 228 (M⁺), *v*/cm⁻¹ 1735 (C=O); **4**: b.p. 110 °C (0.4 mmHg), *m/z* 254 (M⁺); **5**: b.p. 95 °C (10 mmHg), *m/z* 182 (M⁺); **6**: b.p. 120 °C (1 mmHg), *m/z* 207 (M⁺), *v*/cm⁻¹ 1580 (C=C) and 1495 (ArNO₂), δ_H(CDCl₃) 0.86 (t, 3 H, *J* 6.9), 1.2–1.4 (m, 6 H), 1.6–1.7 (m, 2 H), 2.7 (m, 2 H, *J* 7.7) and 7.7 (AA'BB', 4 H, *J* 8.6). ^b Yields reported are for isolated pure compounds.



Reagents and conditions: i, NaBH₄, MeOH, 80 °C; ii, NaBH₄, MeOH, room temp.

at room temperature (the tosylhydrazone of A was obtained in THF at 60 °C in the presence of a catalytic amount of concentrated HCl) then, after addition of NaBH₄ and refluxing at 80 °C the desired alkane was readily obtained.

By this one-pot method tedious work-up is avoided and moreover, the survival of a reducible ester (*e.g.* C) or the nitro group remote from the 2-position (*e.g.* F) demonstrates the chemoselectivity of this method (Table 1). On the other hand since the linear 2-nitro ketones can be prepared by acylation of primary nitroalkanes³ or by nitroaldol reaction between aldehydes and aliphatic nitroalkanes, followed by oxidation of 2-nitroalkanol intermediates,^{8–10} this conversion of both the carbonyl group and the carbon bearing the nitro group into two adjacent methylenes effaces any memory of the donor and acceptor entities used to form the carbon–carbon bond and makes it impossible for the location of these to be recognized in the new molecular structure.

Experimental

The 2-nitro ketone (5 mmol) and tosylhydrazine (5.5 mmol) were added to MeOH (50 cm³). The mixture was allowed to stand at room temperature for 3–10 h, then NaBH₄ (3 g, 80

mmol) was added in small portions over 20 min, and the resulting mixture was heated under reflux for an additional 10 h. The reaction mixture was cooled to room temperature and extracted with pentane and the combined organic phases were dried over MgSO₄. Concentration of the solution afforded the crude product which can be purified by distillation or chromatography.

Details of products and yields are given in Table 1.

Acknowledgements

We thank the Consiglio Nazionale delle Ricerche (C.N.R.) Italia and Ministero dell'Università e della Ricerca Scientifica e Tecnologica (MURST) Italia for financial support.

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Paper 2/05251B

Received 30th September 1992

Accepted 12th October 1992