

## A Novel Route to the 2-Aza-adamantyl System via Photochemical Ring Contraction of Epoxy 4-Azahomoadamantanes

Shoji Eguchi,\* Koji Asai, and Tadashi Sasaki

*Institute of Applied Organic Chemistry, Faculty of Engineering, Nagoya University, Furo-cho, Chikusa-ku, Nagoya 464, Japan*

Epoxy 4-azahomoadamantanes rearranged to give, on photolysis, *N*-acyl-substituted 2-aza-adamantanes as the only products.

Although several synthetic routes to the 2-aza-adamantyl system have been reported, all of them require elusive multistep procedures or starting materials, such as bicyclo[3.3.1]nonane-3,7-dione, bicyclo[3.3.1]nona-2,6-diene, and 3-*endo*-aminobicyclo[3.3.1]non-6-ene, that are not readily accessible.<sup>1,2</sup> We now report a novel and convenient

route to the 2-aza-adamantyl system (**4**) utilizing a facile photochemical ring contraction of the epoxy 4-azahomoadamantanes, (**3**) (Scheme 1).

The required precursors (**3a—d**) were prepared by *m*-chloroperbenzoic acid (*m*-CPBA) oxidation of the azahomoadamantenes (**2a—d**), which are readily obtainable from the

**Table 1.** The epoxy 4-azahomoadamantanes (**3**) obtained from (**2**).<sup>a</sup>

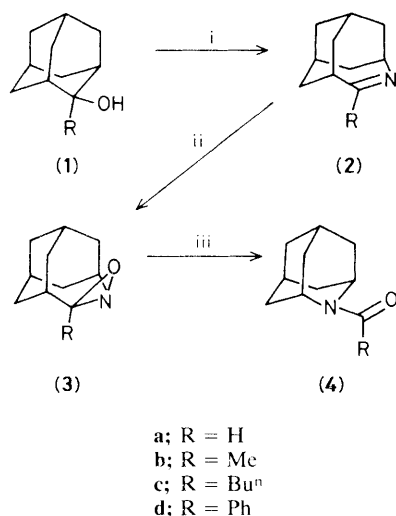
Imine	( <b>3</b> )	Reaction time/h	Yield/% <sup>c</sup>	M.p./°C	$\delta$ 3-H and 6-H <sup>d</sup>
( <b>2a</b> )	( <b>3a</b> )	3 <sup>b</sup>	61	>300	3.90 (s), 2.60 (s)
( <b>2b</b> )	( <b>3b</b> ) <sup>f</sup>	12	91	65–68	3.82 (s), 2.35 (s)
( <b>2c</b> )	( <b>3c</b> )	15	71	Oil	3.74 (s), 2.35 (s) <sup>e</sup>
( <b>2d</b> )	( <b>3d</b> )	12	63	105–107	3.93 (s), 2.99 (s) <sup>e</sup>

<sup>a</sup> Imine (**2**) was oxidized by *m*-CPBA (1.1 equiv.) in CHCl<sub>3</sub>–5% aqueous NaHCO<sub>3</sub> at 5–20 °C. <sup>b</sup> In CH<sub>2</sub>Cl<sub>2</sub>–solid NaHCO<sub>3</sub>. <sup>c</sup> Yield of isolated pure product after chromatography (Woelm neutral alumina–CH<sub>2</sub>Cl<sub>2</sub>). <sup>d</sup> In CDCl<sub>3</sub> (60 MHz). <sup>e</sup> In CCl<sub>4</sub>. <sup>f</sup> For a low yield synthesis by peracetic acid oxidation see T. Sasaki, S. Eguchi, and N. Toi, *J. Org. Chem.*, 1978, **43**, 3810.

**Table 2.** The *N*-acyl-2-aza-adamantanes (**4**) obtained from (**3**).<sup>a</sup>

( <b>3</b> )	Conversion/% <sup>b</sup>	Product	Yield/% <sup>b</sup>	M.p./°C	$\delta$ 3-H and 6-H <sup>c</sup>
( <b>3a</b> )	28	( <b>4a</b> )	67	165–167	4.52 (s), 3.73 (s)
( <b>3b</b> )	46	( <b>4b</b> )	50	Oil	4.72 (s), 3.93 (s)
( <b>3c</b> )	50	( <b>4c</b> )	60	Oil	4.73 (s), 3.98 (s)
( <b>3d</b> )	44	( <b>4d</b> ) <sup>d</sup>	44	88–91	4.93 (s), 3.90 (s)

<sup>a</sup> A 4.7–6.0 mM solution of (**3**) in cyclohexane was irradiated with a 60 W low pressure Hg lamp through a quartz filter under argon for 0.5 h at 20–30 °C. <sup>b</sup> Based on isolated amounts of (**3**) and (**4**). <sup>c</sup> In CCl<sub>4</sub> (60 MHz). <sup>d</sup> Reported as an oil in ref. 1(b); a trace of (**2d**) was also produced.

**Scheme 1.** i, NaN<sub>3</sub>–CHCl<sub>3</sub>–MeSO<sub>3</sub>H (ref. 3); ii, *m*-CPBA–CHCl<sub>3</sub>–NaHCO<sub>3</sub>; iii, *hν*–cyclohexane.

corresponding 2-hydroxyadamantanes (**1a–d**).<sup>3</sup> A mixture of (**2a**) with *m*-CPBA (1.1 equiv.) in CH<sub>2</sub>Cl<sub>2</sub>–NaHCO<sub>3</sub> stored at 5–20 °C, followed by the usual work-up and short column chromatography (Woelm neutral alumina–CH<sub>2</sub>Cl<sub>2</sub>) gave (**3a**) as sublimable crystals (61%).<sup>†</sup> The other epoxy 4-azahomoadamantanes (**3b–d**) were obtained using a similar method (Table 1).

Compounds (**3**) in cyclohexane were irradiated for 0.5 h with a low pressure Hg lamp through a quartz filter under argon. In each case a single product was formed after a short

<sup>†</sup> All new compounds had spectral and microanalytical data in agreement with the assigned structures.

time; longer periods gave a complex mixture. The initial product in each case was isolated by chromatography (Merck, alumina 60 PF<sub>254</sub>, type E–CH<sub>2</sub>Cl<sub>2</sub>) and characterized as the corresponding *N*-acyl-2-aza-adamantane (**4**) by microanalytical and spectral data. The i.r. spectra showed a strong carbonyl absorption at ca. 1640 cm<sup>-1</sup>, and the <sup>1</sup>H n.m.r. spectra showed two broad one-proton singlets at  $\delta$  4.93–4.52 and 3.90–3.73 characteristic of bridgehead protons adjacent to nitrogen. The results are summarized in Table 2.

The above facile and exclusive photochemical ring-contraction of (**3**) is rationalized in terms of stereoelectronic control theory,<sup>4</sup> *i.e.*, the geometrical arrangement of the nitrogen lone pair and the skeletal C-5–C-6 bond in an *anti*-relation in the 4-azahomoadamantane (**3**), is favourable for the rearrangement.

This ring-expansion and ring-contraction sequence of the adamantane skeleton thus provides a novel and convenient route to the 2-aza-adamantyl system.

Received, 1st June 1984; Com. 764

## References

- (a) T. Sasaki, *Adv. Heterocycl. Chem.*, 1982, **30**, 86, and references cited therein; J. G. Henkel, W. C. Faith, and J. T. Hane, *J. Org. Chem.*, 1981, **46**, 3483; (b) J. G. Henkel and W. C. Faith, *ibid.*, p. 4953; (c) W. H. Staas and L. A. Spurlock, *ibid.*, 1974, **39**, 3822; R. J. Schultz, W. H. Staas, and L. A. Spurlock, *ibid.*, 1973, **38**, 3091.
- T. Sasaki, S. Eguchi, N. Toi, T. Okano, and Y. Furukawa, *J. Chem. Soc., Perkin Trans. 1*, 1983, 2529.
- T. Sasaki, S. Eguchi, and N. Toi, *Heterocycles*, 1977, **15**, 315; T. Sasaki, S. Eguchi, and N. Toi, *J. Org. Chem.*, 1978, **43**, 3810; 1979, **44**, 3711; see also ref. 2.
- A. Lattes, E. Oliveros, M. Rivière, C. Belzecki, D. Mostowicz, W. Abramskij, C. Piccinni-Leopardi, G. Germain, and M. Van Meerssche, *J. Am. Chem. Soc.*, 1982, **104**, 3929; E. Oliveros, M. Riviere, J. P. Malrieu, and Ch. Teichtel, *ibid.*, 1979, **101**, 318.