

A FACILE ENTRY TO BICYCLIC  $\gamma$ -LACTONES AND A SHORT  
SYNTHESIS OF ( $\pm$ )-DIHYDROACTINIDIOLIDE

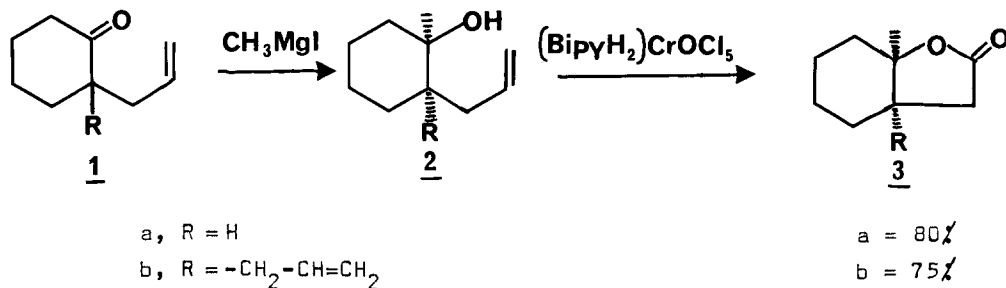
T.K. CHAKRABORTY and S. CHANDRASEKARAN\*

Department of Chemistry, Indian Institute of Technology, Kanpur 208016, India

**Abstract.** A highly useful mode of access to bicyclic  $\gamma$ -lactones **3** from tert-hydroxyolefins **2** with chromium(V) reagent or PCC and its application to the synthesis of ( $\pm$ )-dihydroactinidiolide are described.

In continuation of our studies on oxidation with pentavalent chromium reagents,<sup>1</sup> we have developed a short and efficient route to bicyclic  $\gamma$ -lactones of the type **3**. Carbon skeleton containing bicyclic lactone framework of this type forms part of a large number of naturally occurring substances either in the cis- or trans-fused form. Many of these bicyclic lactones are made from the corresponding hydroxy acids and a large category of lactonizations include those of unsaturated carboxylic acids initiated by suitable electrophilic reagents.<sup>2</sup>

In this communication, we report, a simple and a highly efficient route towards the synthesis of bicyclic  $\gamma$ -lactones **3** via oxidative cyclisation of tert-hydroxyolefins **2** in very high yield. The hydroxyolefins<sup>3</sup> **2** on treatment with

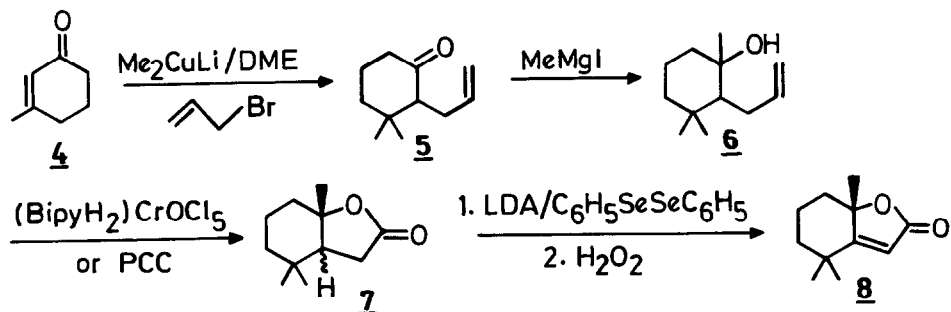


4-5 molar equivalents of the pentavalent chromium reagent, (BipyH<sub>2</sub>)CrOCl<sub>5</sub>, in dichloromethane at 40° for 8 h. yielded the cis-fused bicyclic  $\gamma$ -lactones **3**.<sup>4</sup> In the course of these studies we uncovered an interesting reaction of pyridinium chlorochromate (PCC)<sup>5</sup> hitherto unreported. We observed that PCC (4-5 molar equivalents) can also effect the oxidative cyclisation **2**  $\rightarrow$  **3**, albeit in low yields (**2a**  $\rightarrow$  **3a**, 48 h, 40°, CH<sub>2</sub>Cl<sub>2</sub>, 60% and **2b**  $\rightarrow$  **3b**, 48 h, 40°, CH<sub>2</sub>Cl<sub>2</sub>, 58%). Though extensive studies have been done with PCC,<sup>6</sup> thus far, there is no report on the oxidative cleavage of carbon-carbon double bonds with this reagent.<sup>7</sup> Our studies on this oxidative cleavage followed by cyclisation thus

enhance further the usefulness of this versatile reagent.

This simple process of forming bicyclic  $\gamma$ -lactones was extended to a short synthesis of (+)-dihydroactinidiolide, **8**,<sup>8,9</sup> a constituent of cigar tobacco leaves (SCHEME-1). Conjugate addition of lithium dimethylcuprate to 3-methylcyclohex-2-en-1-one<sup>10</sup> (**4**) followed by alkylation with allyl bromide afforded **5** (75%).<sup>11</sup>

SCHEME-1



Addition of methylmagnesium iodide to **5** gave the hydroxyolefin **6** (96%) as a mixture of diastereomers. Oxidation of **6** with five molar equivalents of (BipyH<sub>2</sub>)-CrOCl<sub>5</sub> at 40° for 8 h yielded the lactone **7** (75%) as a mixture of *cis*- and *trans*-isomers. With PCC (5 molar equivalents in CH<sub>2</sub>Cl<sub>2</sub> at 40° for 48 h) **7** was obtained in 60% yield.  $\alpha$ -Phenylselenenylation of **7** followed by treatment with hydrogen peroxide gave (+)-dihydroactinidiolide **8**.<sup>12</sup>

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12. Dihydroactinidiolide **8** gave satisfactory spectroscopic data: IR (CCl<sub>4</sub>), 1760, 1635 cm<sup>-1</sup>; <sup>1</sup>H NMR (CDCl<sub>3</sub>),  $\delta$ 1.21 (s, 3H), 1.26 (s, 3H), 1.5 (s, 3H), 1.5-2.0 (m, 6H), 5.52 (s, 1H); Exact mass, calcd. for C<sub>11</sub>H<sub>16</sub>O<sub>2</sub>, 180.124, found 180.1720.

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