

# An Efficient Synthesis of BC-ring Moiety of Pimarane-diterpenes Isolated from *Acanthopanax koreanum*

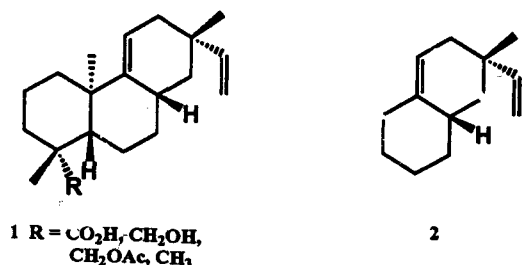
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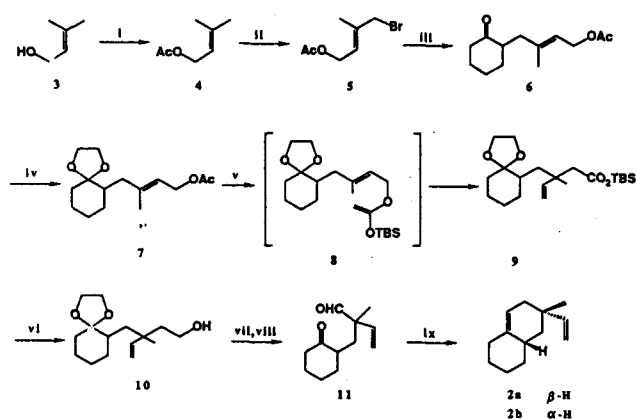
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Recently, a group of new pimarane diterpenes have been isolated from indigenous Korean medicinal plants, *Acanthopanax koreanum* (Kim *et al.*, 1980). These diterpenes have attracted our synthetic interests due to their unique structures and potentially diverse biological activities. We herein report an efficient synthetic route to the BC-ring moiety of these diterpenes which would be utilized for the studies on the structure-activity relationship. This synthesis also implies a model study for the total synthesis of pimaradienoic acid **1** (R=CO<sub>2</sub>H).



Our synthesis was initiated by preparation of tether for construction of C-ring moiety. The commercially available butenol **3** was acetylated and then allylic bromination of the resulting acetate **4** provided the allyl bromide **5** as a major product. The allyl acetate moiety was introduced into cyclohexanone by standard alkylation with allyl bromide **5** to give the allylated cyclohexanone **6**. After carbonyl protection of cyclohexanone (Barco *et al.*, 1980), The allylic acetate was subjected to the Ireland Claisen rear-



**Scheme 1.** i) Ac<sub>2</sub>O, DMAP, 0°C, 30 min, 100% ii) NBS, CCl<sub>4</sub>, reflux, 4h, 30% iii) NaI, DMPU, 50°C, 30min then cyclohexanone, LDA, THF, 0°C to rt, 1h, 73% iv) MED, (CH<sub>2</sub>OH)<sub>2</sub>, PTSA, rt, 16h, 99% v) LDA, TBSCl, THF/DMPU, -78°C to rt, 2h then toluene, reflux 8h vi) LAH, THF, 0°C, 4h, 48% from **7** vii) PCC, CH<sub>2</sub>Cl<sub>2</sub>, rt, 2h, 60% viii) PPTS, acetone/H<sub>2</sub>O, rt, 15h, 88%, ix) TiCl<sub>3</sub>, Zn/Cu, reflux, 20h, 50%.

angement (Suh *et al.*, 1989) for the elaboration of quaternary carbon unit of the C-ring moiety. LDA treatment of allylic acetate **7** in THF at -78°C followed by silylation of the resulting ester enolate furnished the ketene acetal **8**. The ketene acetal **8** smoothly rearranged by reflux in CHCl<sub>3</sub> to afford the silyl ester **9** which was directly reduced to alcohol **10** by LAH treatment in 48% yield from **7**. The alcohol **10** was finally transformed into the cyclization precursor **11** by sequential PCC oxidation and standard deketalization. McMurry dicarbonyl coupling reaction (Lenoir, 1989) for the construction of C-ring moiety was conducted by TiCl<sub>3</sub> treatment of ketoaldehyde **11** in DME (reflux, 20 h) to give the final carbocycle **2** in 50% yield as a 3:1 diastereomeric mixture of **2a** and **2b**. (scheme 1)

In summary, an efficient synthetic route to BC-ring moiety of pimaraditerpenes isolated from *Acanthopanax koreanum* has been developed. The key part of this synthesis involves a facile construction of quaternary carbon unit by Ireland Claisen rearrangement of allylic acetate and an efficient C-ring construction by McMurry dicarbonyl coupling reaction. At present, the total synthesis of pimaraditerpenes is in good progress as an application of this methodology.

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