

Enzymes in Natural Product Synthesis: A Brief Introduction

**Chuanzhen Tan
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Author



Hans Renata



Education:

2004-2008 B.S., Columbia University

Advisor: Tristan H. Lambert

2008-2013 Ph.D., The Scripps Research Institute

Advisor: Phil S. Baran

2013-2016 Postdoctoral Fellow, California Institute of Technology

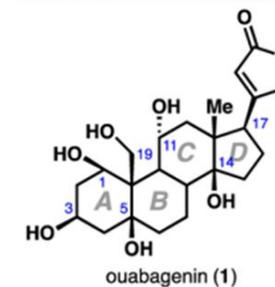
Advisor: Frances H. Arnold

Experience:

2016-2022 The Scripps Research Institute Florida

2022 Associate professor with tenure

2022-present Rice University



Content

1

Enzymatic Modifications at Early-Stage Synthesis

**Introducing Key Chiral Centers or
Functional Groups into Starting Materials**

Providing Complex Synthetic Precursors

2

Enzymatic Applications in Late-Stage Synthesis

Content

1

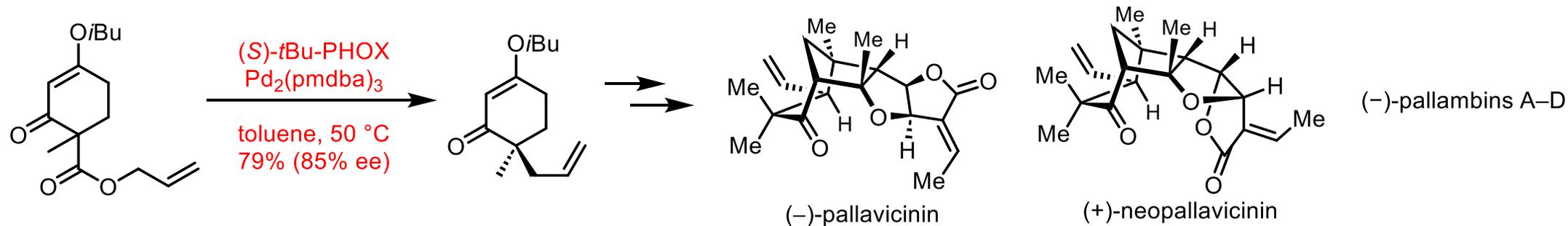
Enzymatic Modifications at Early-Stage Synthesis

**Introducing Key Chiral Centers or
Functional Groups into Starting Materials**

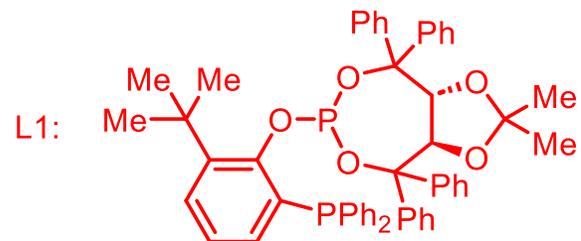
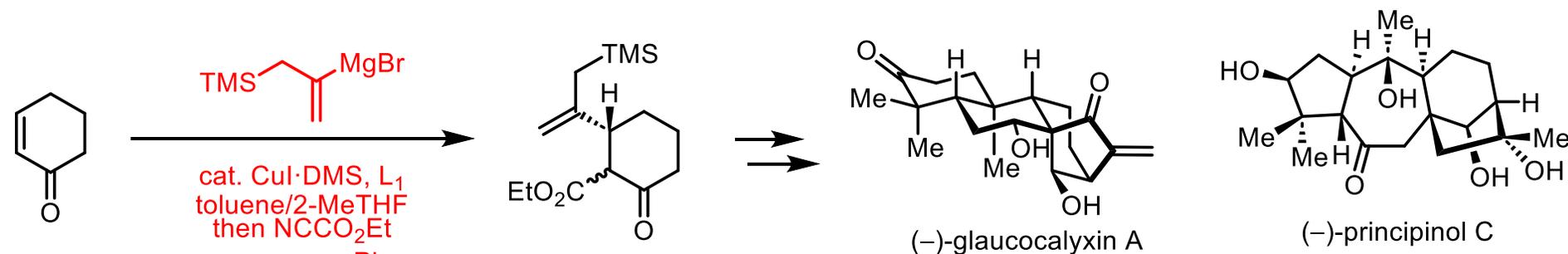
Providing Complex Synthetic Precursors

2

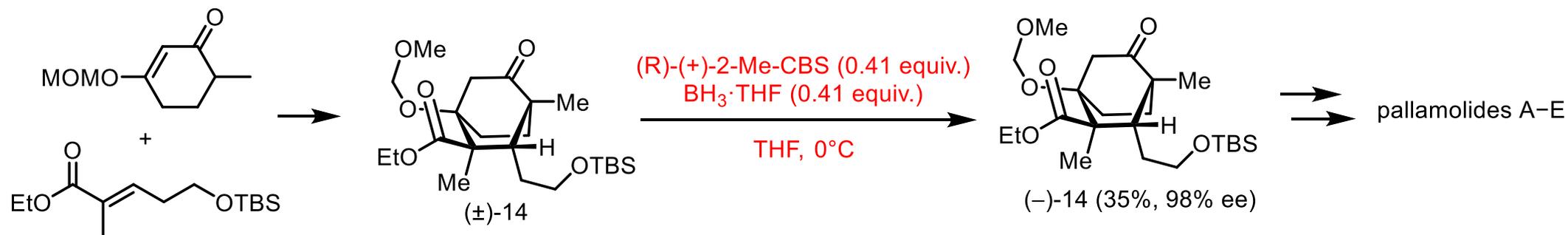
Enzymatic Applications in Late-Stage Synthesis



Bin Huang, Lei Guo, Yanxing Jia*. *Angew. Chem. Int. Ed.* **2015**, *54*, 13599–13603.
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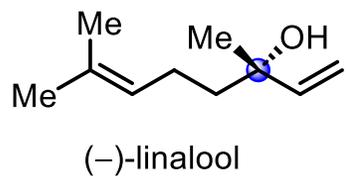
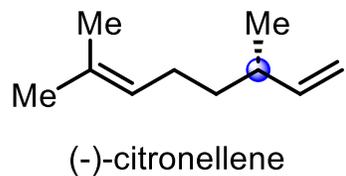
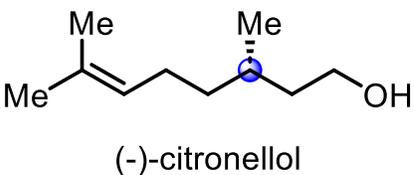
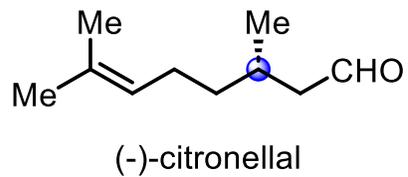
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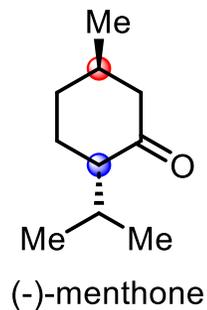
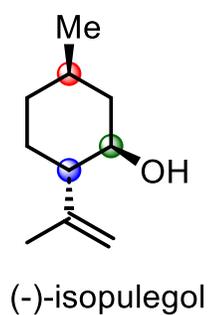
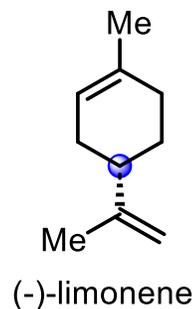
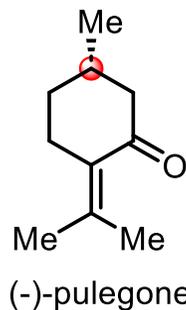
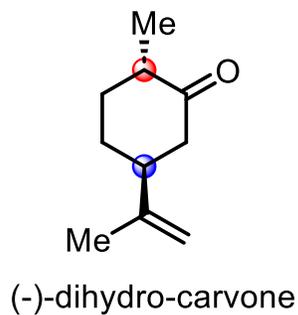
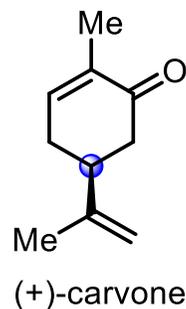
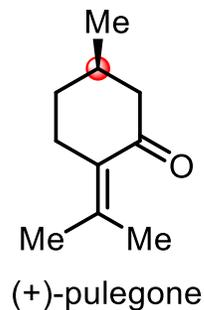
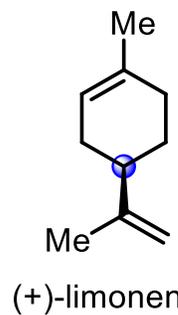
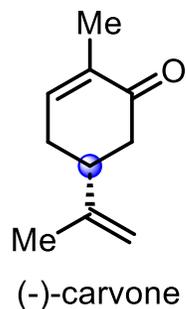
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Chiral pool

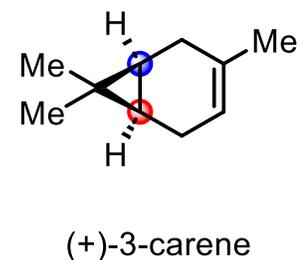
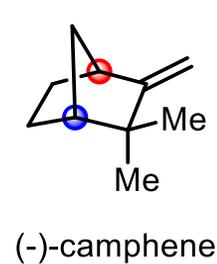
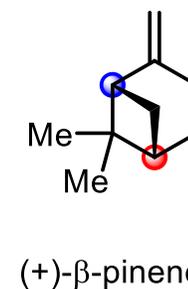
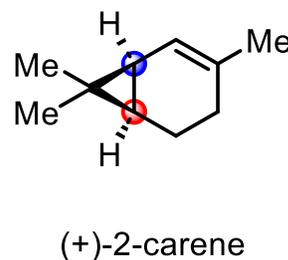
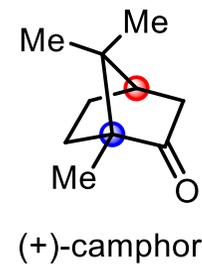
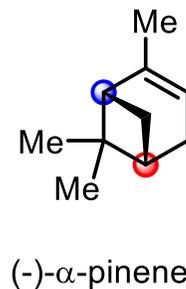
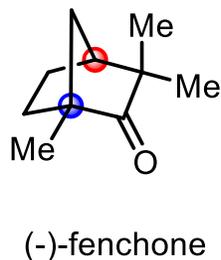
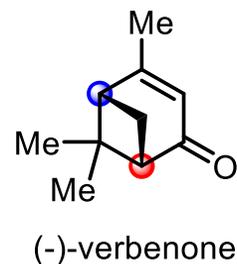
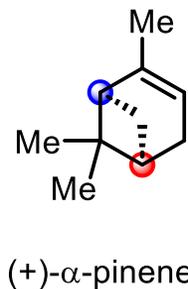
Acyclic



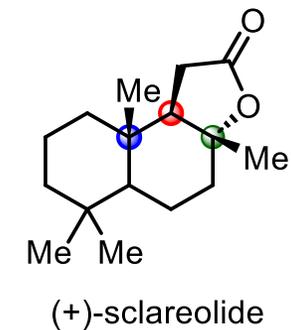
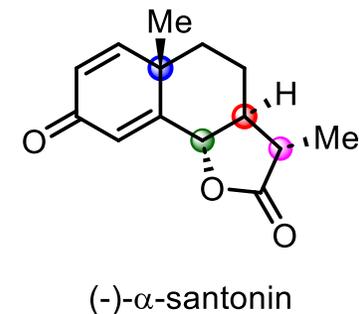
Monocyclic

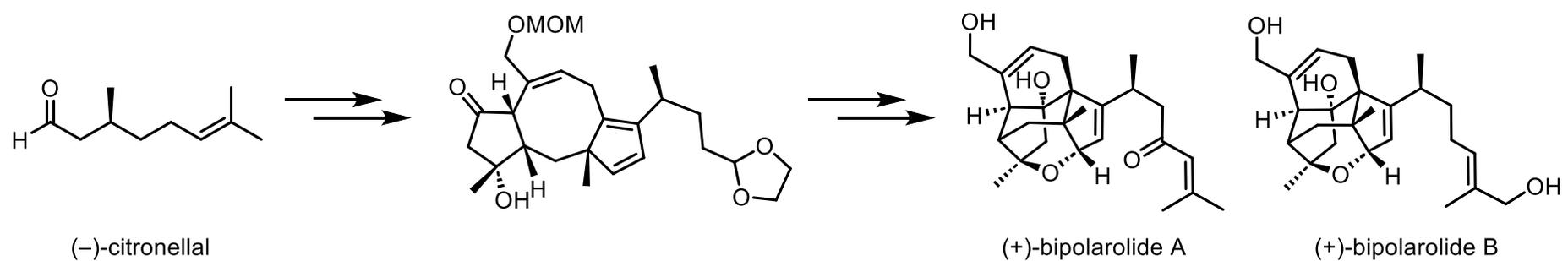


Bicyclic

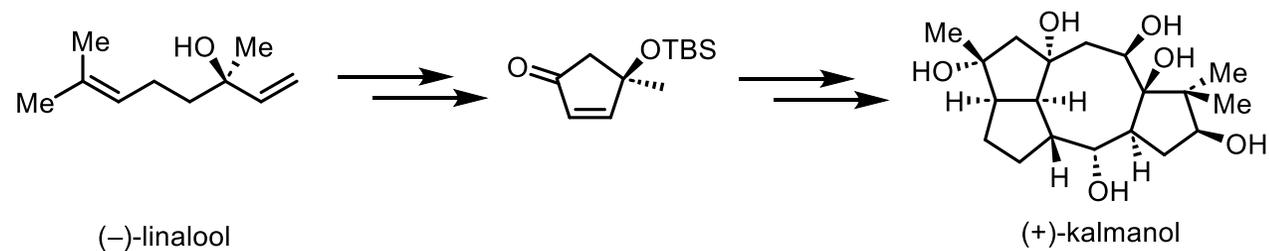


Polycyclic

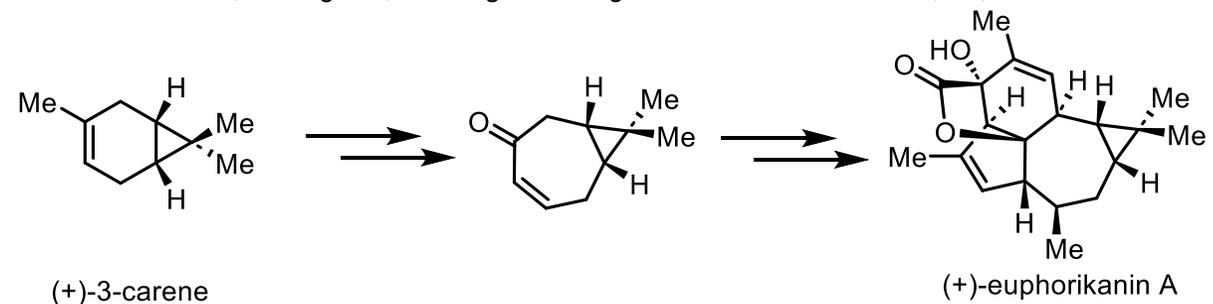




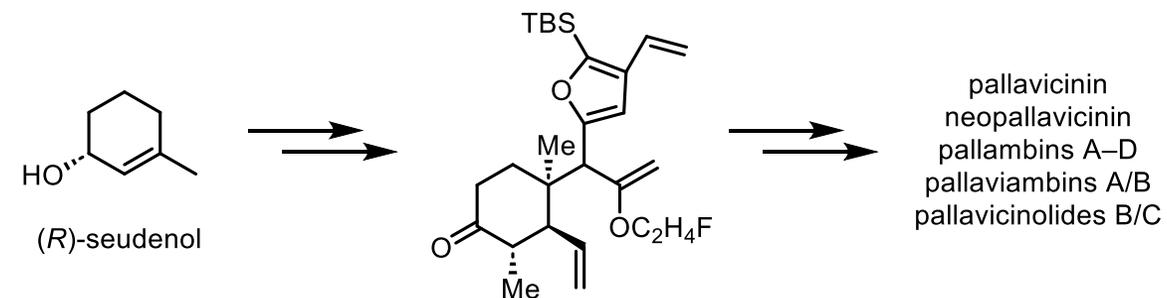
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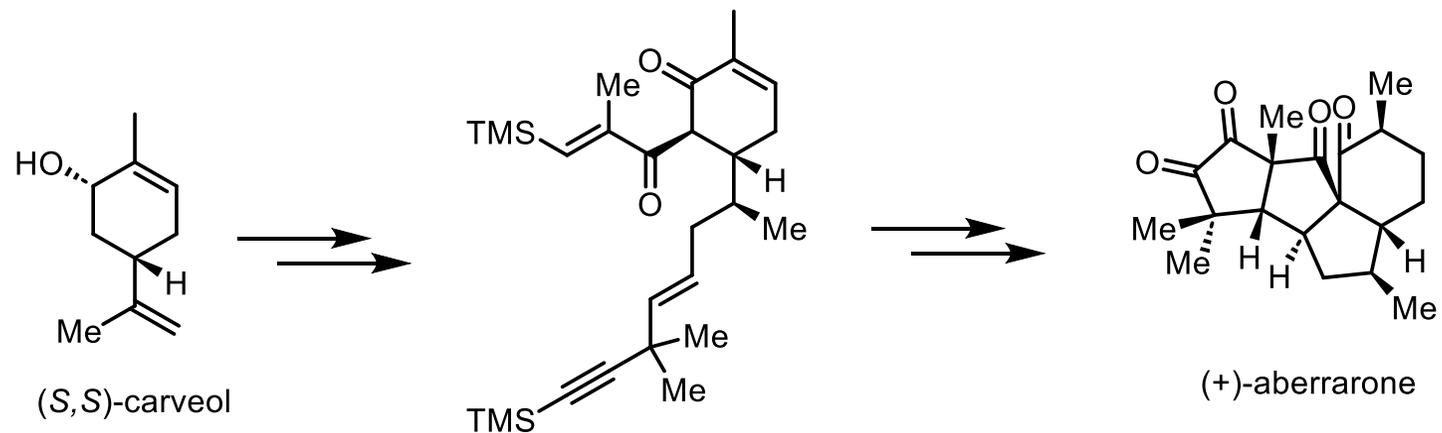
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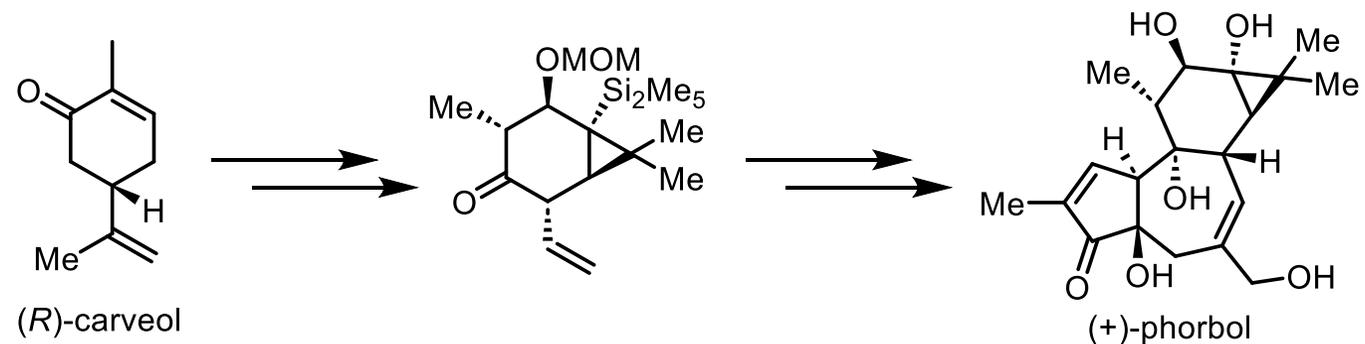
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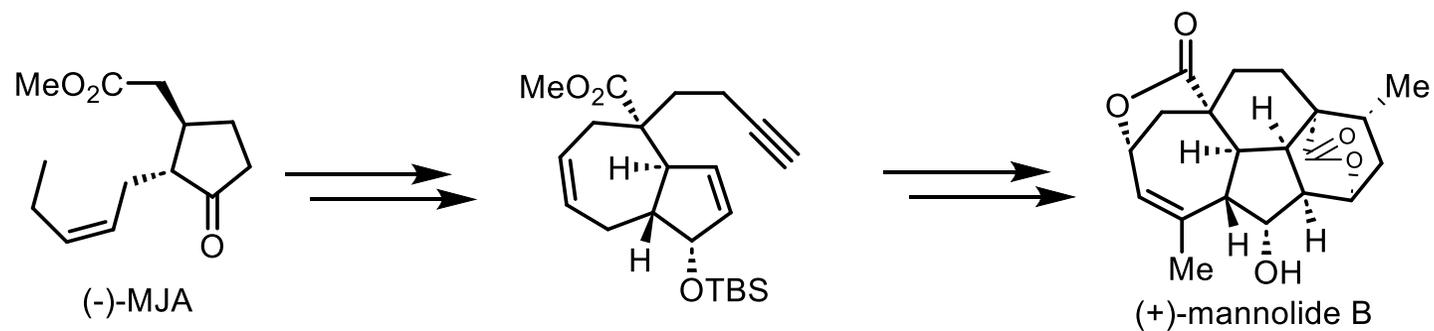
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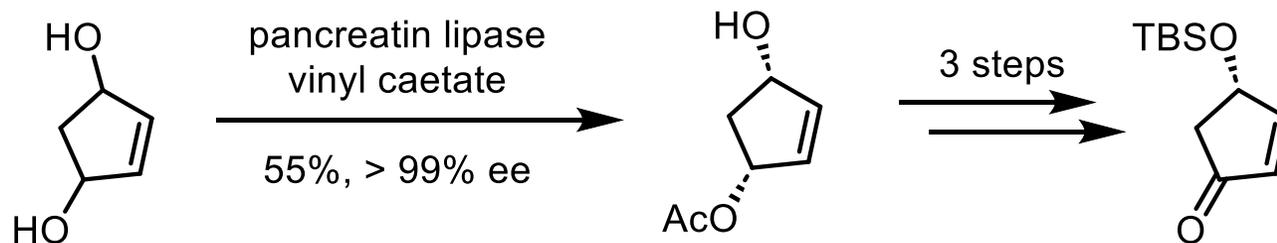
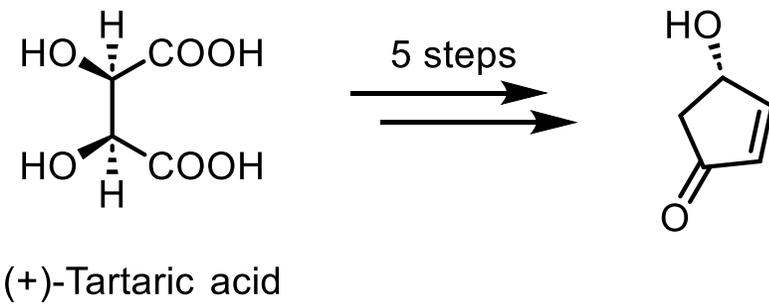
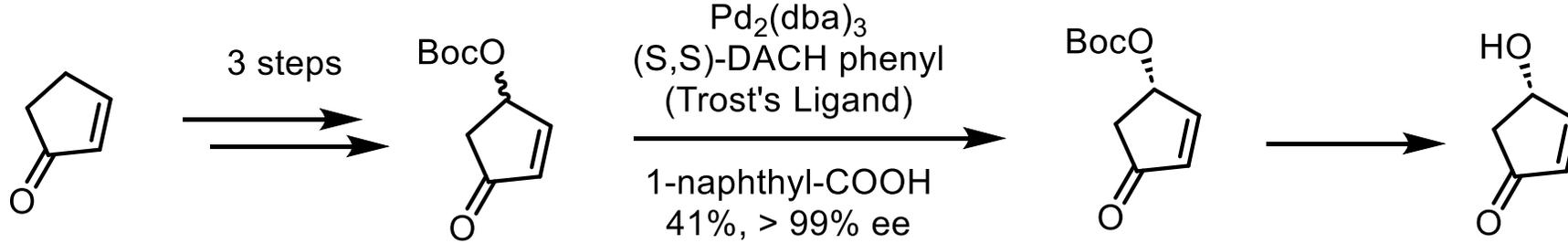


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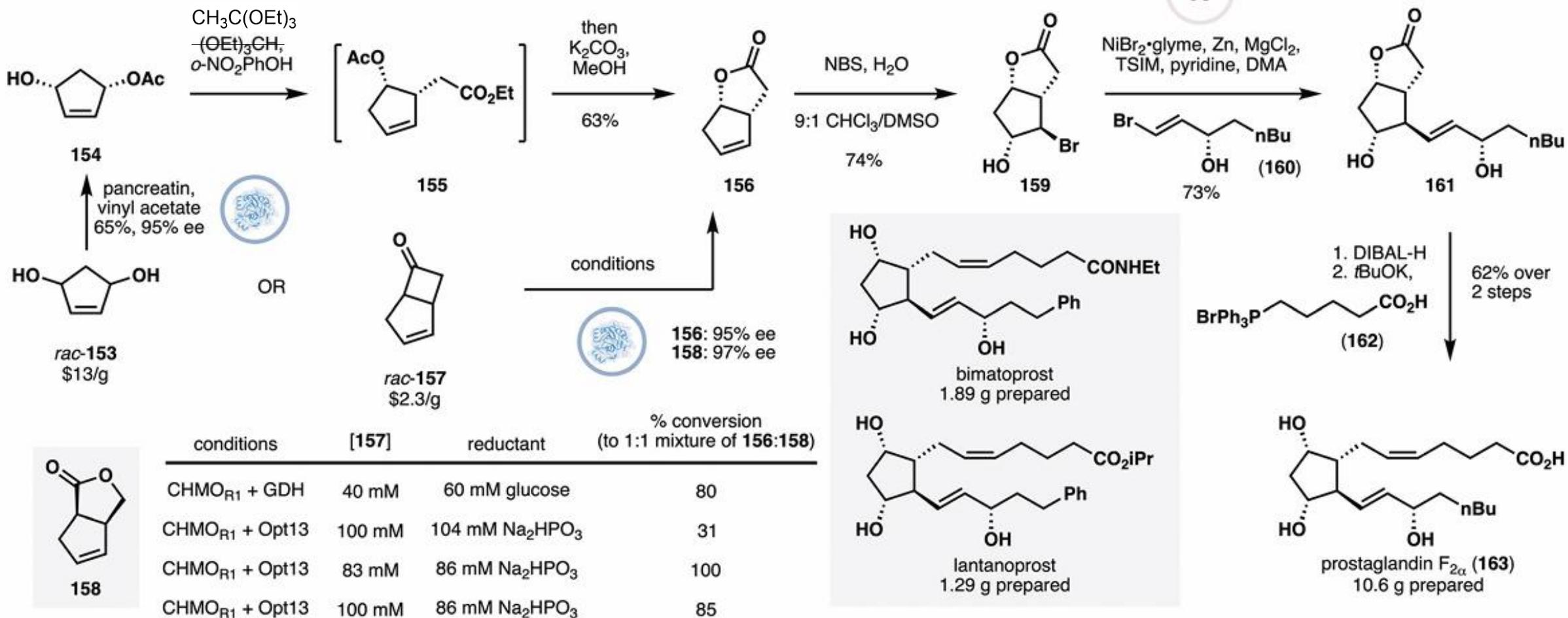
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Synthesis of (4*S*)-hydroxycyclopent-2-enone

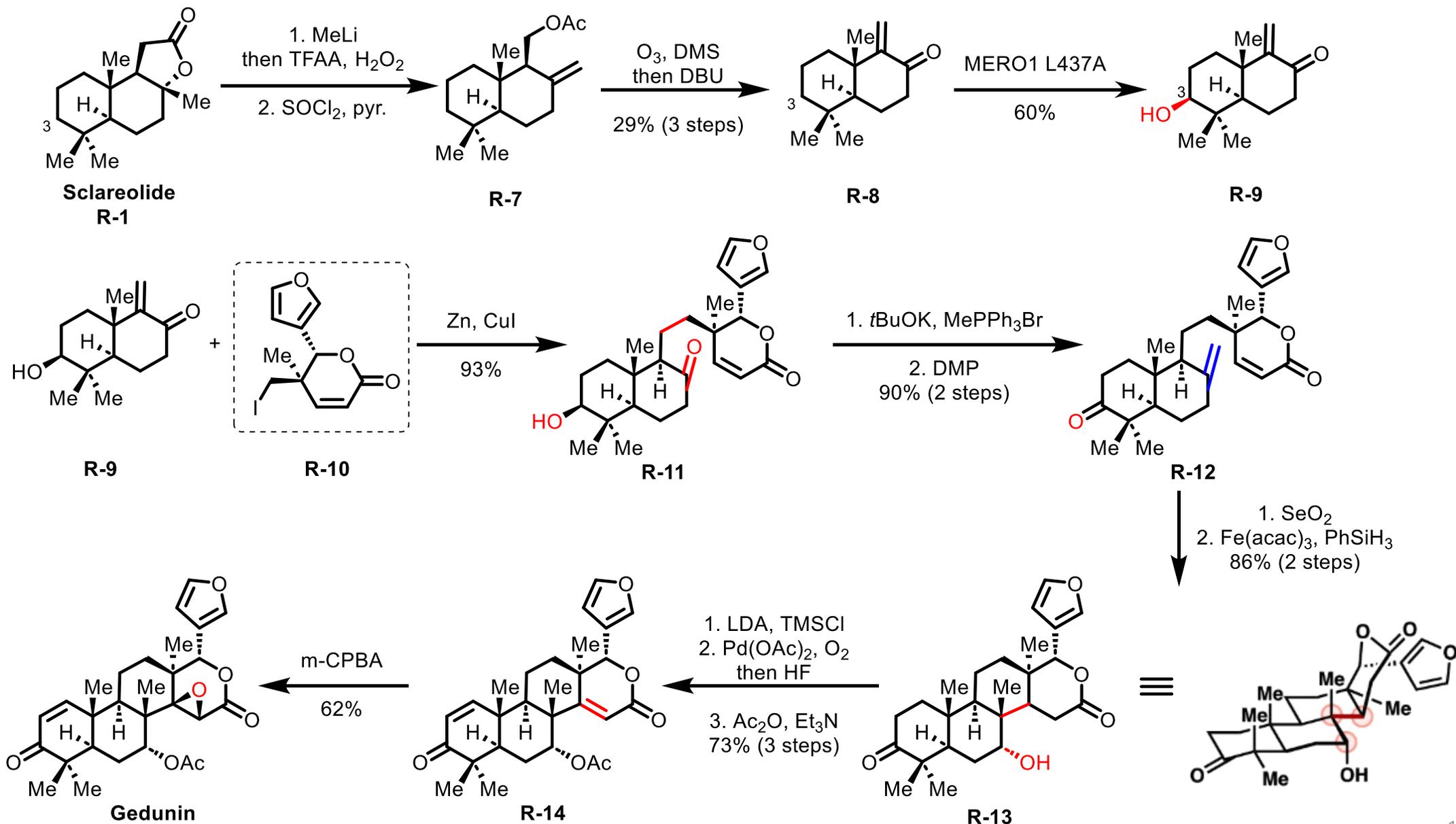


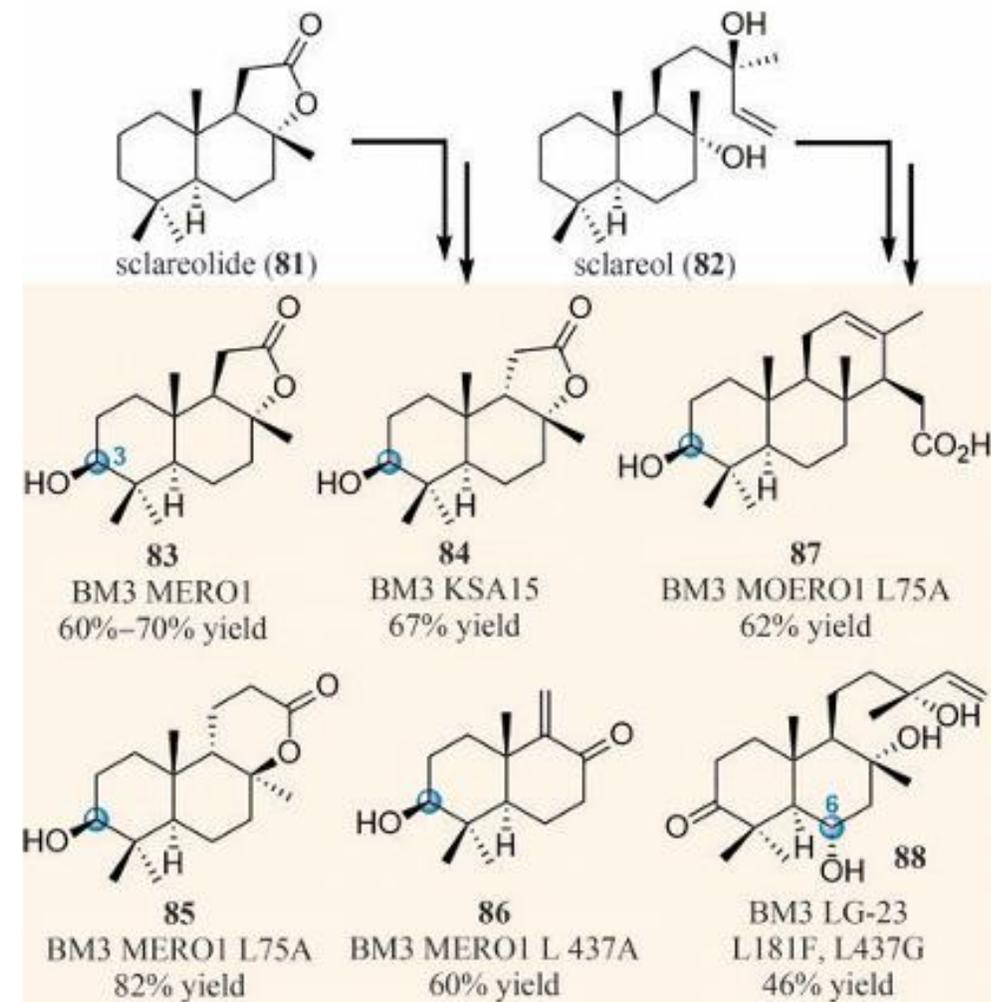
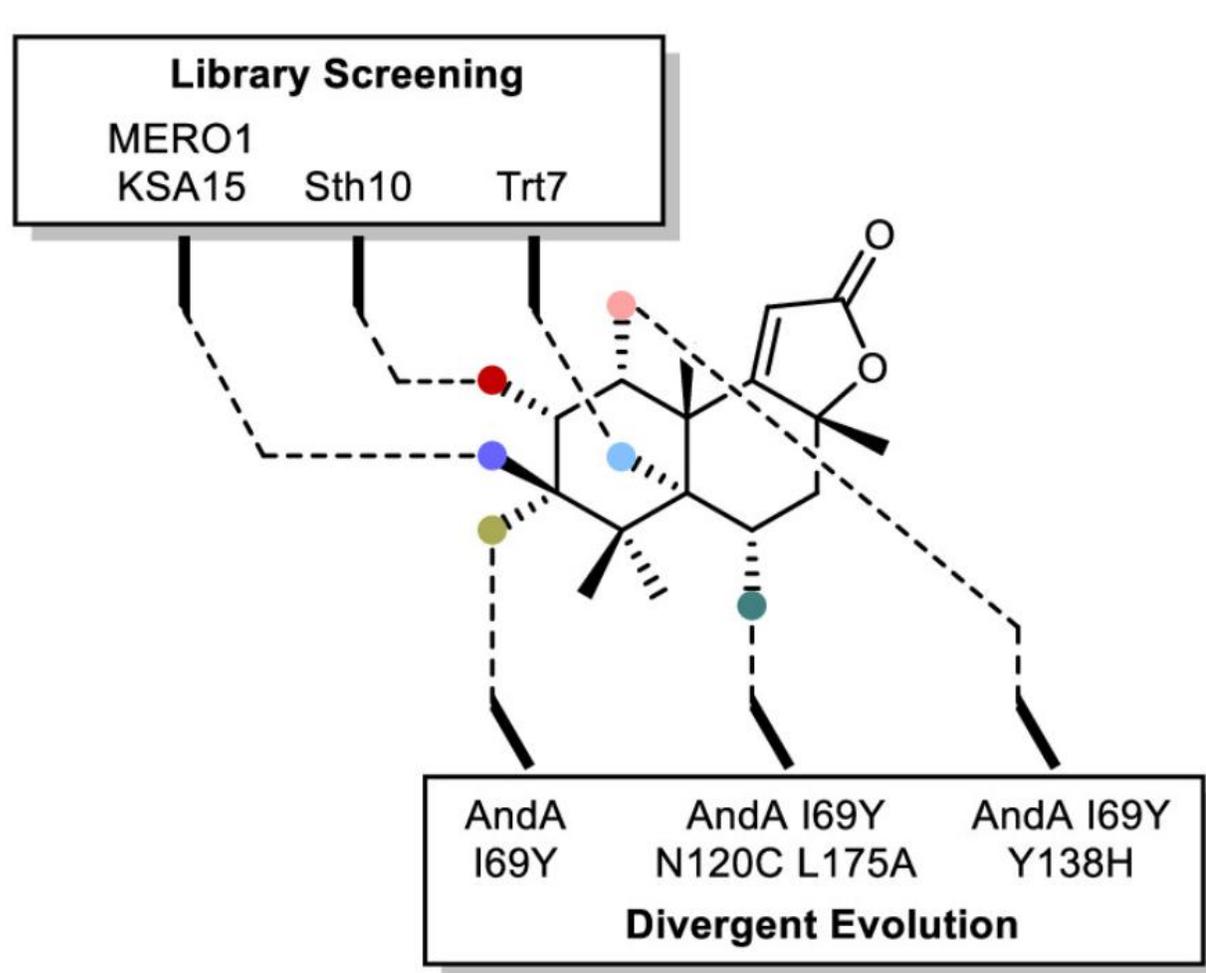
Chemoenzymatic synthesis of prostaglandins

B



Selective Hydroxylation of Sclareolide Derivatives





Content

1

Enzymatic Modifications at Early-Stage Synthesis

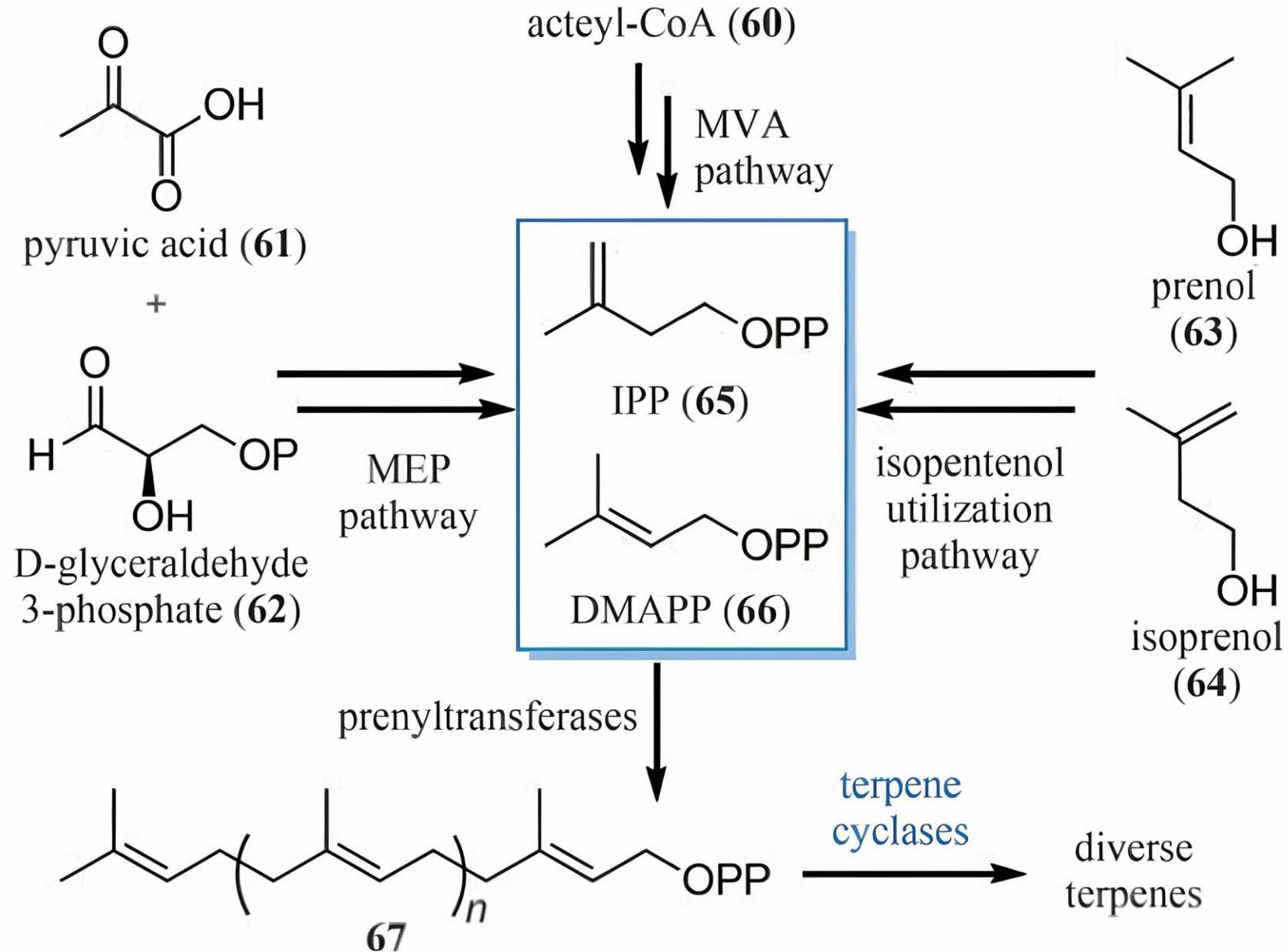
Introducing Key Chiral Centers or
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Providing Complex Synthetic Precursors

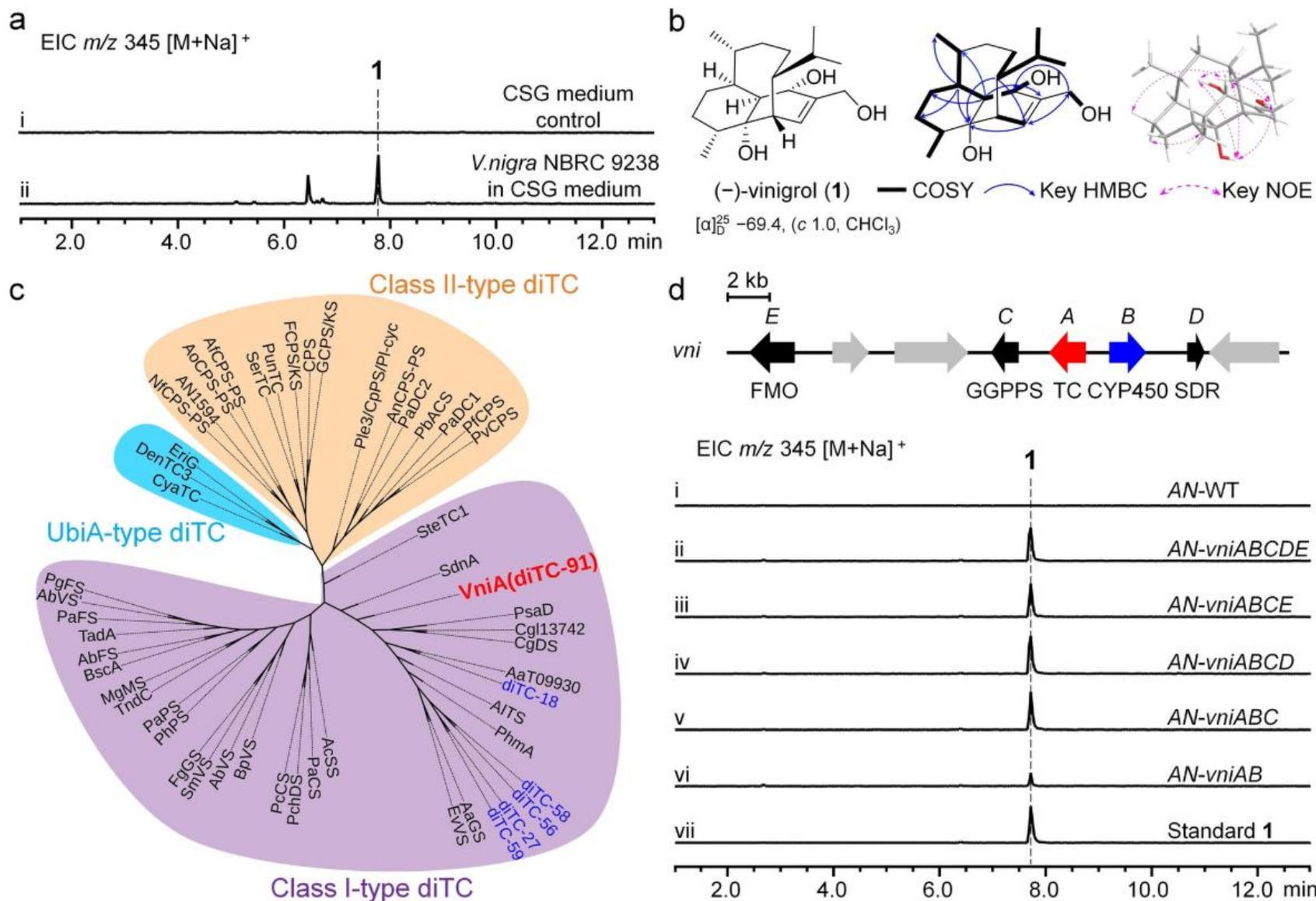
2

Enzymatic Applications in Late-Stage Synthesis

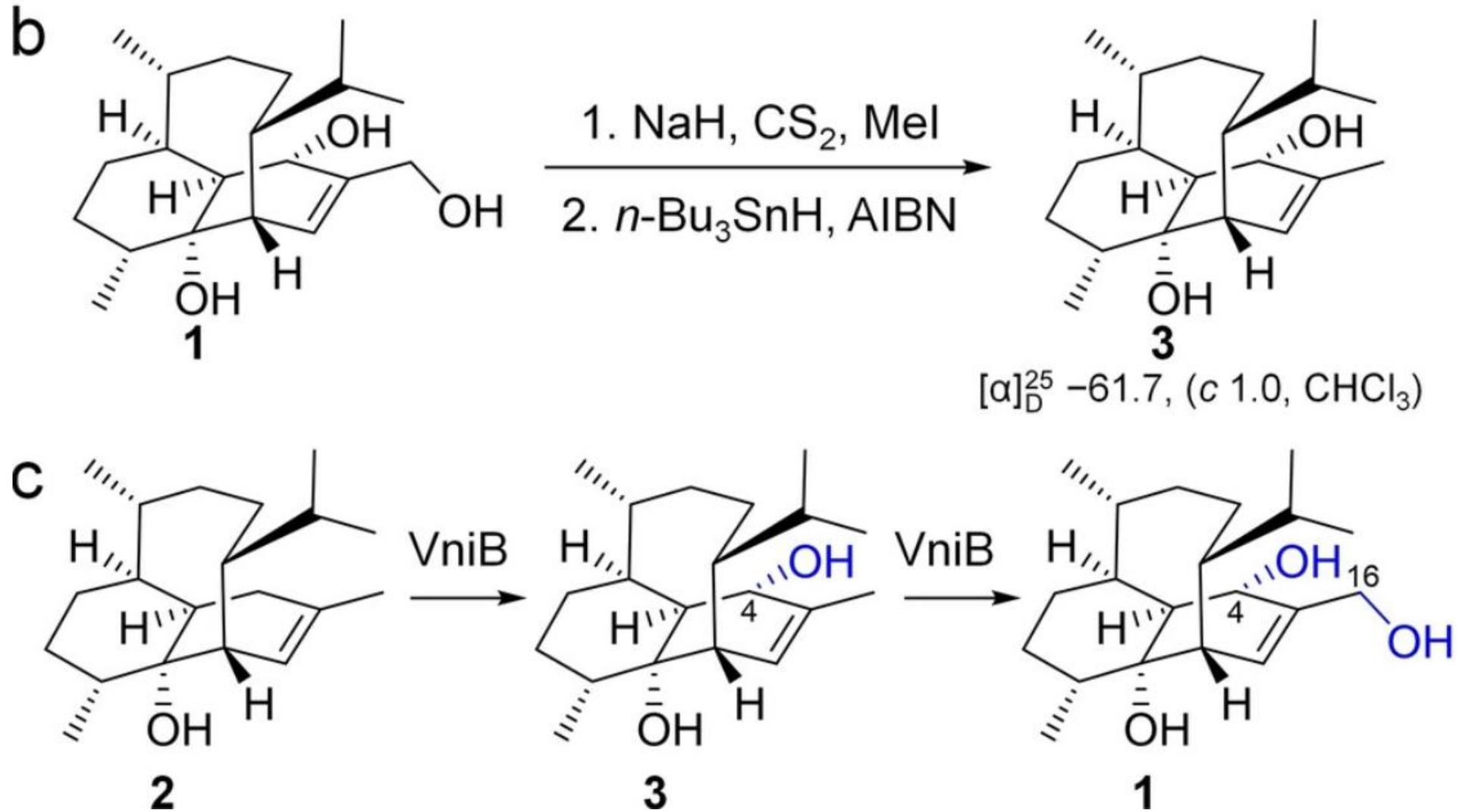
Heterologously production in
E. coli, yeast, *Streptomyces* sp. etc.



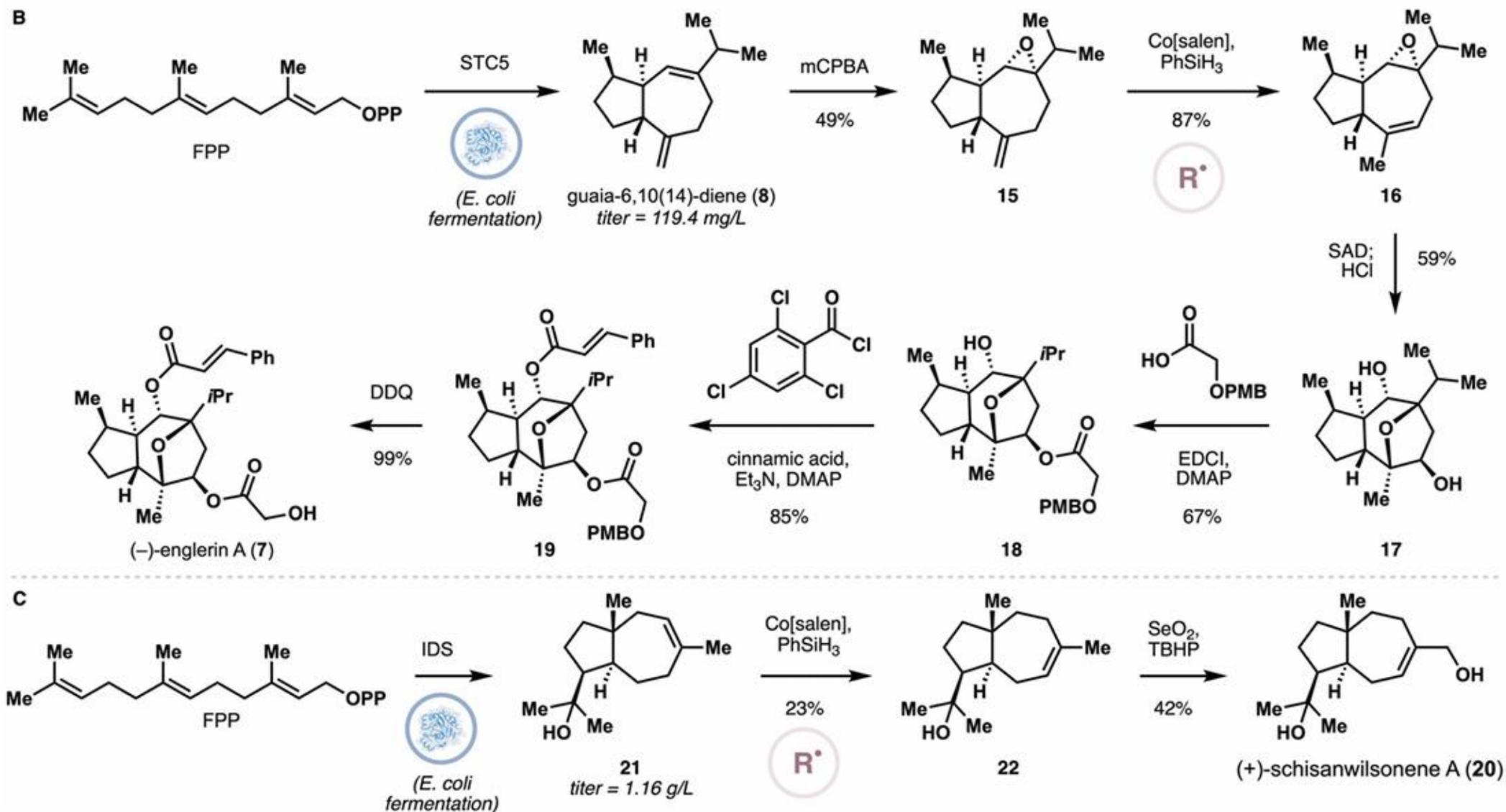
Biosynthesis of (-)-Vinigrol



Biosynthesis of (-)-Vinigrol



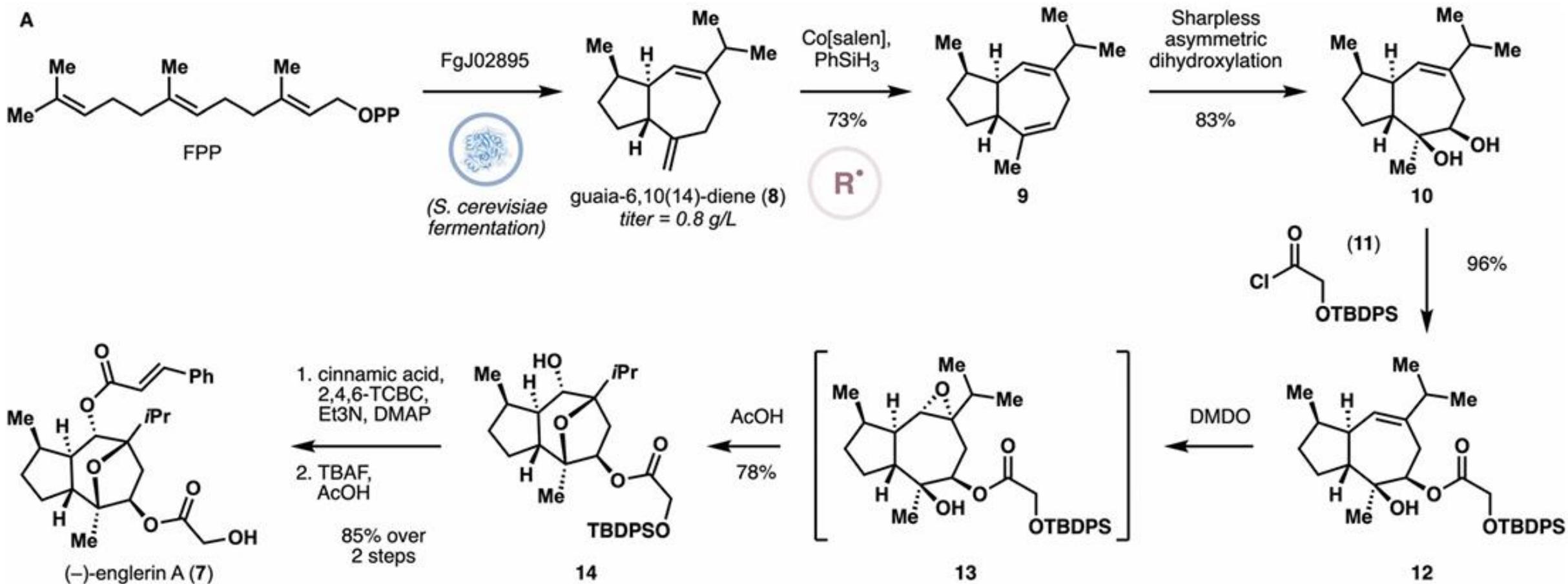
Providing Complex Synthetic Precursors



Xiang, Z. *et al. Organic Letters*, **2020**, *22*, 1976-1979

Xiang, Z. *et al. Organic Letters*, **2021**, *23*, 400-404.

Providing Complex Synthetic Precursors



Liu, T. *et al.* *J. Am. Chem. Soc.*, **2020**, *142*, 2760.

Content

1

Enzymatic Modifications at Early-Stage Synthesis

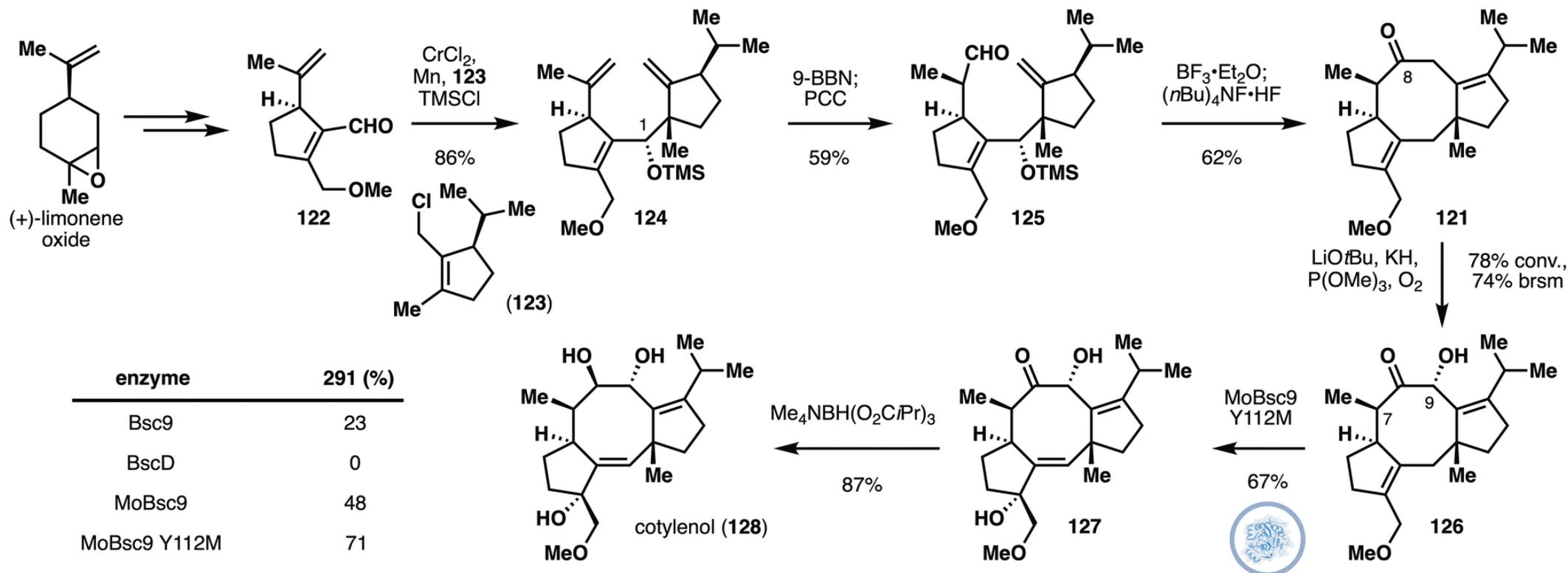
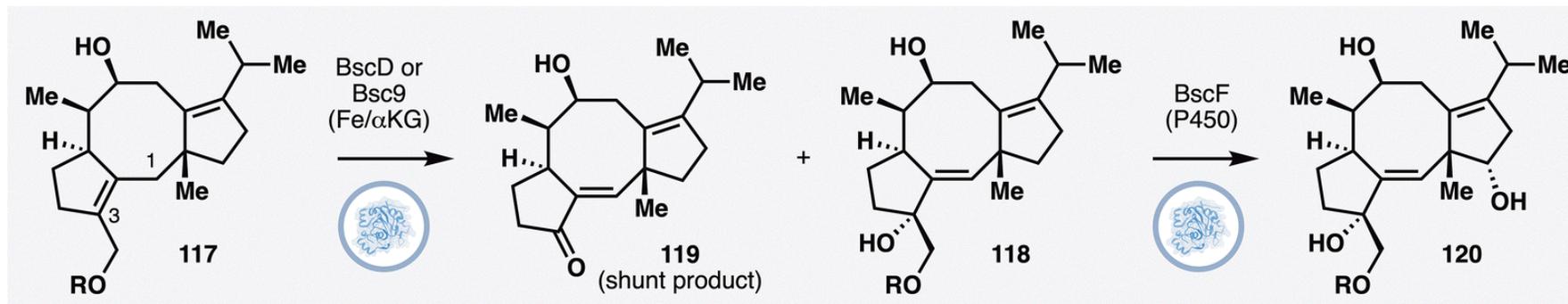
Introducing Key Chiral Centers or
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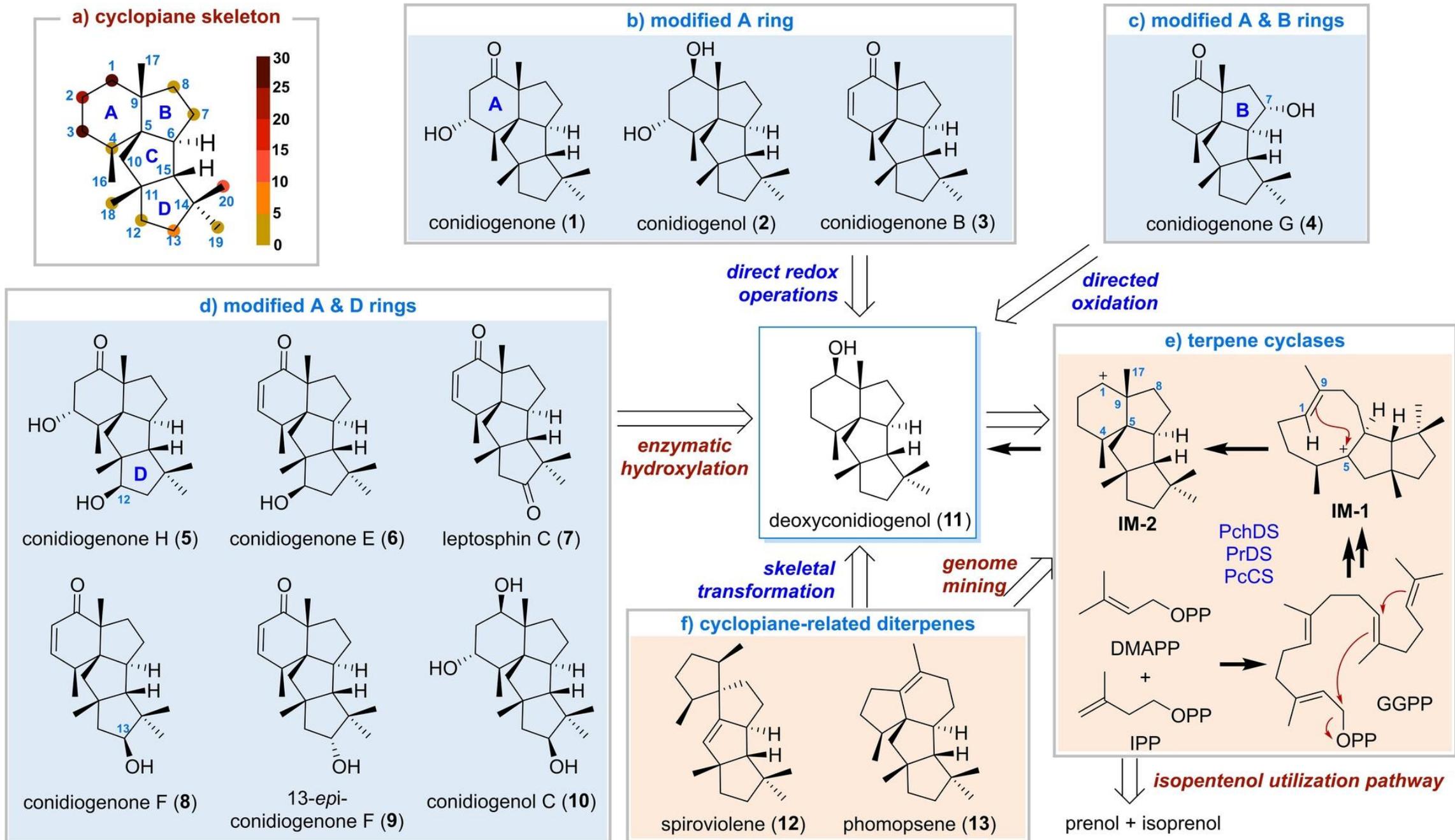
Providing Complex Synthetic Precursors

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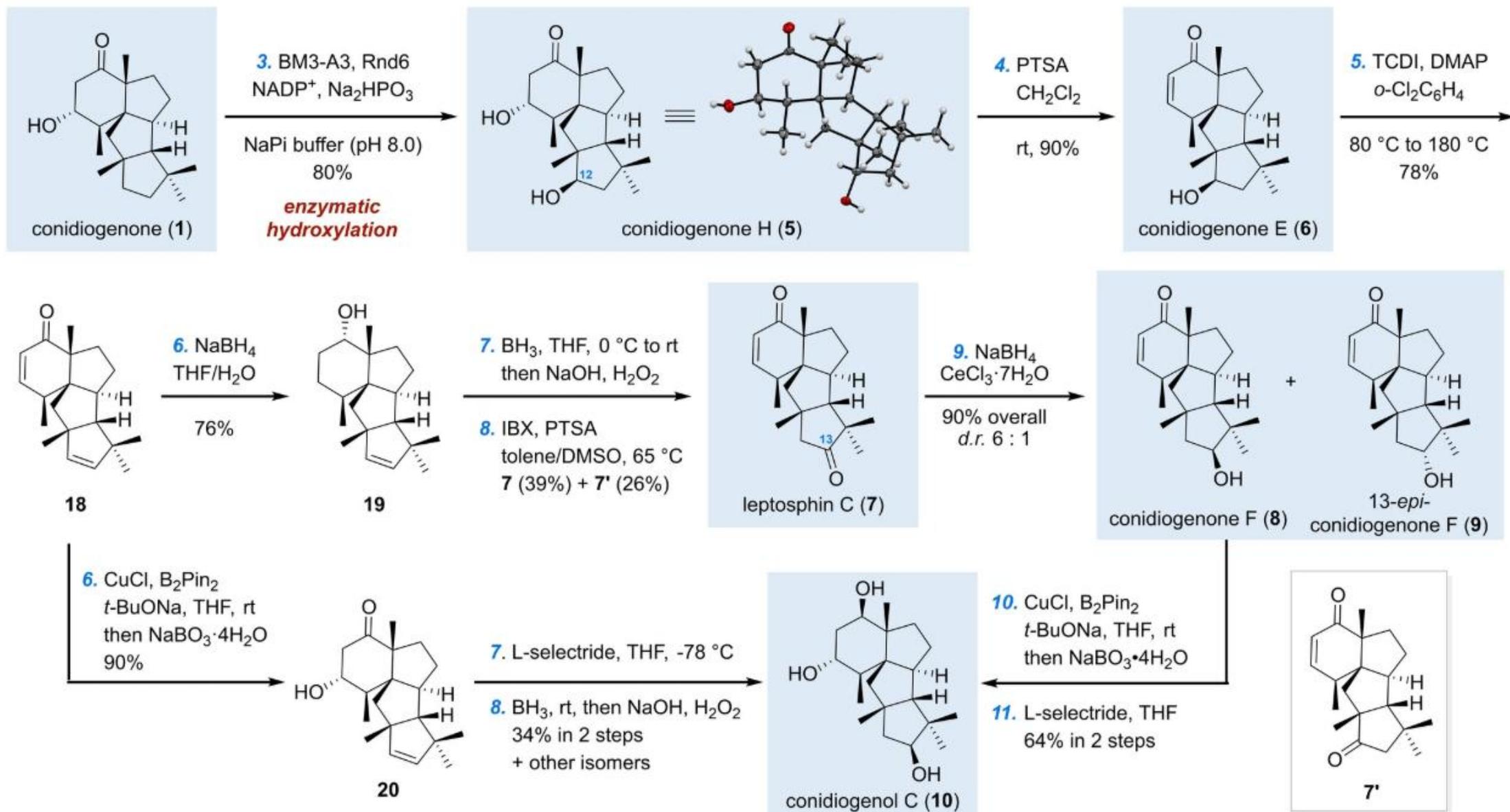
Enzymatic Applications in Late-Stage Synthesis

C3 oxidation of 126 with engineered MoBsc9



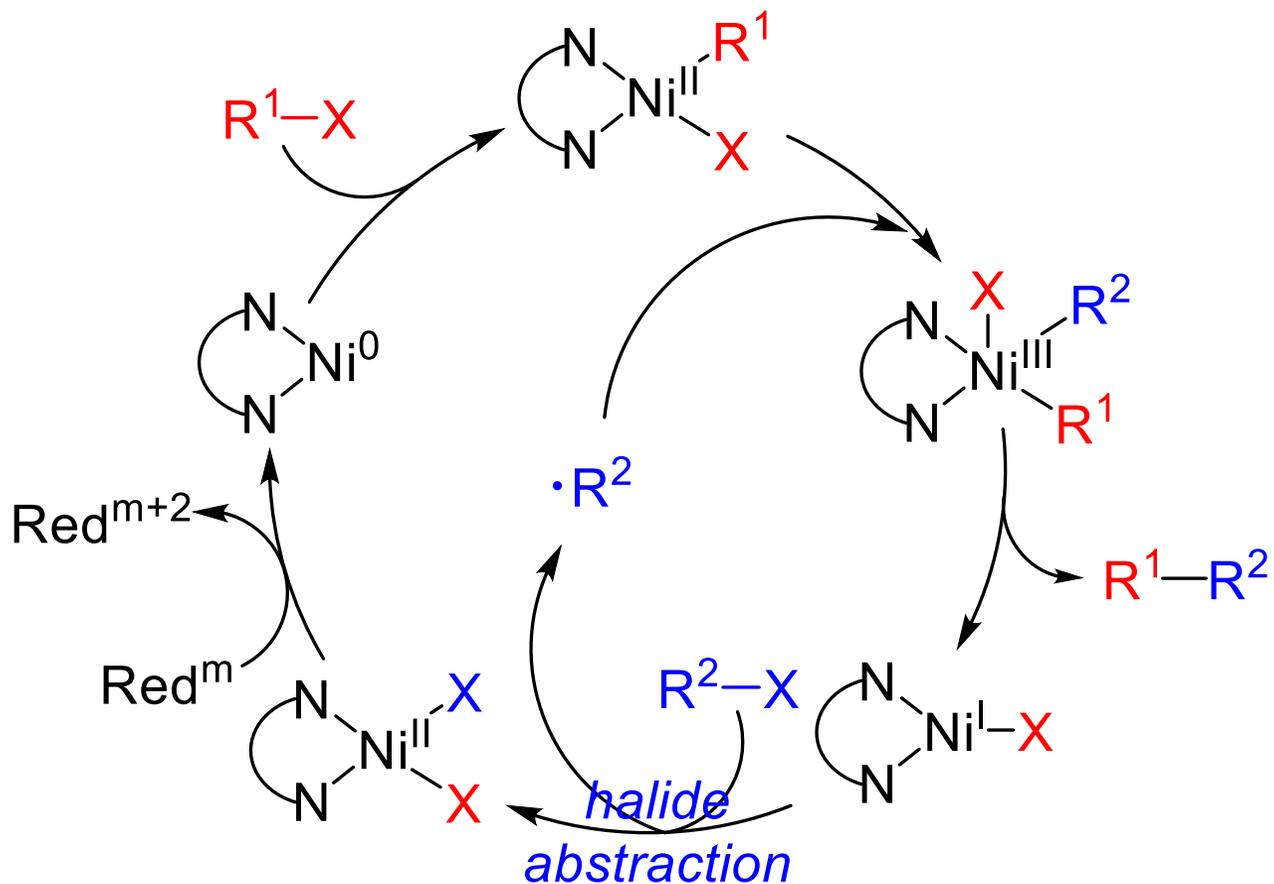
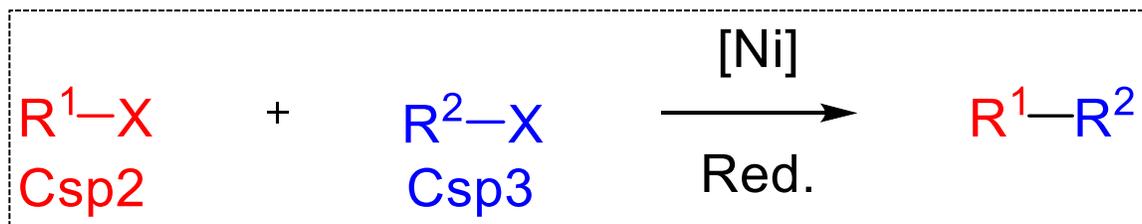


d) modification of ring D: enzymatic hydroxylation

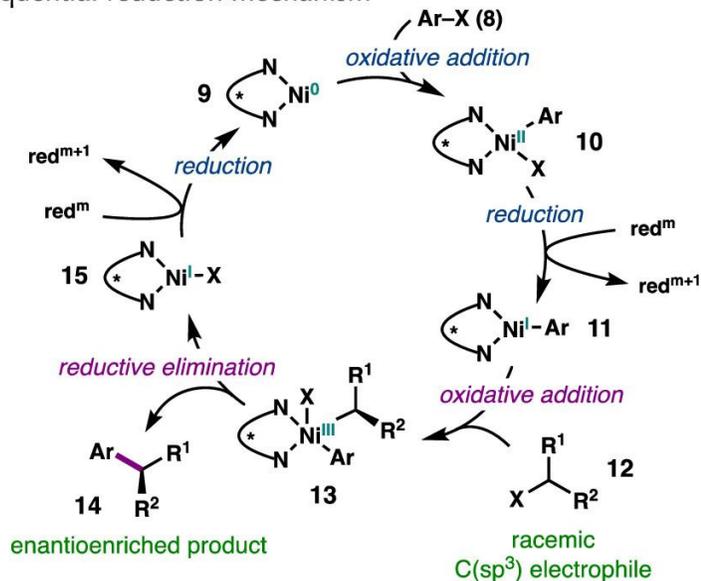


Thanks for your attention!

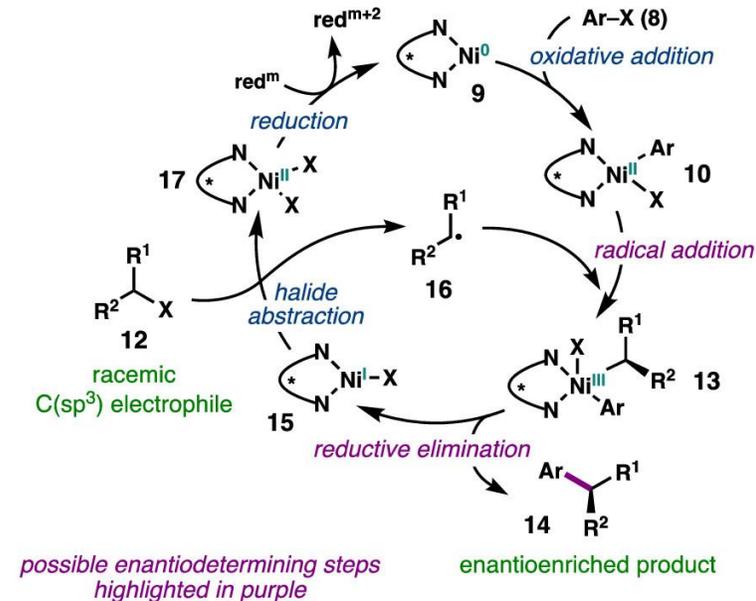
镍催化的还原偶联反应



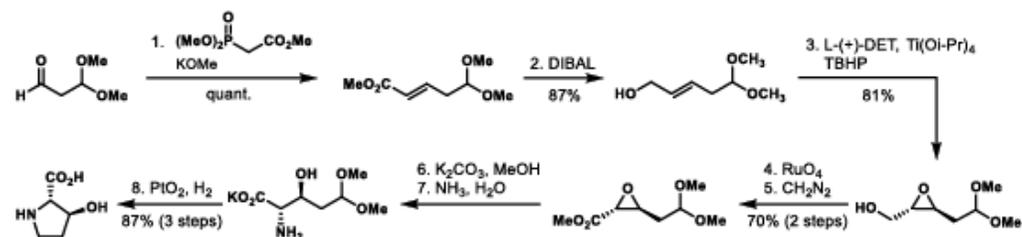
a) Sequential reduction mechanism



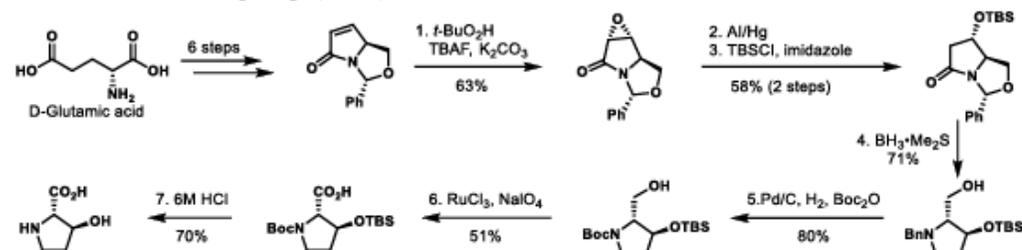
b) Radical chain mechanism



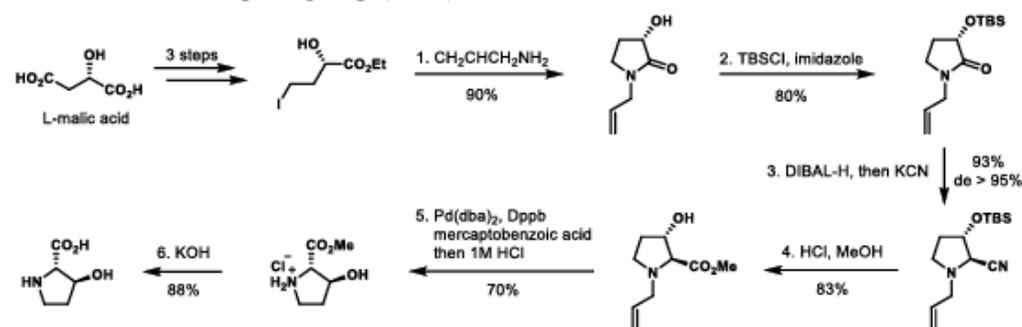
1. Philip Hughes' group (1989)¹⁷



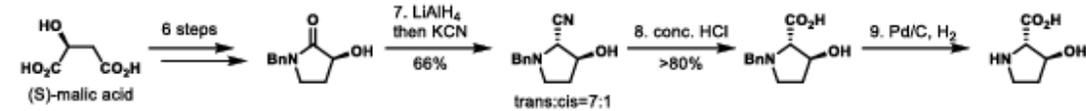
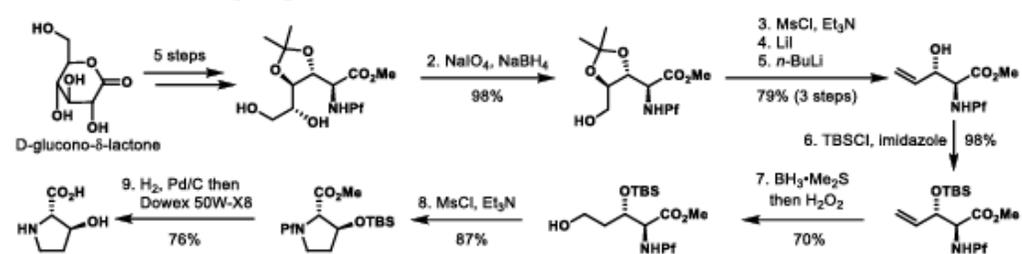
2. Claus Herdeis' group (1994)¹⁸



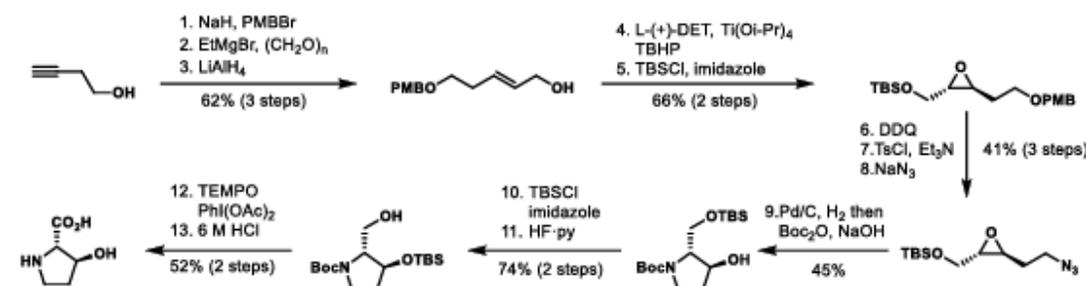
3. Marc Larchevêque's group (1998)¹⁹



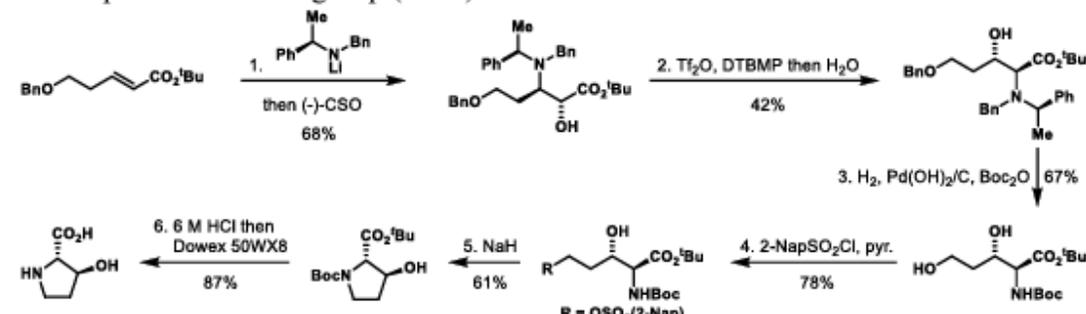
4. Ki Hun Park's group (2001)²⁰



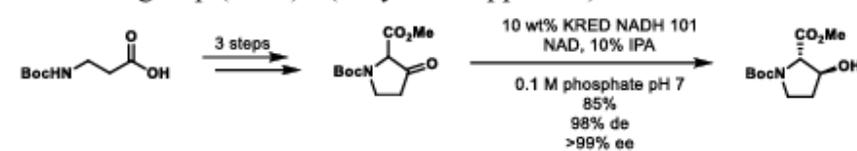
6. Srivari Chandrasekhar's group (2012)²²



7. Stephen G. Davies' group (2018)²³



8. Prier's group (2019)²⁴ (enzymatic approach)



9. Satoshi Ichikawa's group (2022)²⁵

