Concise Total Synthesis of Ambiguine P

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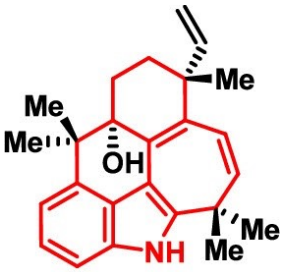
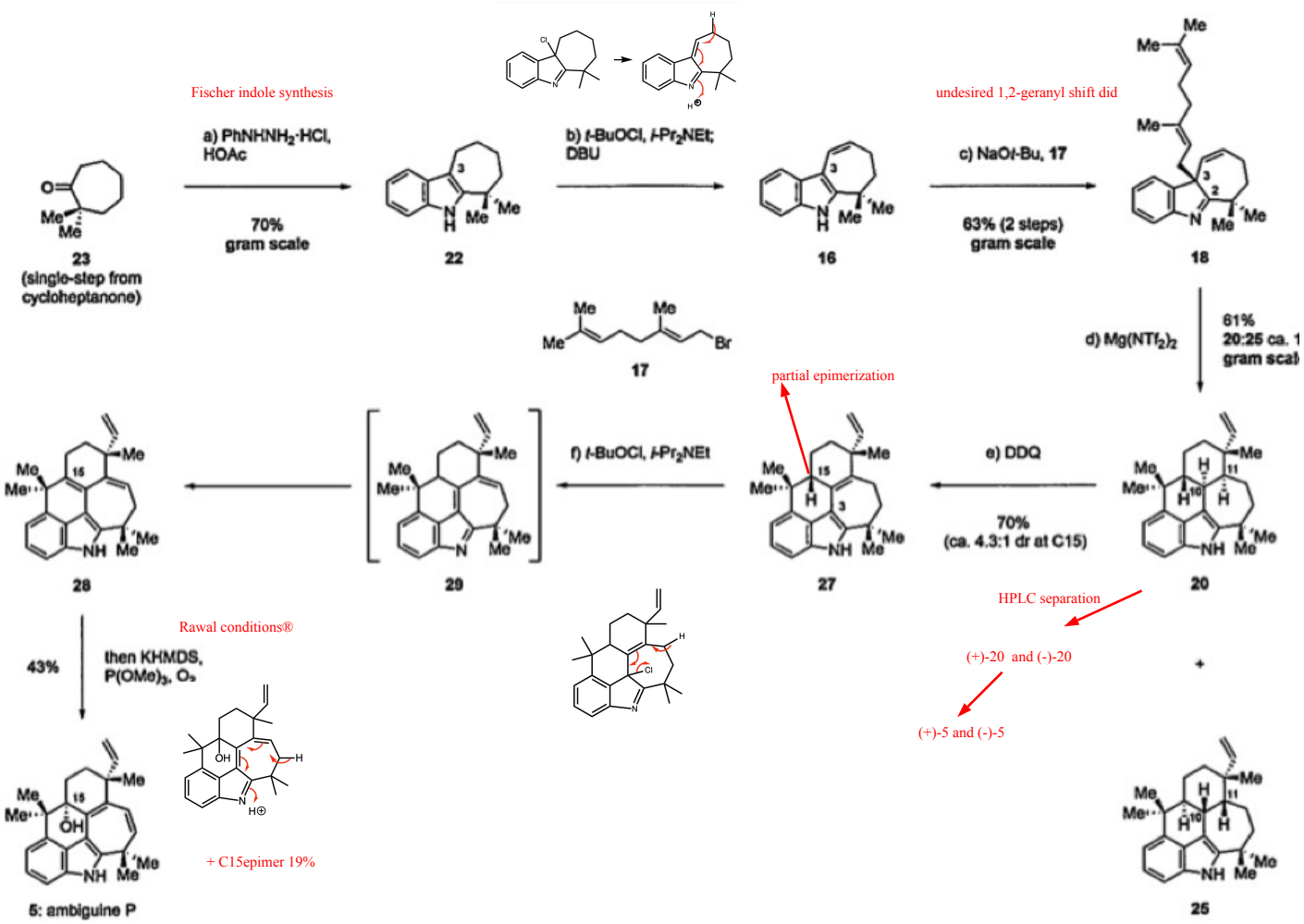
hapalindole-type natural product



ambiguine P



a Cope/Prins/Friedel-Crafts cascade reaction.

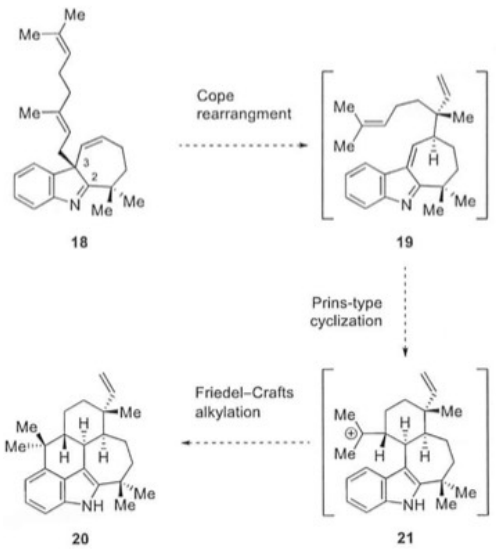
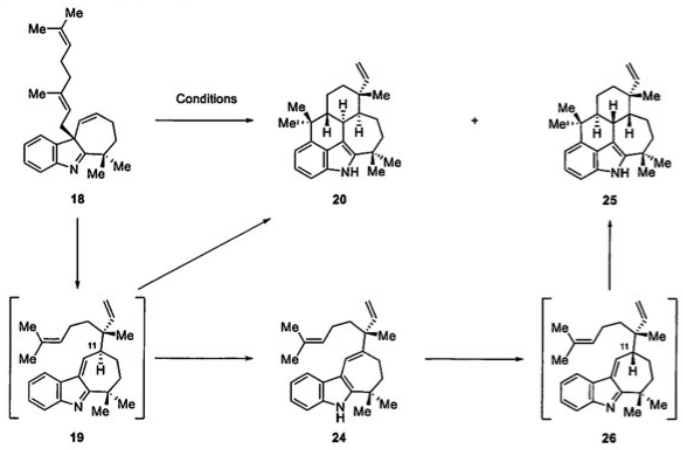


Table 1. Investigation of the Cope/Prins/Friedel–Crafts Cascade



Entry	Conditions	20 + 25 (%)	20:25
1[a]	150 °C	0[b]	– → 24 only
2[c]	Sc(OTf)3,[d] 70 °C, 15 h	42	1.2:1
3[c]	Bi(OTf)3,[d] 70 °C, 15 h	36	1.3:1
4[c]	Zn(OTf)2,[d] 70 °C, 24 h	45	3:1
5[c]	Zn(NTf2)2,[d] 70 °C, 72 h	62	7:1
6[c]	Ca(NTf2)2,[d] 70 °C, 120 h	51	2:1
7[c]	Mg(NTf2)2,[d] 70 °C, 72 h	68	10:1
8[c]	Mg(NTf2)2,[e] 70 °C, 36 h	59	10:1
9[c]	Mg(NTf2)2,[d] 80 °C, 24 h	49	4:1

[a]BHT (3.5 equiv) was added. *o*-DCB was used as a solvent. [b]Compound 24 was obtained in 52% yield. [c]DCE was used as a solvent. [d]20 mol %. [e]30 mol %.