Asymmetric Total synthesis of Asperones A and B through Organocatalyzed Quinone [5 + 2] Cycloaddition

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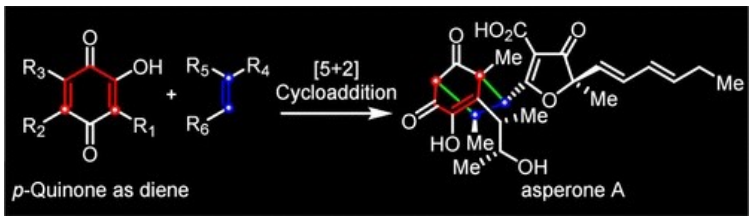
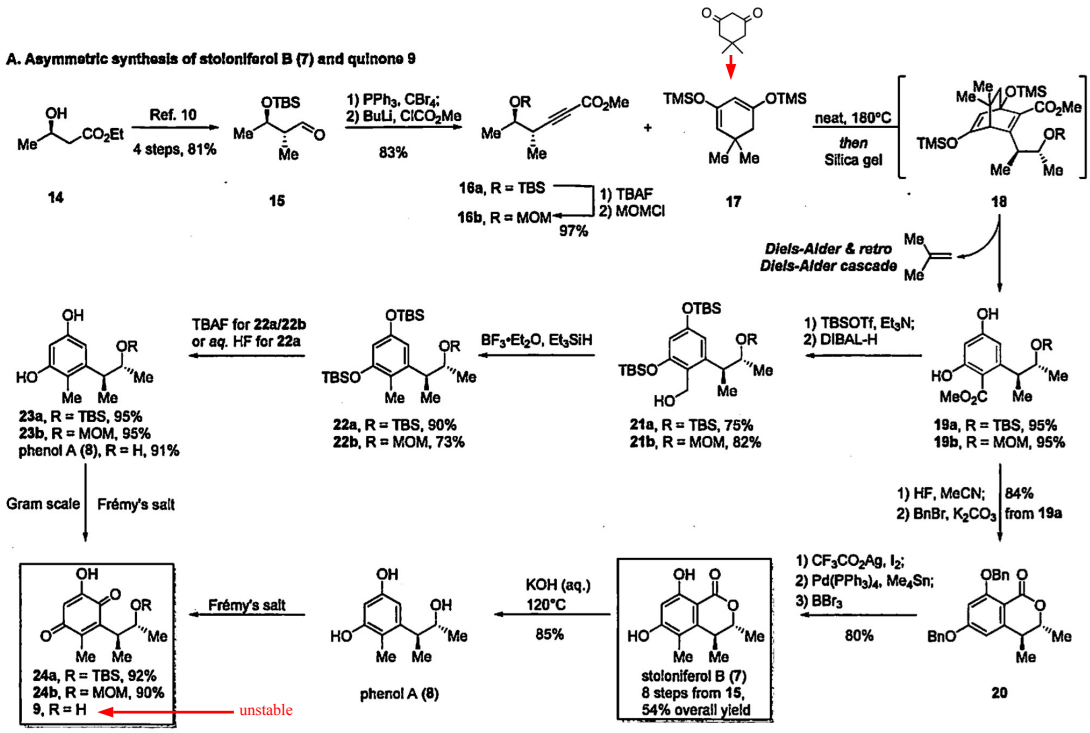


A. Asymmetric synthesis of stoloniferol B (7) and quinone 9



B. Catalytic asymmetric synthesis of gregatin A (13)

the use of unconjugated

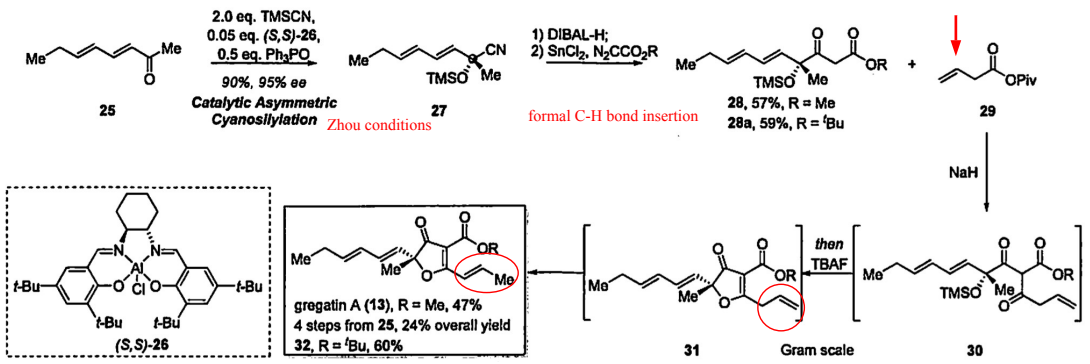
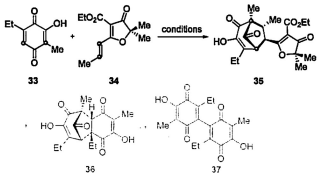
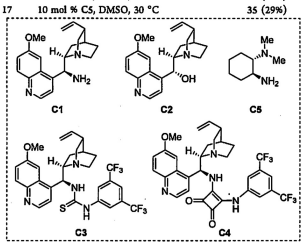


Table 1. Optimization of the Reaction Conditions for Intermolecular [5 + 2] Cycloaddition of *p*-Quinones

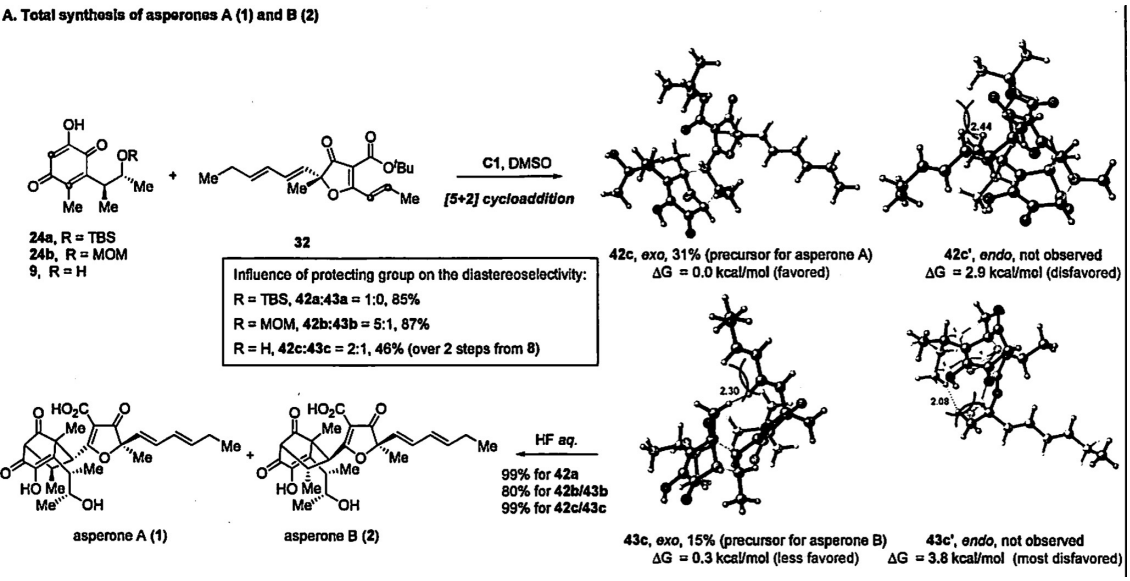


Entry	Condition	Product (yield)
1	CuI, Et_3N, 50 °C	36 (75%)
2	$FeCl_2$, Et_3N, 23 °C	37 (28%)
3	$Mn(OAc)_3$, 80 °C	decomposition
4	$BF_3{\cdot}Et_2O$, 23 °C	n.d.
5	$TiCl_4$, $Ti(O^iPr)_4$, − 78 °C	n.d.
6	$^iPr_2NH$, 30 °C	n.d.
7	*L*-Proline, 23 °C	n.d.
8	Piperidine, AcOH, 23 °C	n.d.
9	Quinoline, 120 °C	n.d.
10	10 mol % C1, 10 mol % TFA, DMSO, 23 °C	n.d.
11	10 mol % C2, DCE, 30 °C	n.d.
12	10 mol % C1, DCE, 30 °C	35 (5%)
13[a]	10 mol % C1, DMSO, 30 °C	35 (77%)
14	10 mol % C1, DMF, 30 °C	35 (68%)
15	10 mol % C3, DMSO, 30 °C	35 (31%)
16	10 mol % C4, DMSO, 30 °C	35 (16%)
17	10 mol % C5, DMSO, 30 °C	35 (29%)

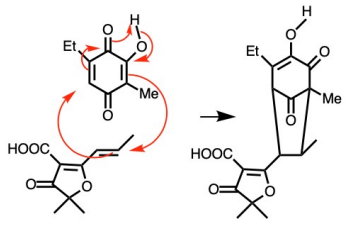


[a](*exo*:*endo* = 7:1) (entry 13). Notably, both the primary amine and the cinchona skeleton were essential for achieving high reactivity (Tables S2–S4 for details).

A. Total synthesis of asperones A (1) and B (2)



exo adducts are thermodynamically favored to avoid the steric repulsion



not double Michael
not concerted (stepwise)

from 13C KIE experiment