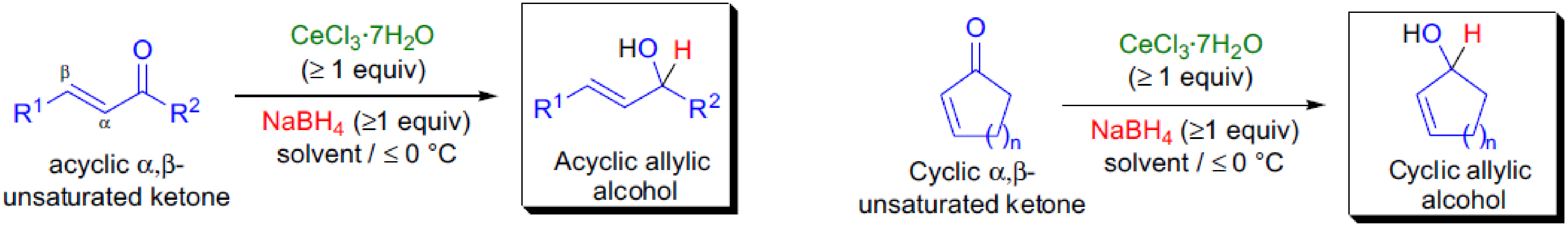
LUCHE REDUCTION



$R^{1\text{-}2}$ = H, alkyl, aryl; n = 1-3; solvent = methanol, ethanol, isopropanol

1) both acyclic and cyclic enones are reduced to the corresponding allylic alcohols in high yield with no or little 1,4-reduction byproduct;
2) among various lanthanide salts, the heptahydrate of CeCl3 was found to give the highest 1,2-selectivity;
3)under the reaction conditions most functional groups (such as carboxylic acids, esters, amides, alkyl halides,tosylates, acetals, sulfides, azides, epoxides, nitriles, nitro compounds) are unaffected;
4) the reactions are usuallyconducted at or below room temperature, and the reduction is complete within 5-10 minutes;
5) the reaction vessel and the solvents do not need to be dried, the regioselectivity and the yield is unaffected by water content up to 5% by volume;
6) the cerium chloride can be used directly as its heptahydrate and no drying is needed;

7) no inert atmosphere is required as the reaction is not sensitive to the presence of oxygen;

8) the best solvent is methanol,since the reaction rates are the highest, but occasionally ethanol and isopropanol are used, even though the reduction is slower in these solvents;

9) steric hindrance has little or no effect on the regioselectivity;

10) The combination of CeCl3/NaBH4 is excellent for the chemoselective reduction of ketones in the presence of aldehydes,since under these conditions aldehydes undergo rapid acetalization, which prevents their reduction;

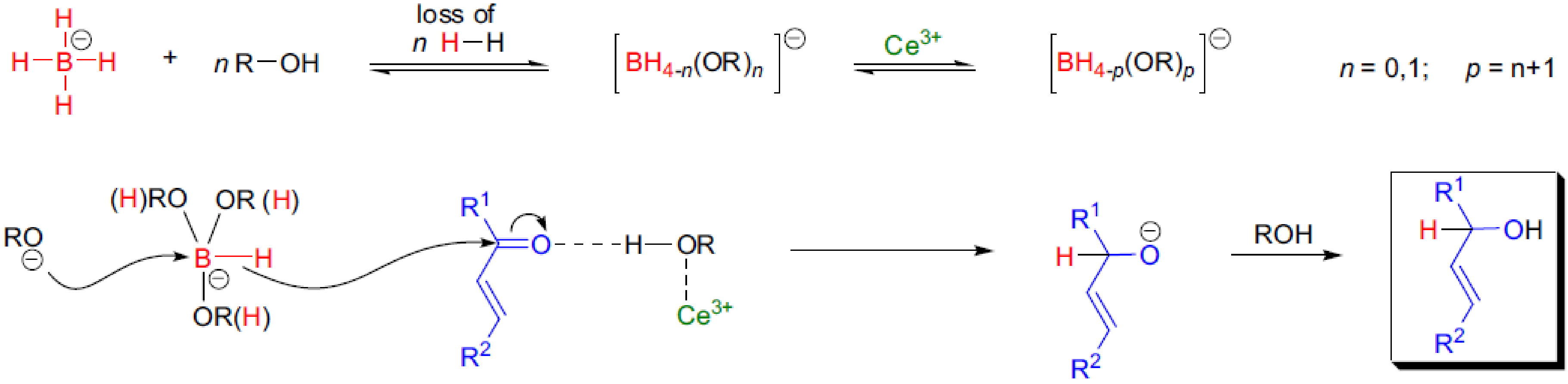
11) substitutedcyclohexenones undergo mainly an axial attack of hydride, so equatorial alcohols are obtained;

12) in rigid cyclic or polycyclic systems the hydride delivery occurs from the least hindered face of the carbonyl group;

13) conjugated or aromatic aldehydes are reduced preferentially in the presence of isolated aliphatic aldehydes; and

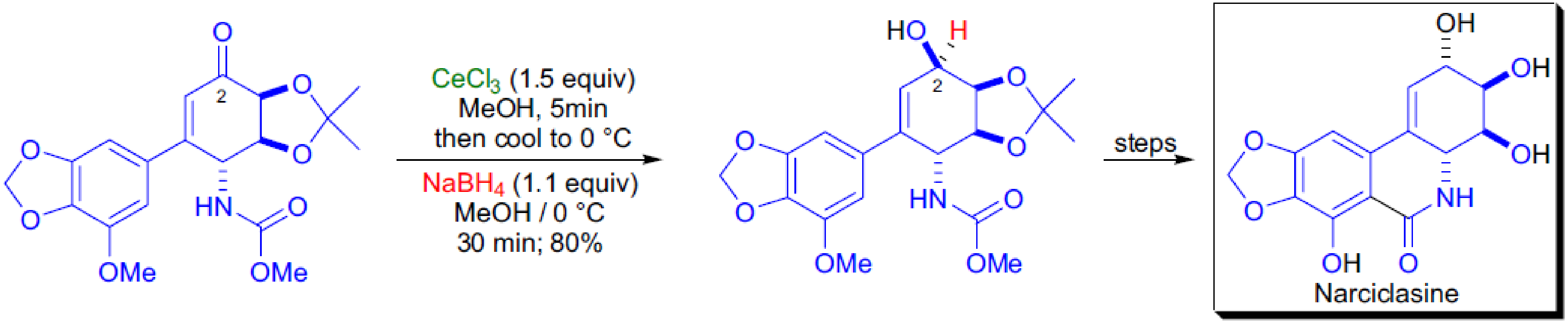
14) the lowering of the reaction temperature well below zero (e.g., -78 ° C) usually increases the diastereoselectivity of the reduction of chiral substrates.

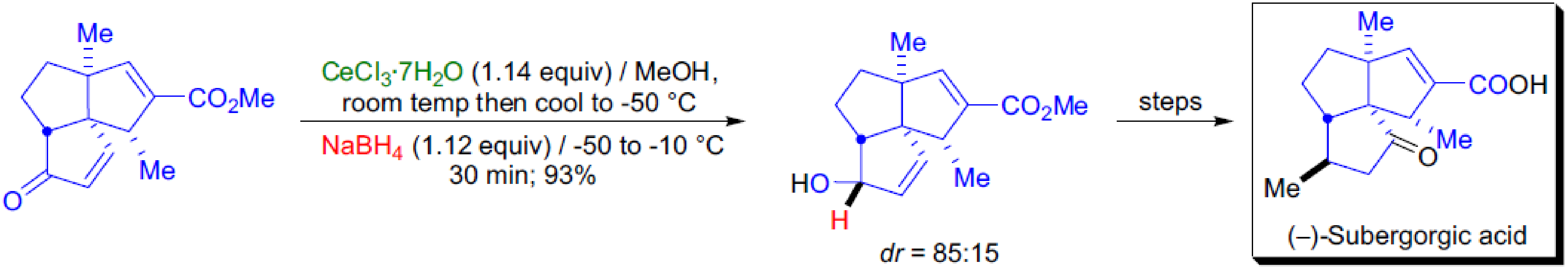
Mechanism



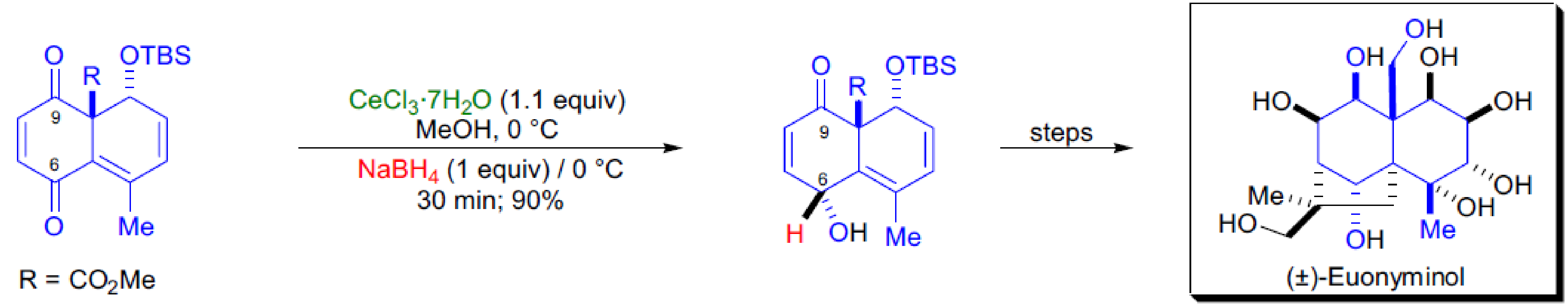
H–B–H (H, H)
+
n R–OH
loss of
n H–H
[BH4-n(OR)n]⊖
Ce3+
[BH4-p(OR)p]⊖
n = 0,1; p = n+1
RO⊖
(H)RO
OR (H)
B–H
OR(H)
R1
O
H–OR
Ce3+
R2
R1
H
O⊖
R2
ROH
R1
H
OH
R2

Synthetic Applications





Synthetic Applications

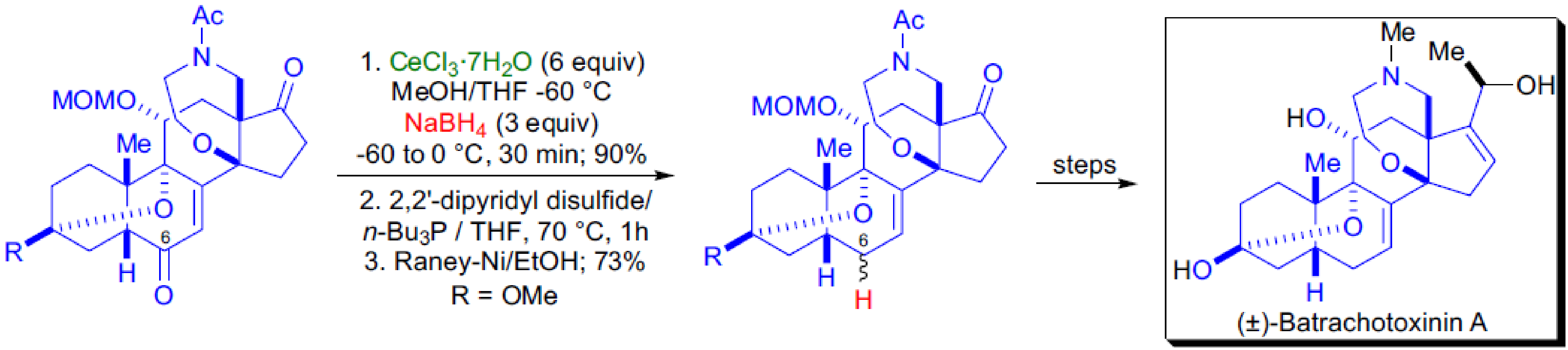


R = CO_2Me

$CeCl_3 \cdot 7H_2O$ (1.1 equiv)
MeOH, 0 °C
$NaBH_4$ (1 equiv) / 0 °C
30 min; 90%

steps

(±)-Euonyminol



1. $CeCl_3 \cdot 7H_2O$ (6 equiv)
MeOH/THF -60 °C
$NaBH_4$ (3 equiv)
-60 to 0 °C, 30 min; 90%

2. 2,2'-dipyridyl disulfide/
n-Bu_3P / THF, 70 °C, 1h
3. Raney-Ni/EtOH; 73%
R = OMe

steps

(±)-Batrachotoxinin A

Thanks