Total Synthesis of the Tetracyclic Lupin Alkaloid (+)-Allomatrine

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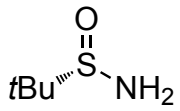
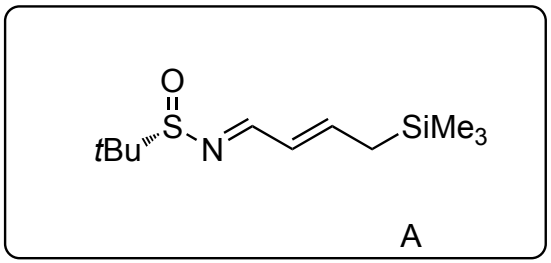
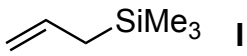


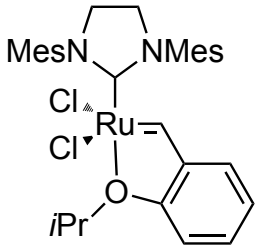
1,2

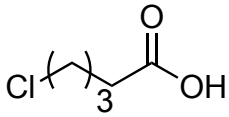


1) acrolein, $Ti(OEt)_4$, THF, rt
2) **I**, Grubbs-Hoveyda-II Cat. CH_2Cl_2

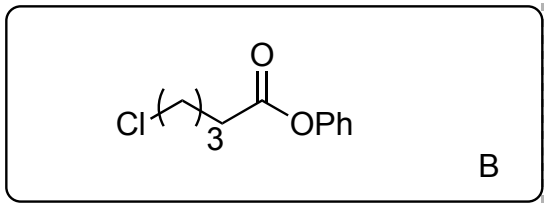


please give the structure of the Grubbs-Hoveyda catalyst and a detailed mechanism for step 2)





3,4

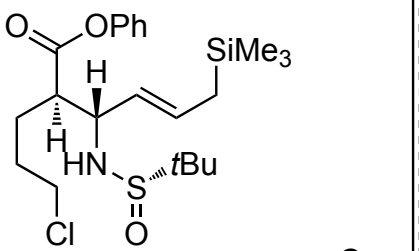


3) $(COCl)_2$, CH_2Cl_2, cat. DMF, 0ºC to rt
4) PhOH, CH_2Cl_2, rt

A + B

5

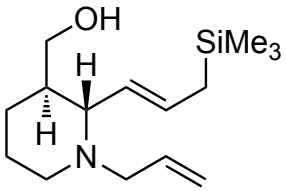
5) LDA, THF, –78ºC, then A



C

6-8

6) HCl, dioxane, rt
7) K_2CO_3, NaI, MeCN, rt, then CH_2=$CHCH_2Br$
8) $LiAlH_4$, Et_2O, 0ºC to rt

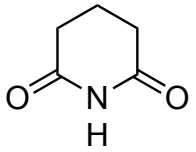


D

9)

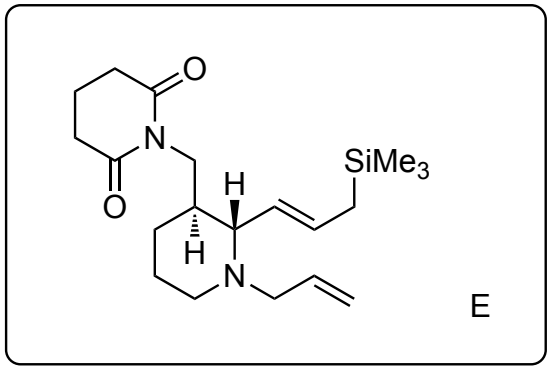
9) DIAD, PPh_3, THF/CH_2Cl_2, 0ºC to rt, **II**

Please, provide a detailed mechanism for step 9).



II

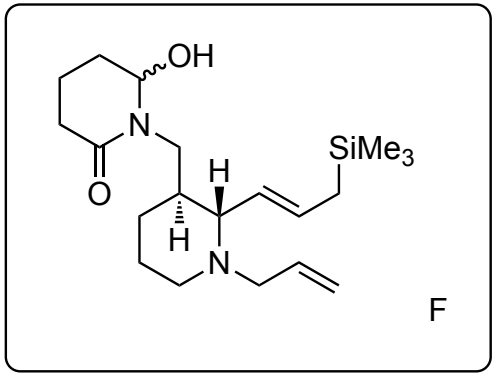
Mitsunobu reaction



E

10

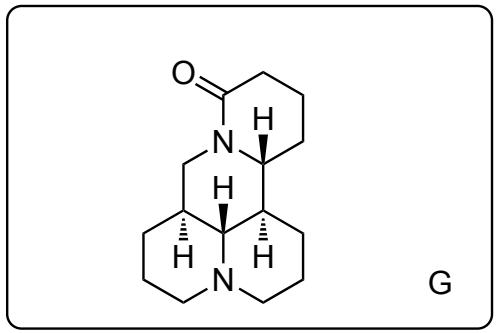
10) $NaBH_4$, EtOH, HCl, –15ºC



F

11 - 13

11) TfOH, CH_2Cl_2, 0ºC to rt
12) Hoveyda-Grubbs Cat., CH_2Cl_2, 40ºC
13) H_2 (1atm), Pd/C, EtOH



G

Please, draw a clear 3D represnetation of G