Asymmetric Total Syntheses of Kopsia Indole Alkaloids

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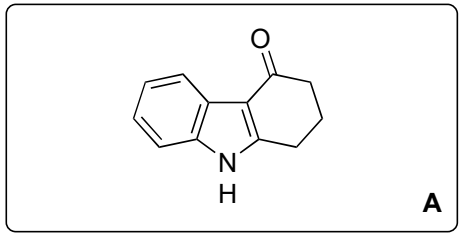
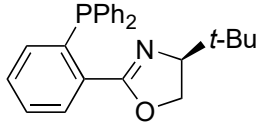


1–3

1) $(Boc)_2O$, DMAP, CH_2Cl_2
2) LiHMDS, THF *then* allyl chloroformate, –78 °C
3) 3-bromo-5-(bromomethyl) isoxazole, K_2CO_3, acetone, 56 °C

B

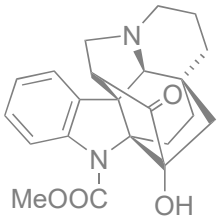


C

Please Name the reaction in step 4.

4–7

4) $[Pd_2(dba)_3]$, **C**, PhMe
5) catecholborane, $[RhCl(PPh_3)_3]$, THF then $NaBO_3 \cdot H_2O$, THF/H_2O
6) MsCl, Et_3N, CH_2Cl_2
7) NaN_3, DMF, 60 °C



Kopsine

D

8–12

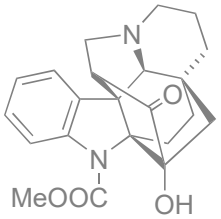
8) PPh_3, THF/H_2O, reflux
9) $NaBH_4$, EtOH/THF
10) TrocCl, Na_2CO_3, CH_2Cl_2/H_2O
11) $FeCl_2$, CH_3CN, reflux
12) 1H-imidazole-1-sulfonyl azide, pyridine

E

13–15

13) [Cu(hfacac)$_2$], chlorobenzene, 120 °C
14) Zn, EtOH/THF/AcOH
15) CH_2O (30% aq.), EtOH, reflux

Structure of hfacac?

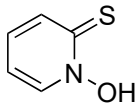


Kopsine

F

16–20

16) CF_3CO_2H, CH_2Cl_2, 0 °C to 23 °C
17) TMSCN, $AlCl_3$, CH_2Cl_2
18) SmI_2, THF
19) HCl (conc.), 100 °C
20) **G**, EDCI, DMAP, CH_2Cl_2

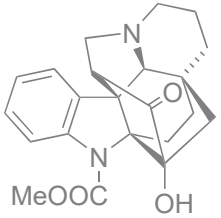


G

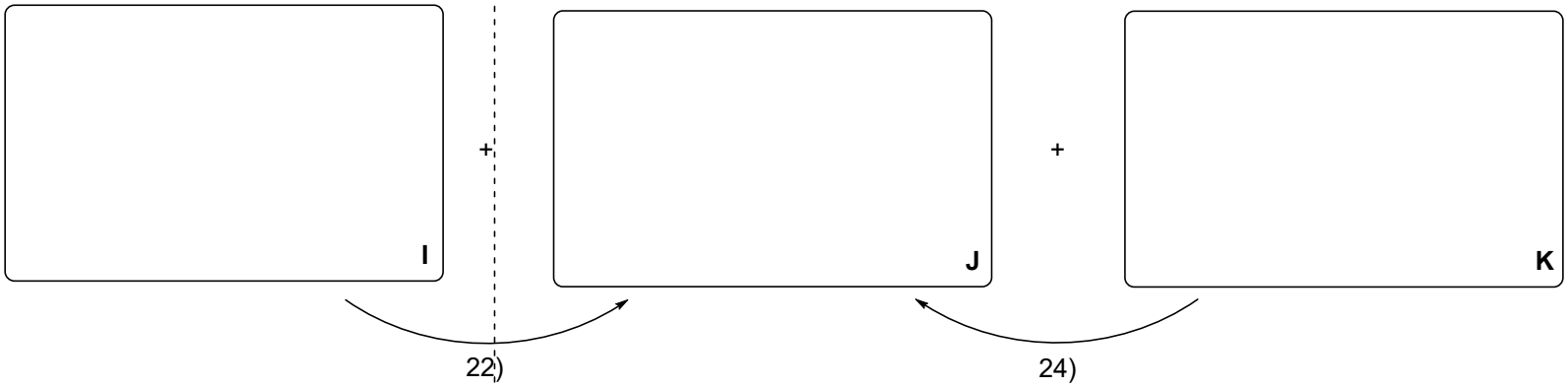
H

21

21) AIBN, *n*-Bu_3SnH, benzene, reflux



Kopsine



22) DMP, CH_2Cl_2
23) NaOH aq./1,4-dioxane
24) NaOH aq./1,4-dioxane

J

25–27

25) triphosgene, pyridine CH_2Cl_2, 0 °C *then* MeOH reflux
26) MeOH/pyridine/H_2O, 70 °C
27) $Pb(OAc)_4$, MeOH,

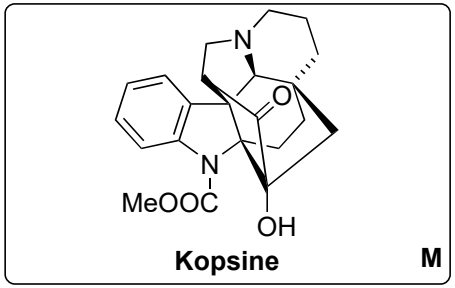
What is the structure of triphosgene?

Methyl chanofruticosinate **L**

If **J** is heated in benzene for 1 h, a 1:1 mixture of **J** and **K** was obtained.
Please classify the reaction and give a mechanism.

K

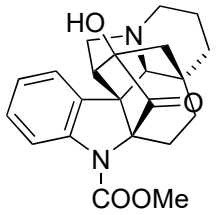
28



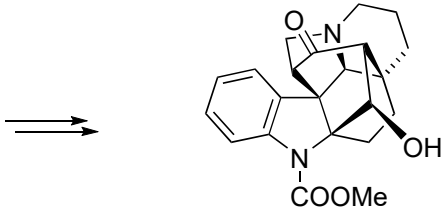
Kopsine **M**

28) BTC, pyridine CH_2Cl_2, 0 °C *then* MeOH reflux

Please give a sequence for the following transformation.



Isokopsine



Fruticosine