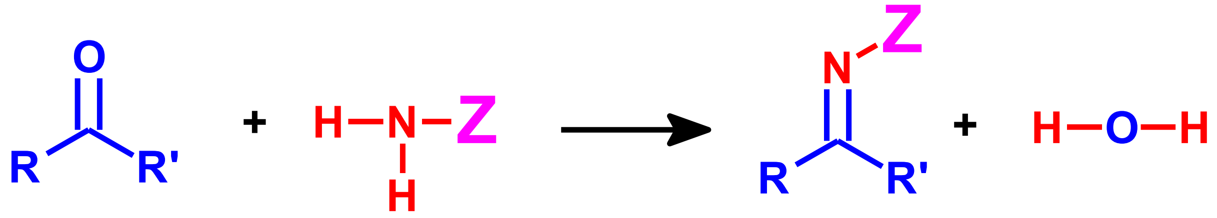
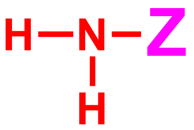
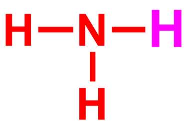
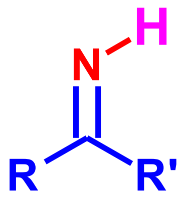
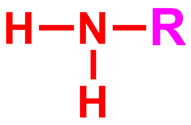
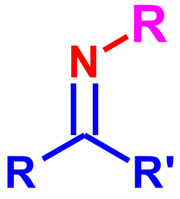
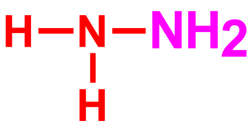
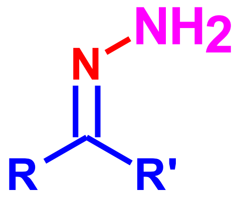
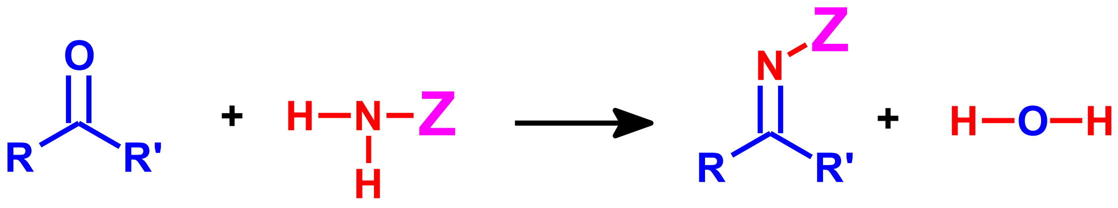
REVISIÓN
GRUPO CARBONILO

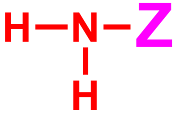
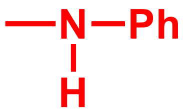
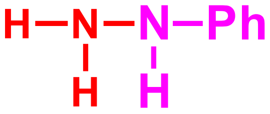
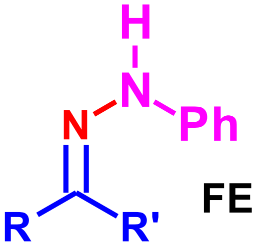
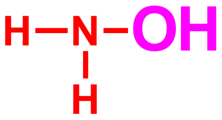
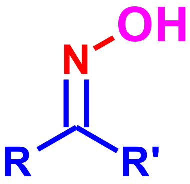
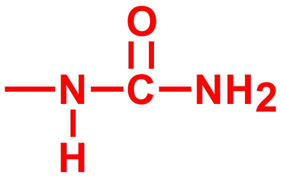
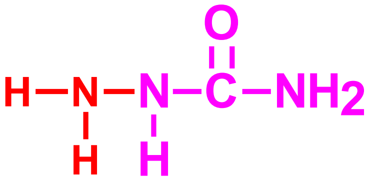
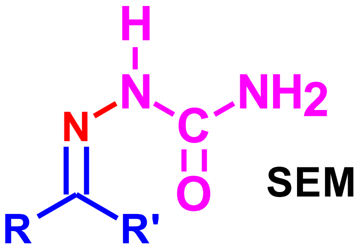
FORMACIÓN DE IMINAS

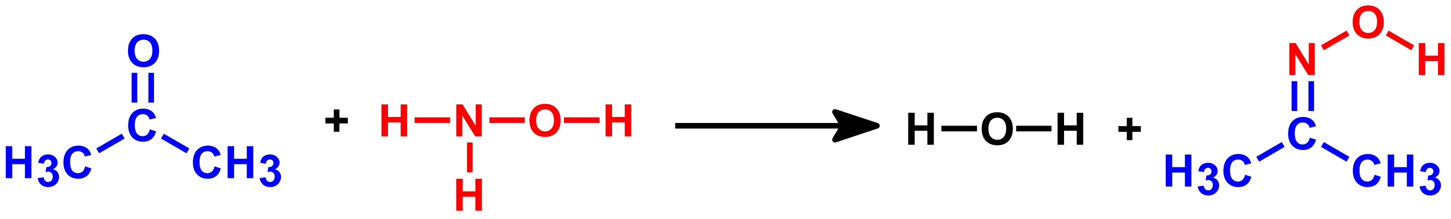


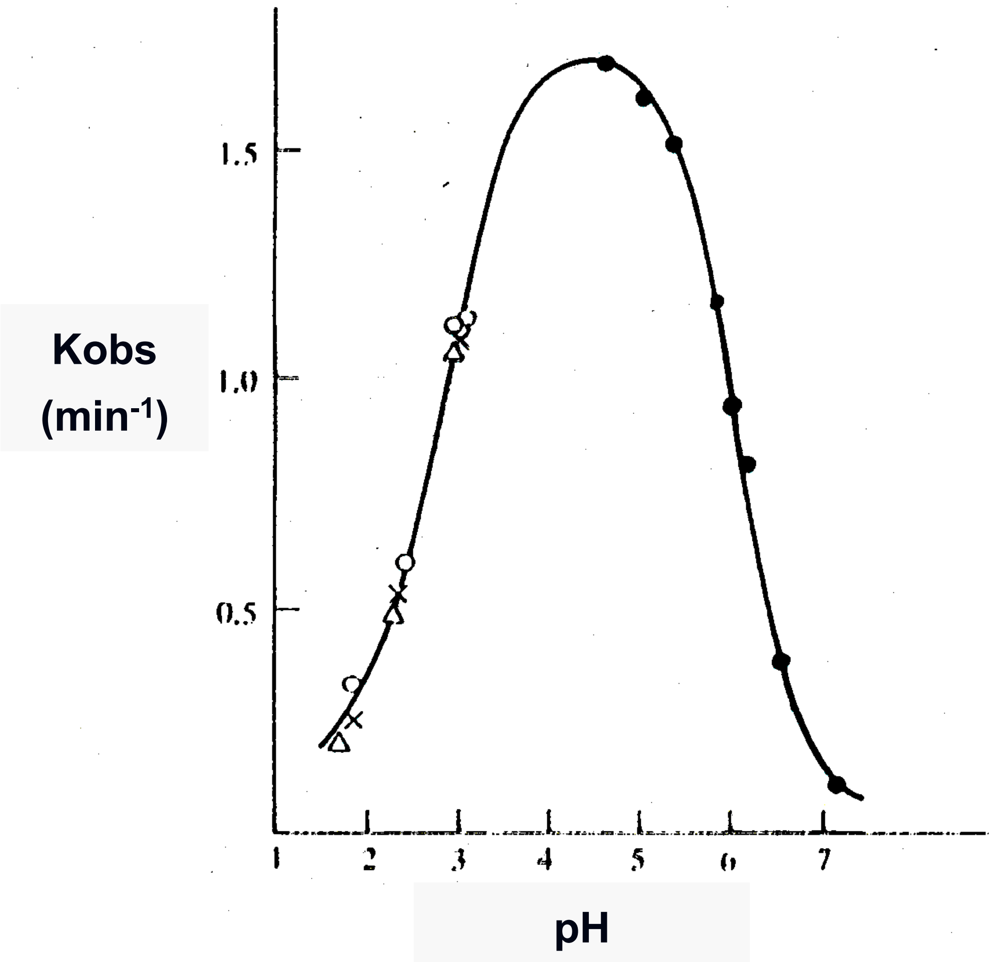
$$R-CO-R' + H-\underset{H}{\underset{|}{N}}-Z \longrightarrow R-C(=N-Z)-R' + H-O-H$$

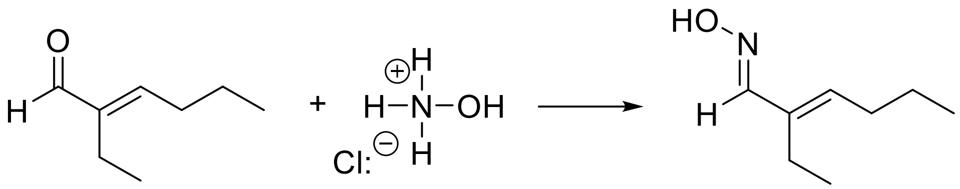
Z en  $H-\underset{H}{\underset{|}{N}}-Z$	REACTIVO		PRODUCTO	
$-H$	 $H-\underset{H}{\underset{|}{N}}-H$	AMONIACO		IMINA
$-R$	 $H-\underset{H}{\underset{|}{N}}-R$	AMINA PRIMARIA		IMINA BASE DE SCHIFF
$-NH_2$	 $H-\underset{H}{\underset{|}{N}}-NH_2$	HIDRAZINA		HIDRAZONA



Z en  $H-\underset{\substack{\vert\\ H}}{N}-Z$	REACTIVO	PRODUCTO
 $-\underset{\substack{\vert\\ H}}{N}-Ph$	 $H-\underset{\substack{\vert\\ H}}{N}-\underset{\substack{\vert\\ H}}{N}-Ph$ FENILHIDRAZINA	 FENILHIDRAZONA
$-OH$	 $H-\underset{\substack{\vert\\ H}}{N}-OH$ HIDROXILAMINA	 OXIMA
 $-\underset{\substack{\vert\\ H}}{N}-\overset{\substack{O\\ \Vert}}{C}-NH_2$	 $H-\underset{\substack{\vert\\ H}}{N}-\underset{\substack{\vert\\ H}}{N}-\overset{\substack{O\\ \Vert}}{C}-NH_2$ SEMICARBAZIDA	 SEMICARBAZONA




Kobs
(min⁻¹)
1.5
1.0
0.5
1
2
3
4
5
6
7
pH



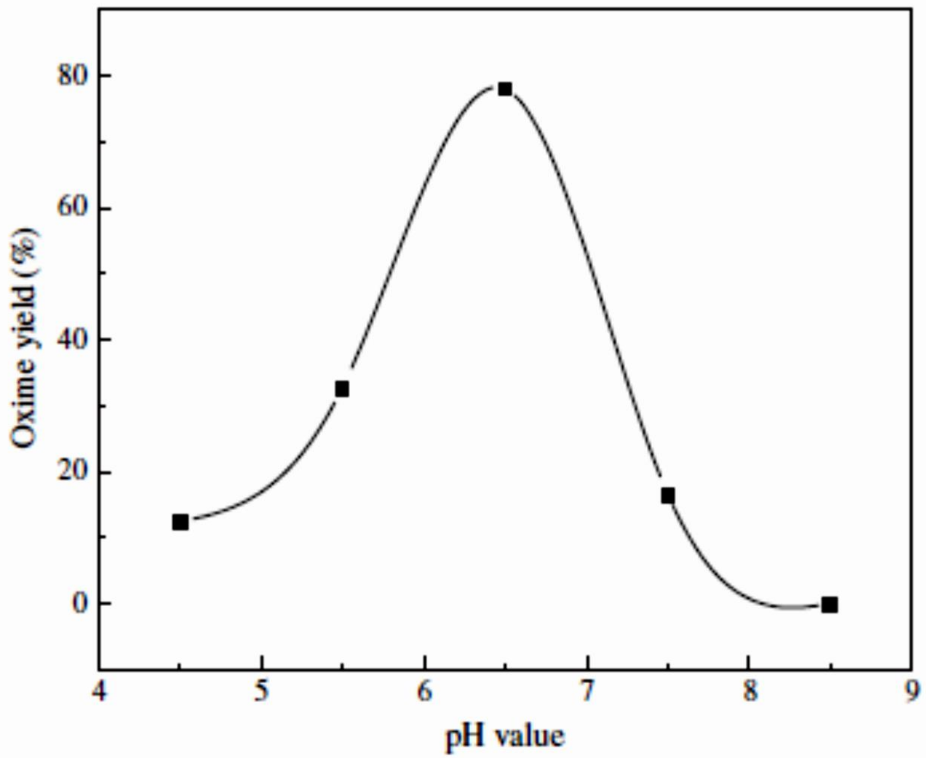


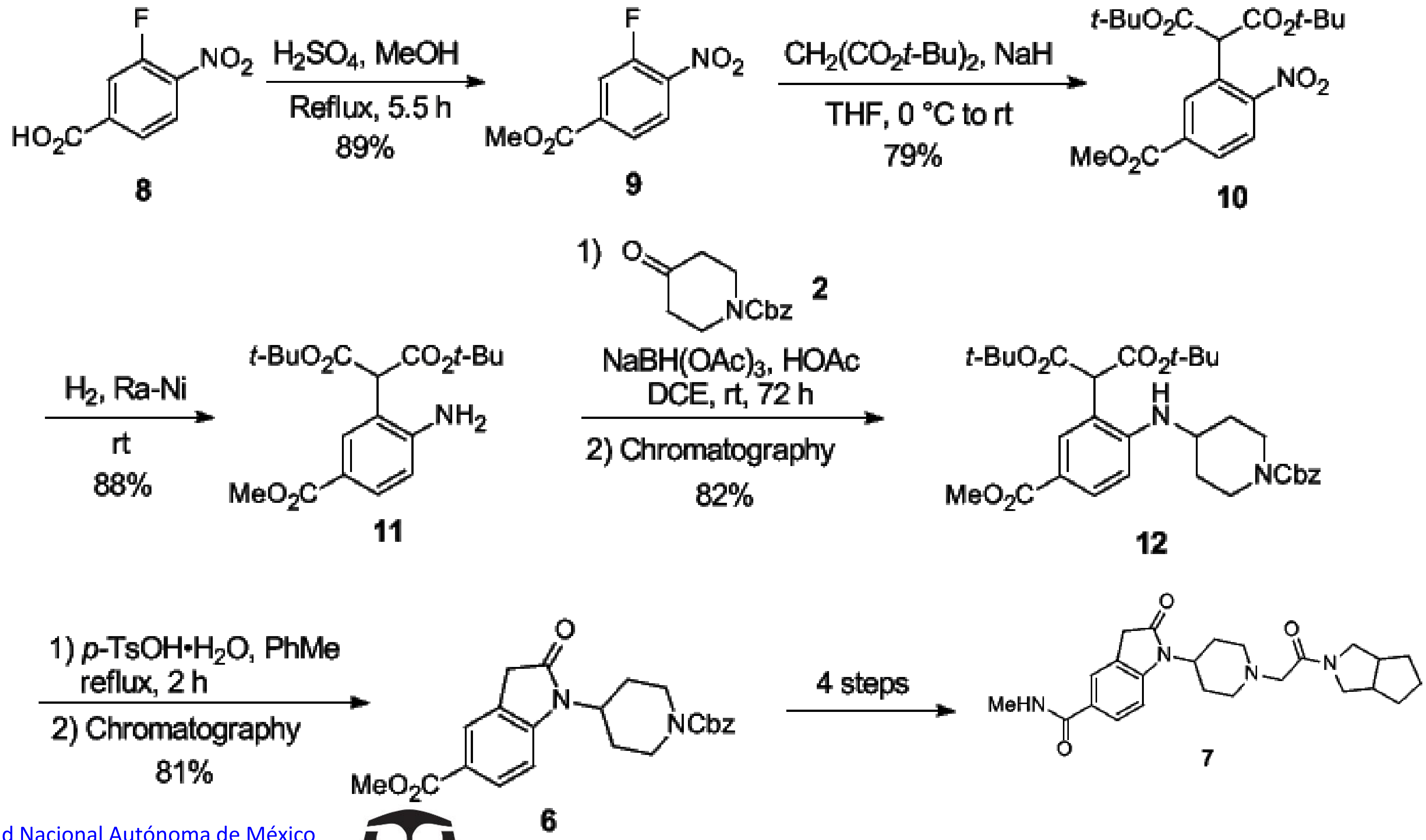
Fig. 5. The effect of pH value on the oximation of 2-ethyl-2-hexenal. Oximation conditions: $NH_2OH \cdot HCl$/2-ethyl-2-hexenal molar ratio, 1.1; temperature, 45 °C; time, 3 h.

Haifeng Xu[a], Hong Zhong[a,b,*], Shuai Wang[a,b,*], Yanan Niu[a], Guangyi Liu[a]

Minerals Engineering 66–68 (2014) 173–180

Oxindole Synthesis via Palladium-catalyzed C-H Functionalization

Magano, J.; Jason, E.K.; Shine, R.J.; and Chen, M.H.; *Org. Synth.* **2013**, *90*, 74-86

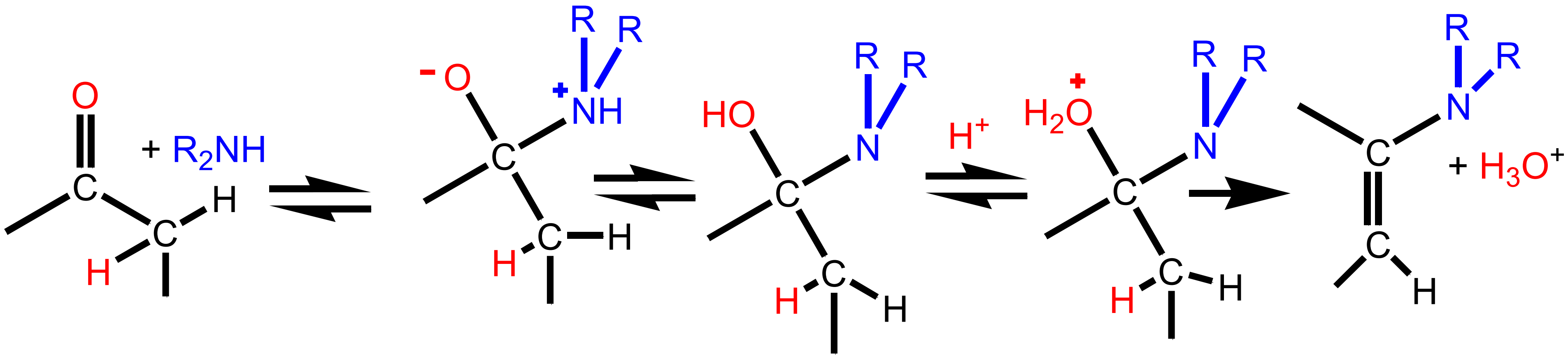


http://www.orgsyn.org/content/figures/V90P0074-4.gif

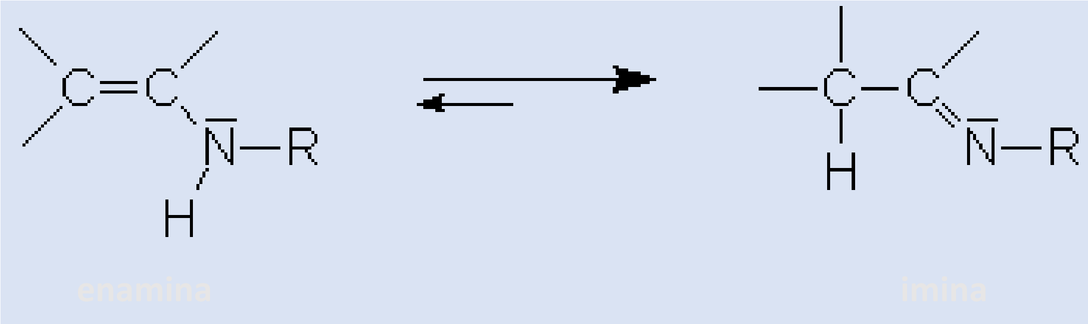
FORMACIÓN DE ENAMINAS

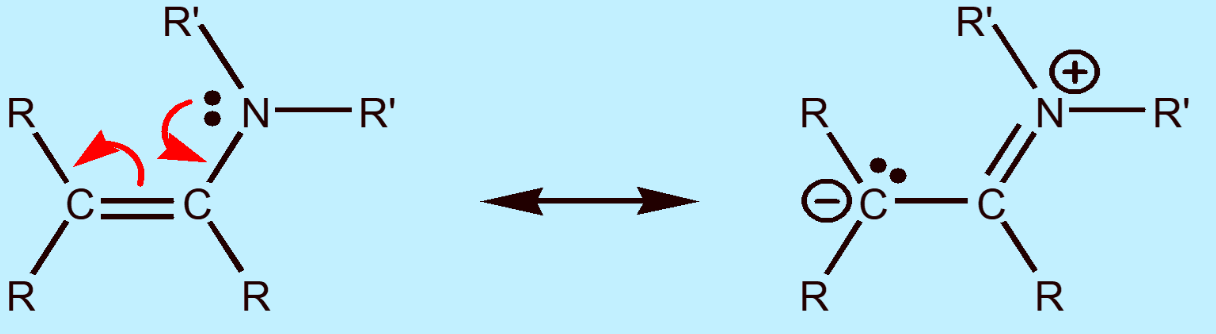
Formación Enaminas

- Después de la adición de R_2NH, el proton se pierde en el átomo de carbono adyacente

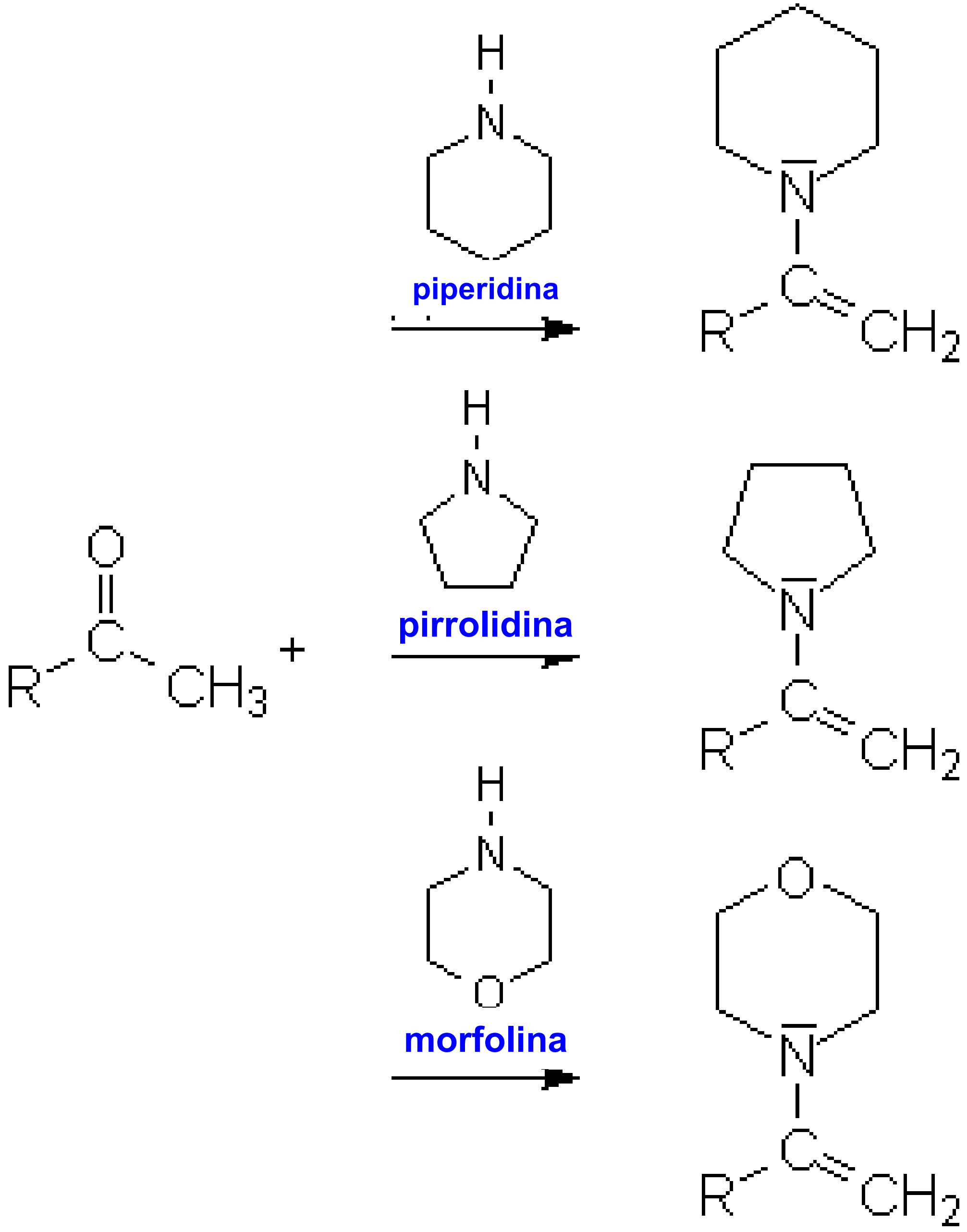


Gilbert Stork
(1921 - 2017)
Químico orgánico belga-norteamericano


enamina
imina



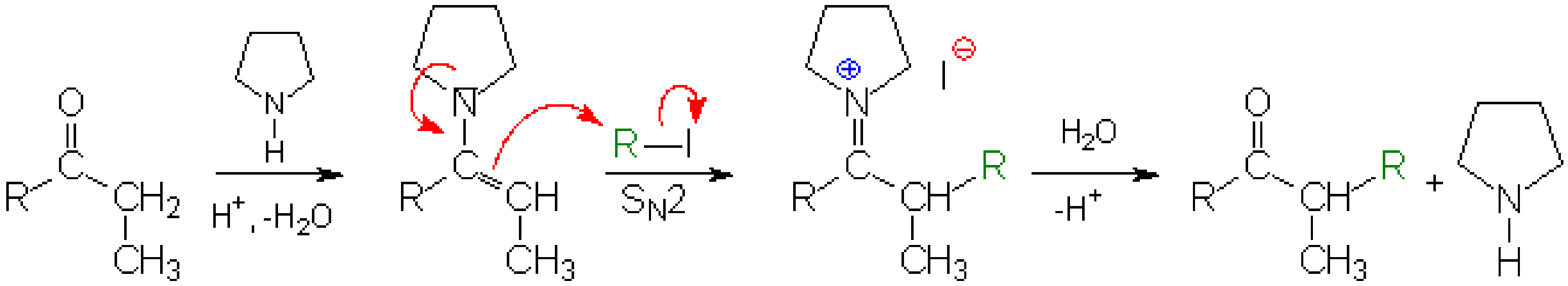
Aminas secundarias más utilizadas



Formación de la enamina

Alquilación de la enamina

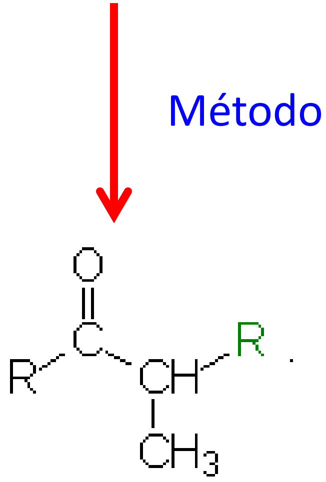
Hidrólsis catálisis ácida de la enamina alquilada



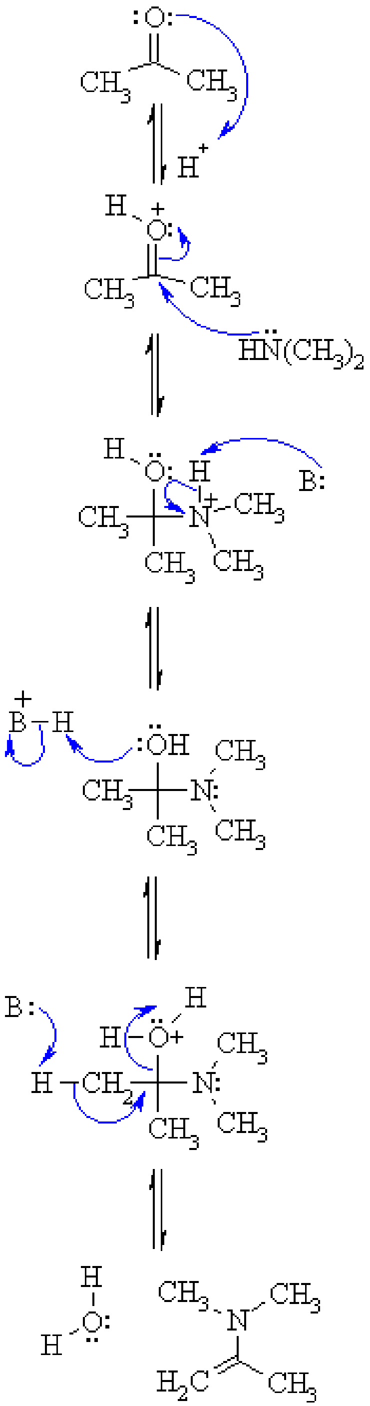
Enamina

Sal de iminio

Método para monoalquilar cetonas en posición α



Gilbert Stork and Susan R. Dowd J. Am. Chem. Soc.;**1963**;*85*(14),2178–80

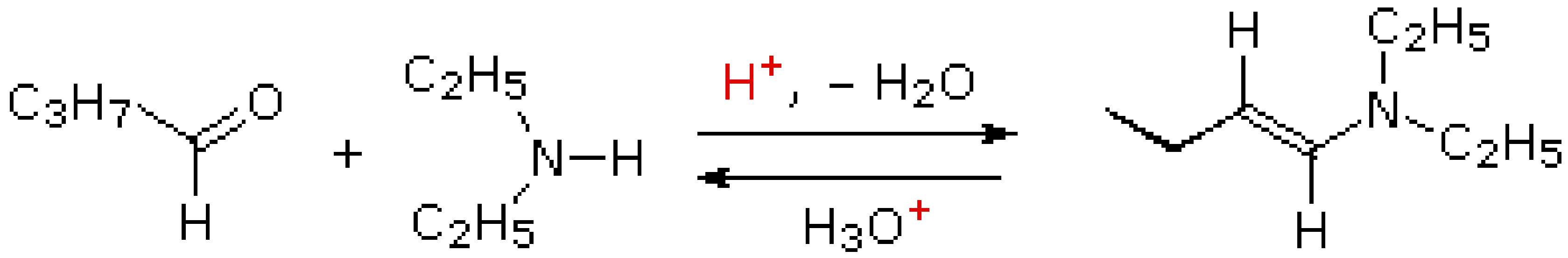


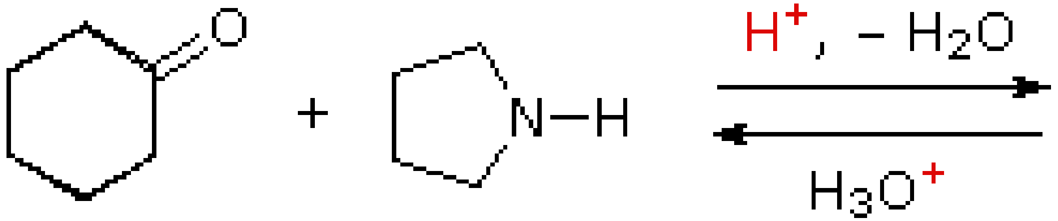
1er. Paso. Activación del grupo carbonilo

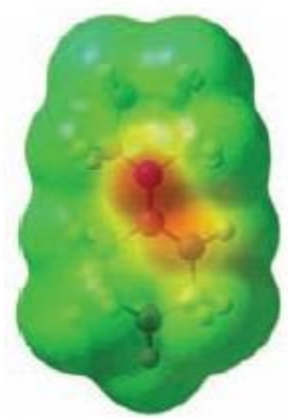
2o. Paso. Adición de la amina 2ª

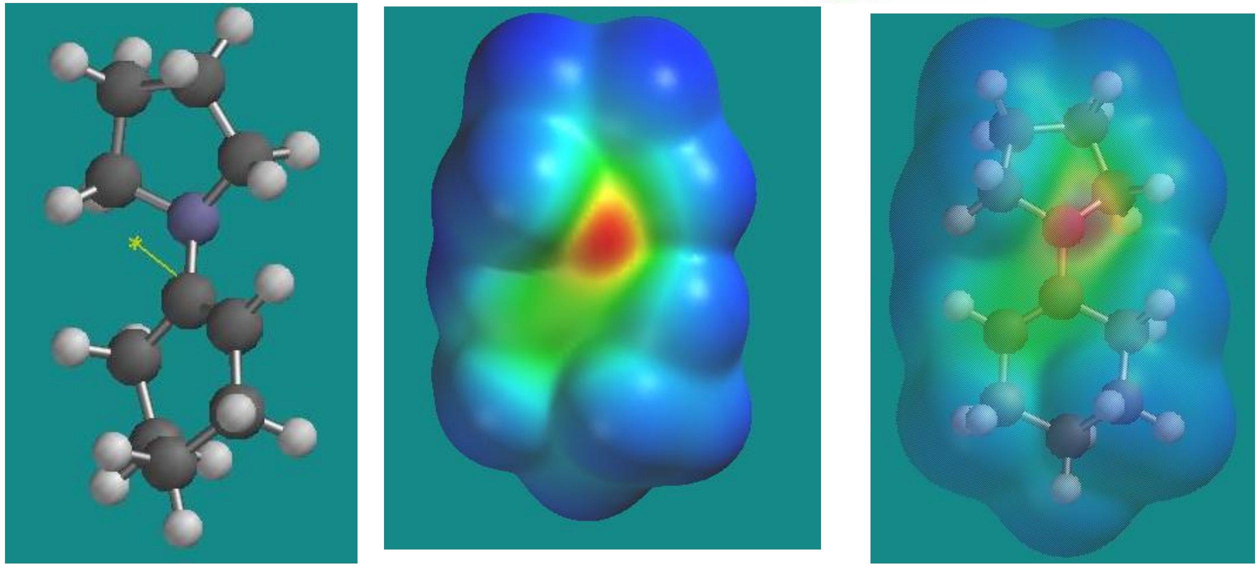
3er. Paso. Equilibrios ácido base
Formación de agua como grupo saliente

4o. Paso. Eliminación de agua y del protón del carbono β para formar la enamina (pasando por la sal de iminio)

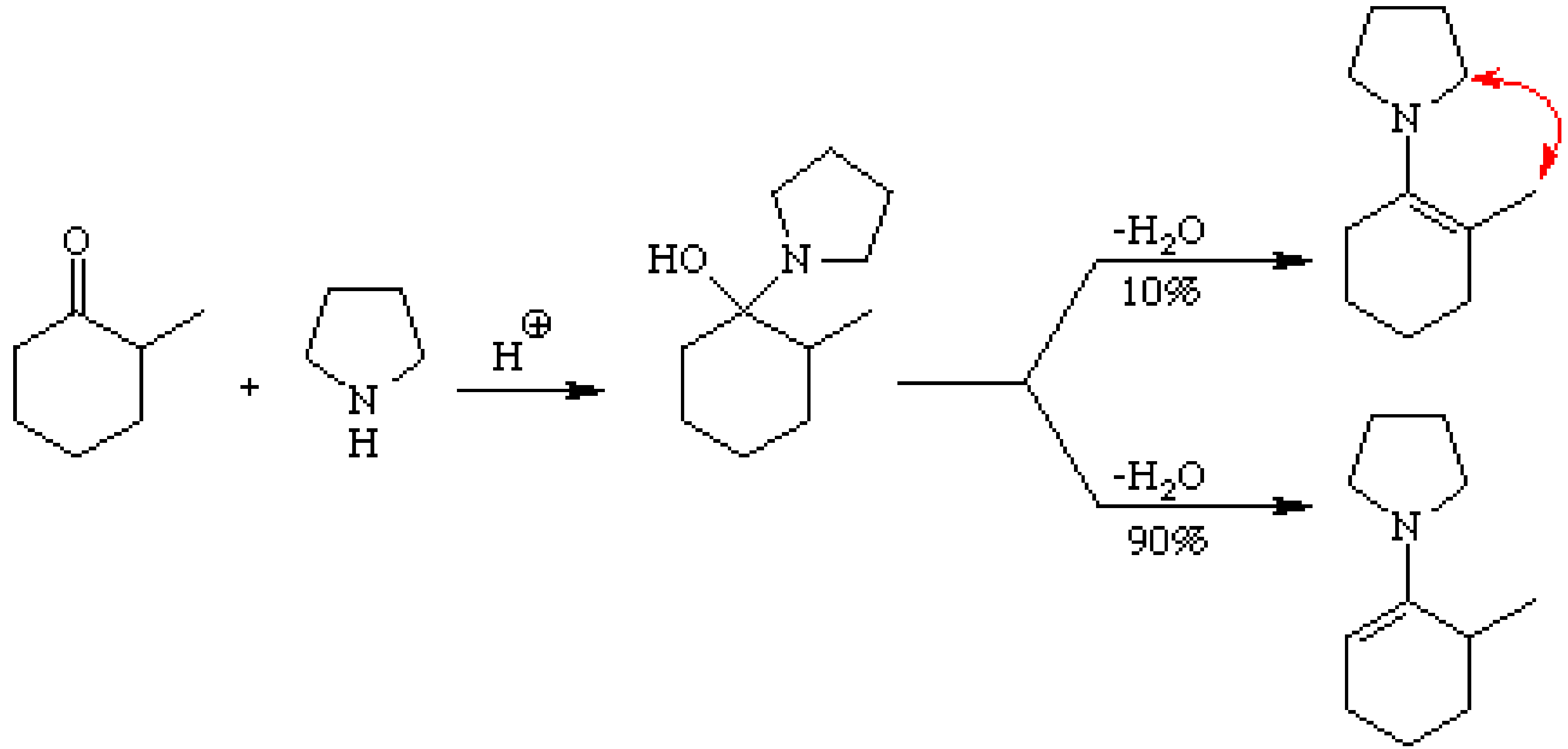








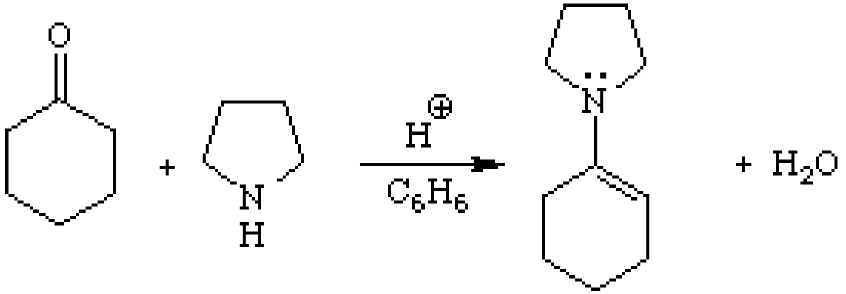
Mapa de potencial electrostático Programa Spartan



+
$H^{\oplus}$
HO
N
N
H
$-H_2O$
10%
$-H_2O$
90%

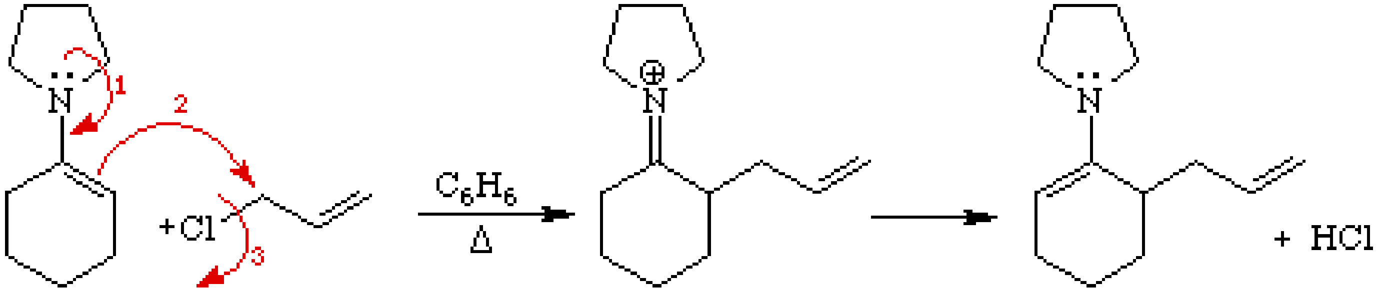
Secuencia sintética a través de la cual se lleva a cabo la monoalquilación de una cetona en posición α

Paso1



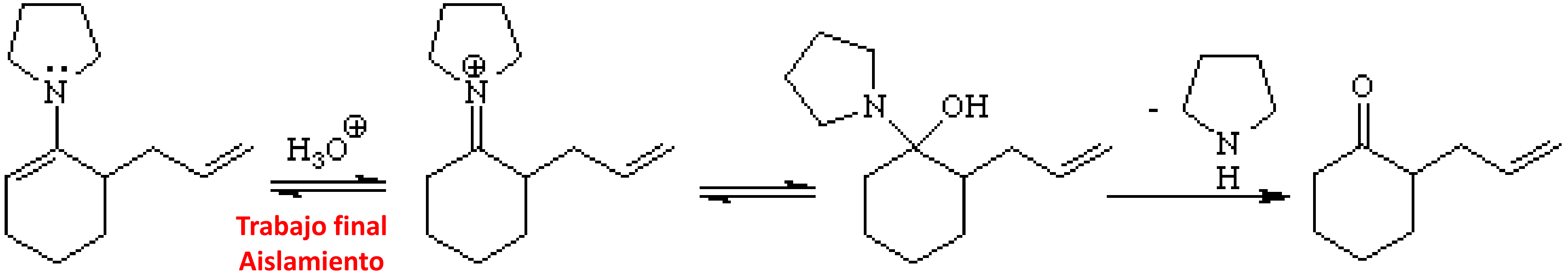
Formación de la enamina

Paso 2

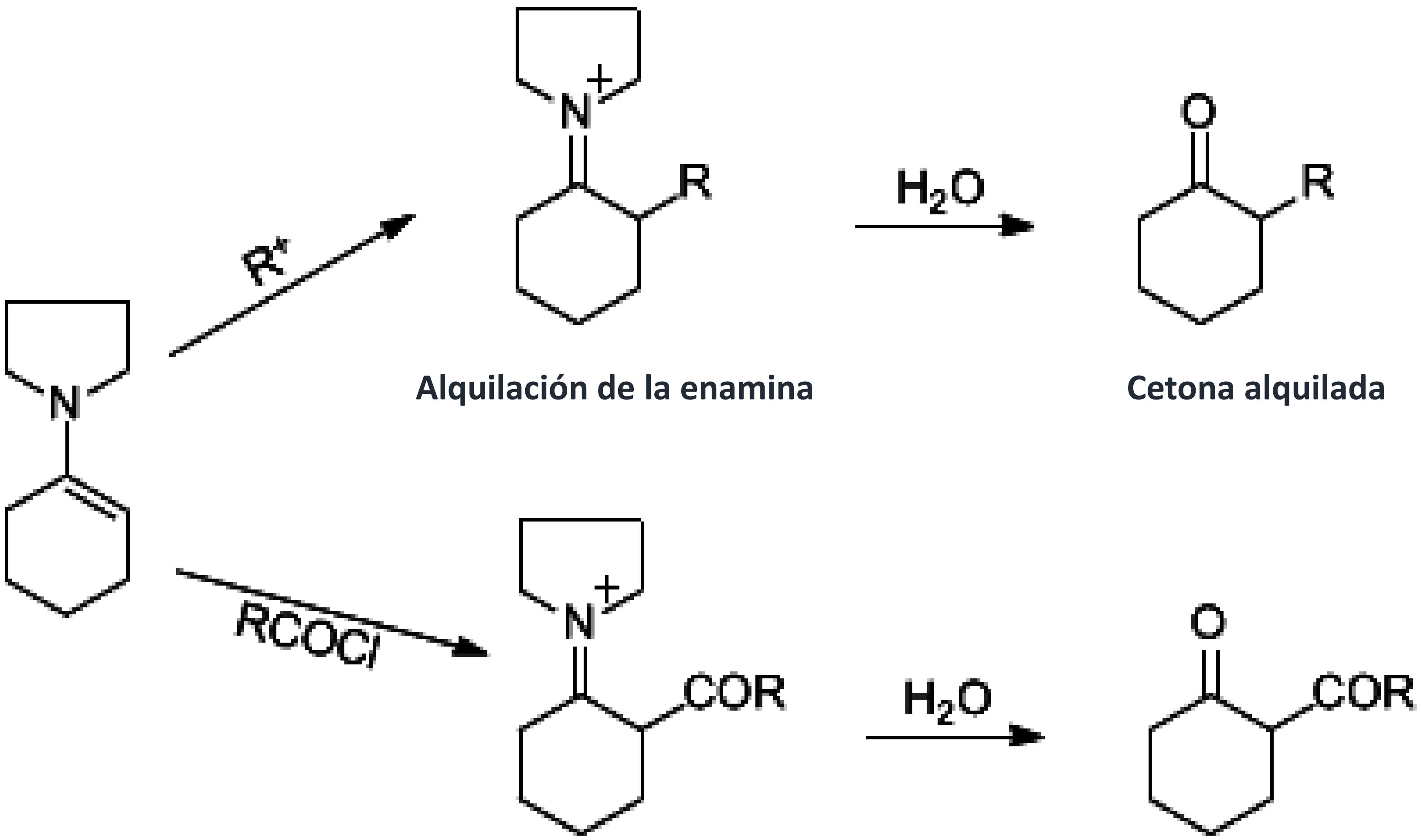


Alquilación de la enamina

Paso 3



Hidrólisis bajo catálisis ácida de la enamina alquilada



Alquilación de la enamina

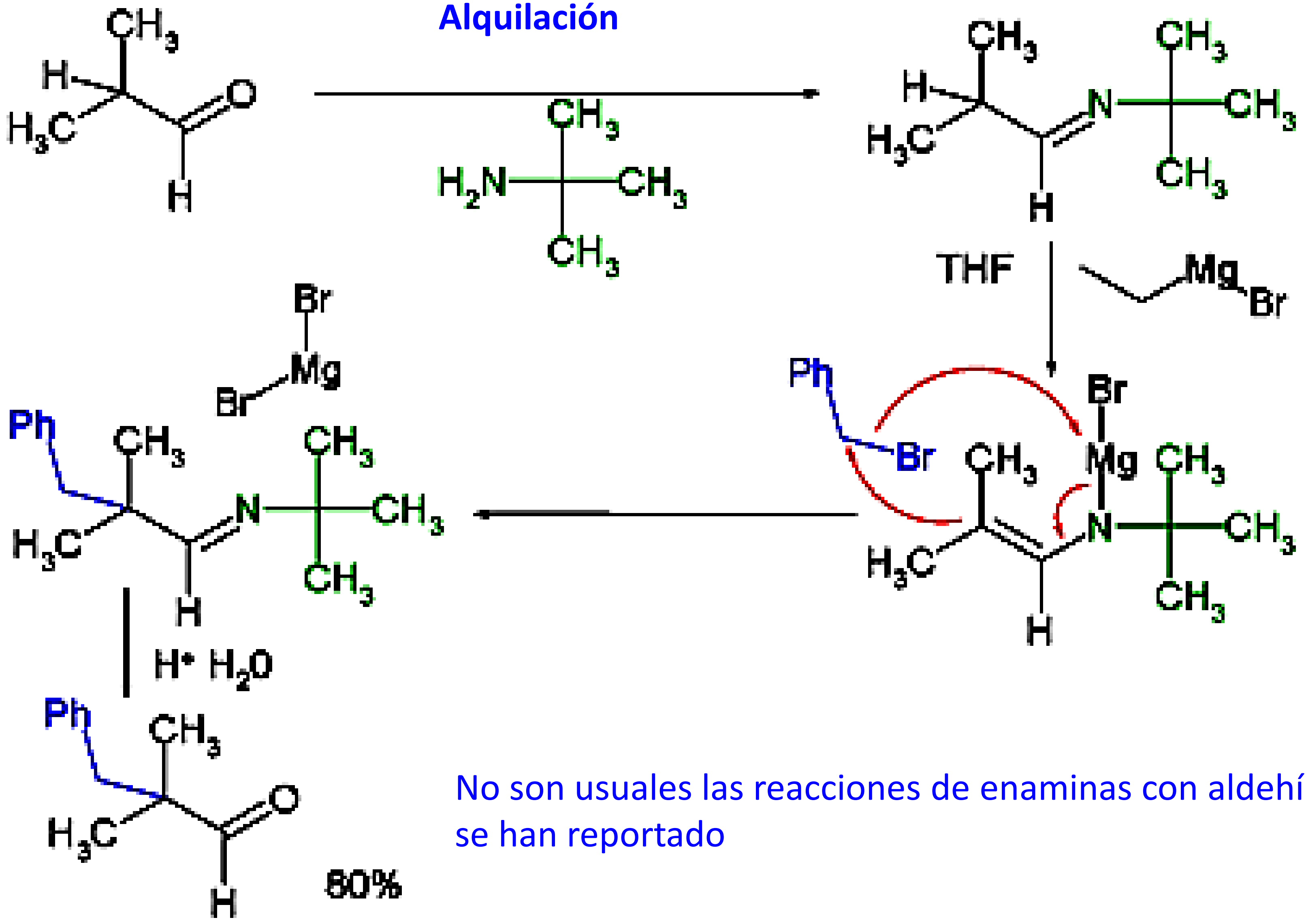
Cetona alquilada

Acilación de la enamina

Cetona acilada
Compuestos 1,3-dicarbonílicos

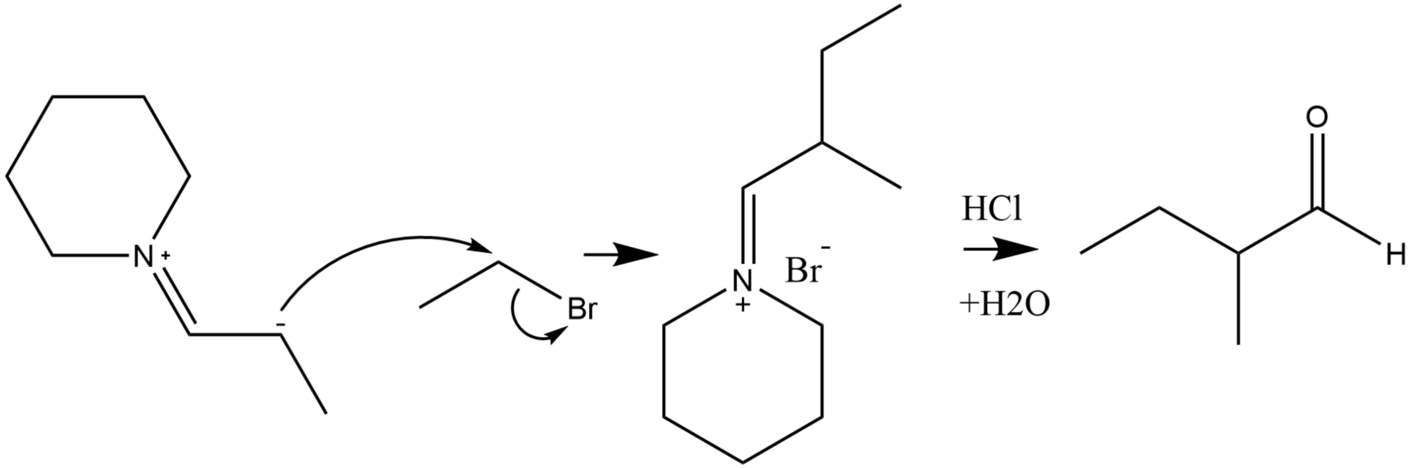
Reacciones de enaminas de aldehídos

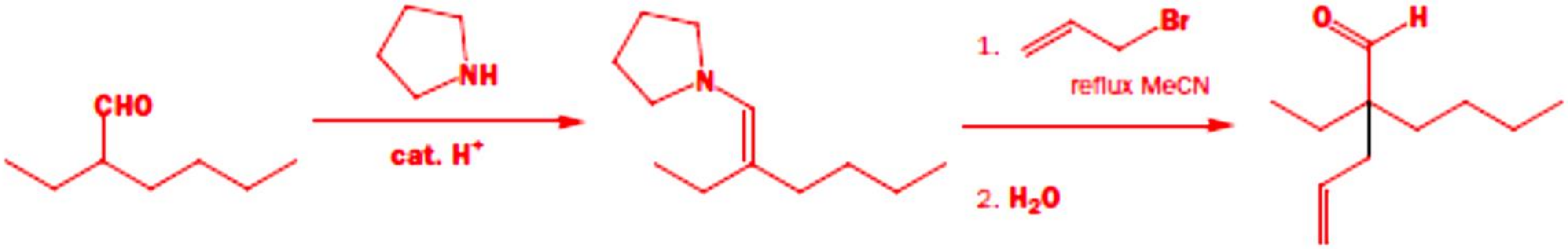
Alquilación



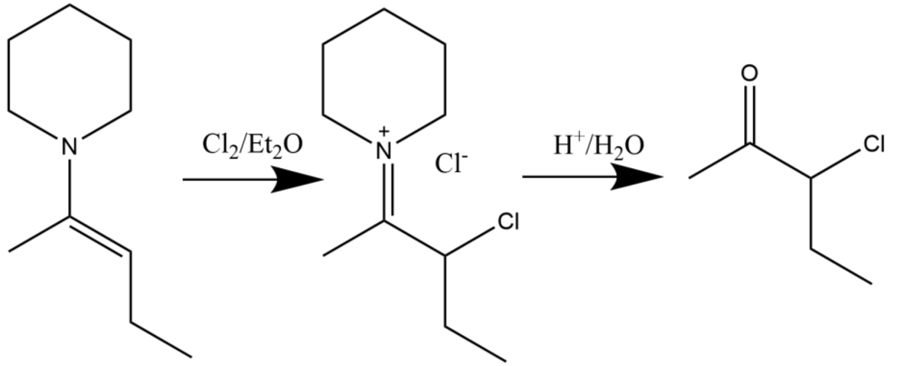
No son usuales las reacciones de enaminas con aldehídos, pero si se han reportado

Reacciones de enaminas de aldehídos: alquilación



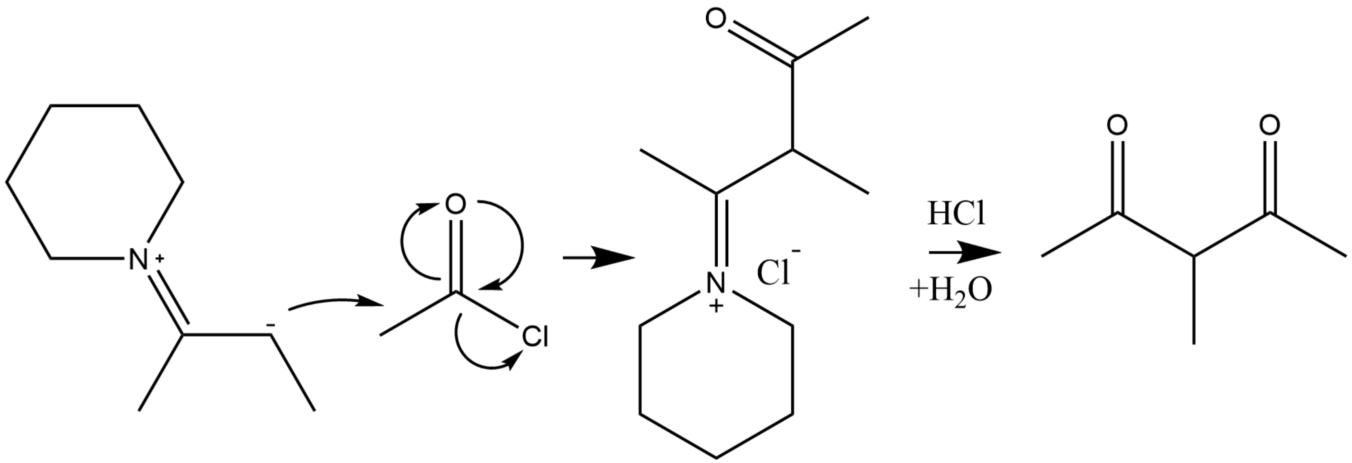


Reacciones de enaminas de cetonas: halogenación



https://en.wikipedia.org/wiki/Enamine#/media/File:Enamine_Halogenation.png

Reacciones de enaminas de cetonas: acilación



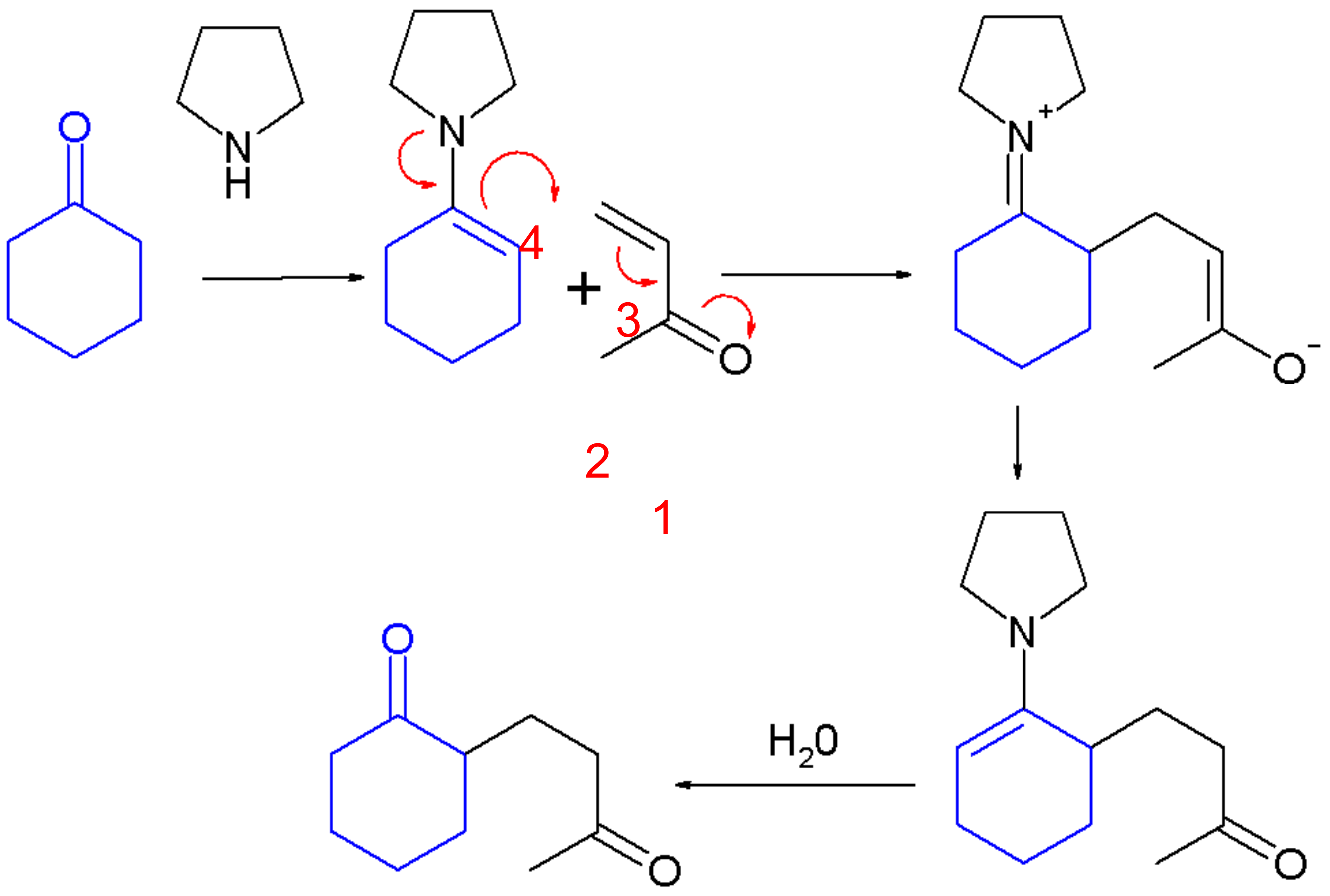
Sal de iminio

Compuesto 1,3-dicarbonílico

https://en.wikipedia.org/wiki/Enamine#/media/File:Enamine_Acylation_to_form_a_Dicarbonyl_Species.png

Reacciones de enaminas de cetonas: adición de Michael

ADICIÓN DE MICHAEL: ADICIÓN-1,4

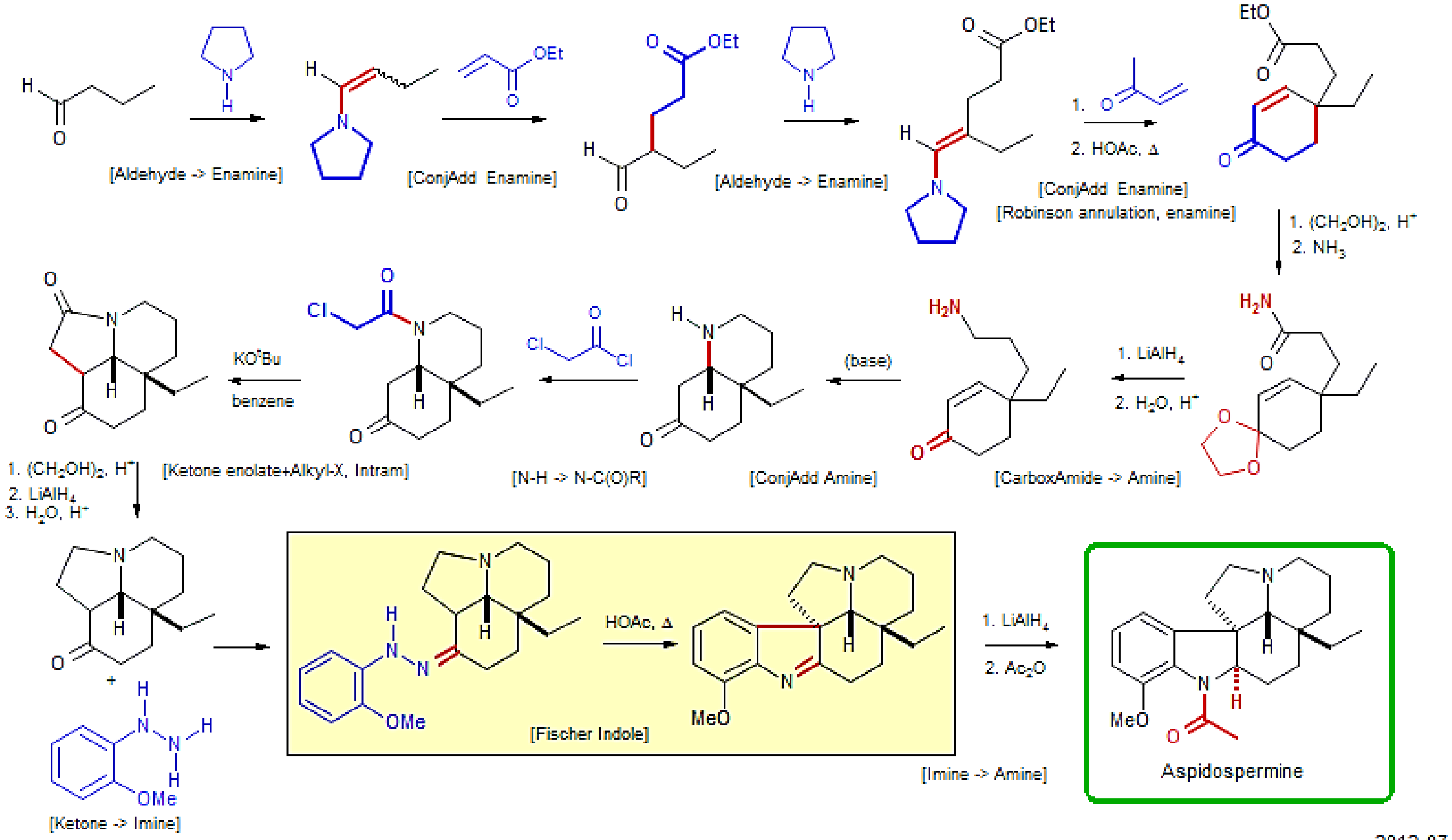


https://en.wikipedia.org/wiki/Stork_enamine_alkylation#/media/File:Stork_enamine_reaction.png

Aspidospermine

63-05

Stork, G.; Dolfini, J. E. *J. Am. Chem. Soc.* 1963, *85*, 2872-2873.

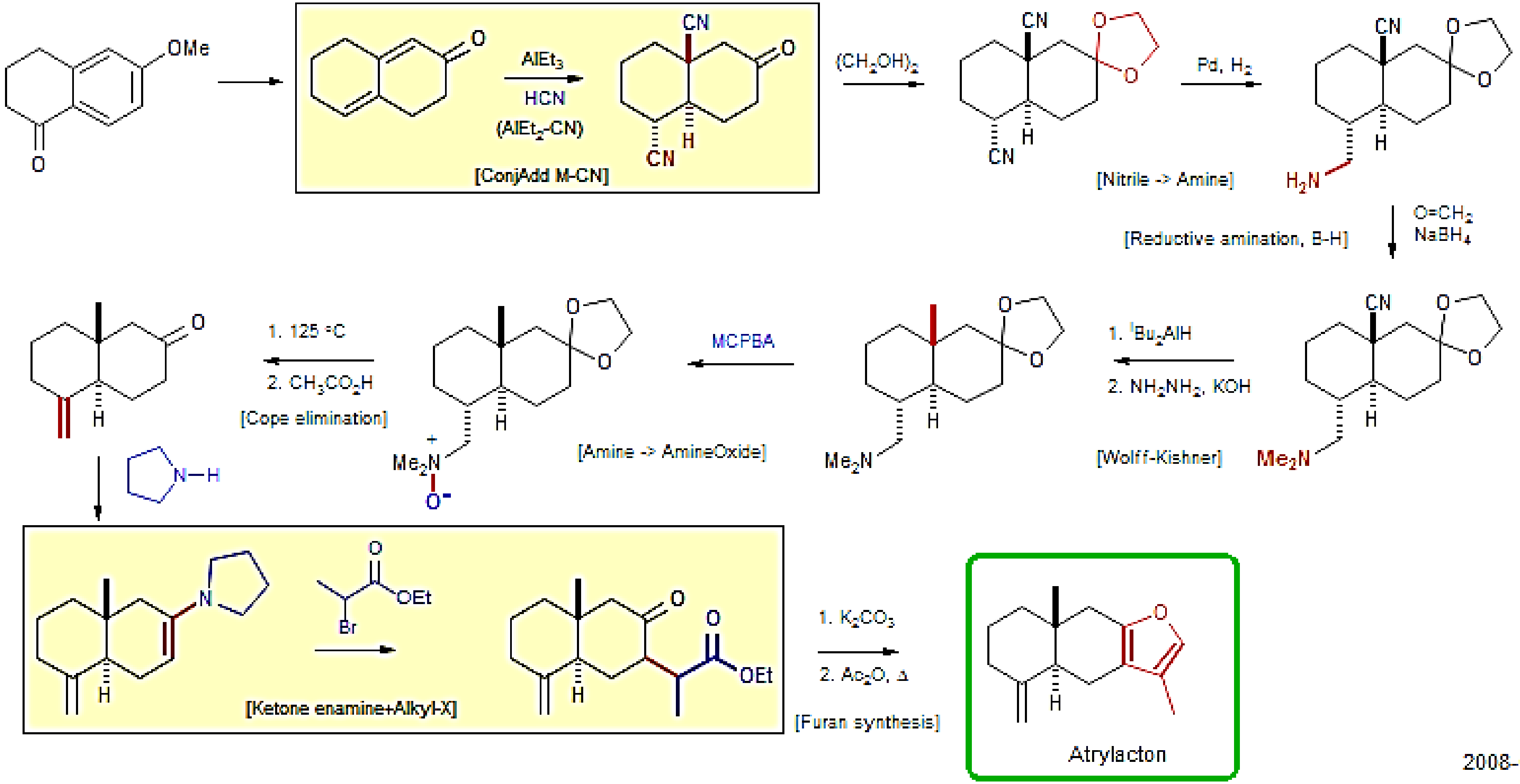


2012-07-24

Atrylacton

65-01

Minato, H.; Nagasaki, T *Chem. Comm.* **1965**, 377.

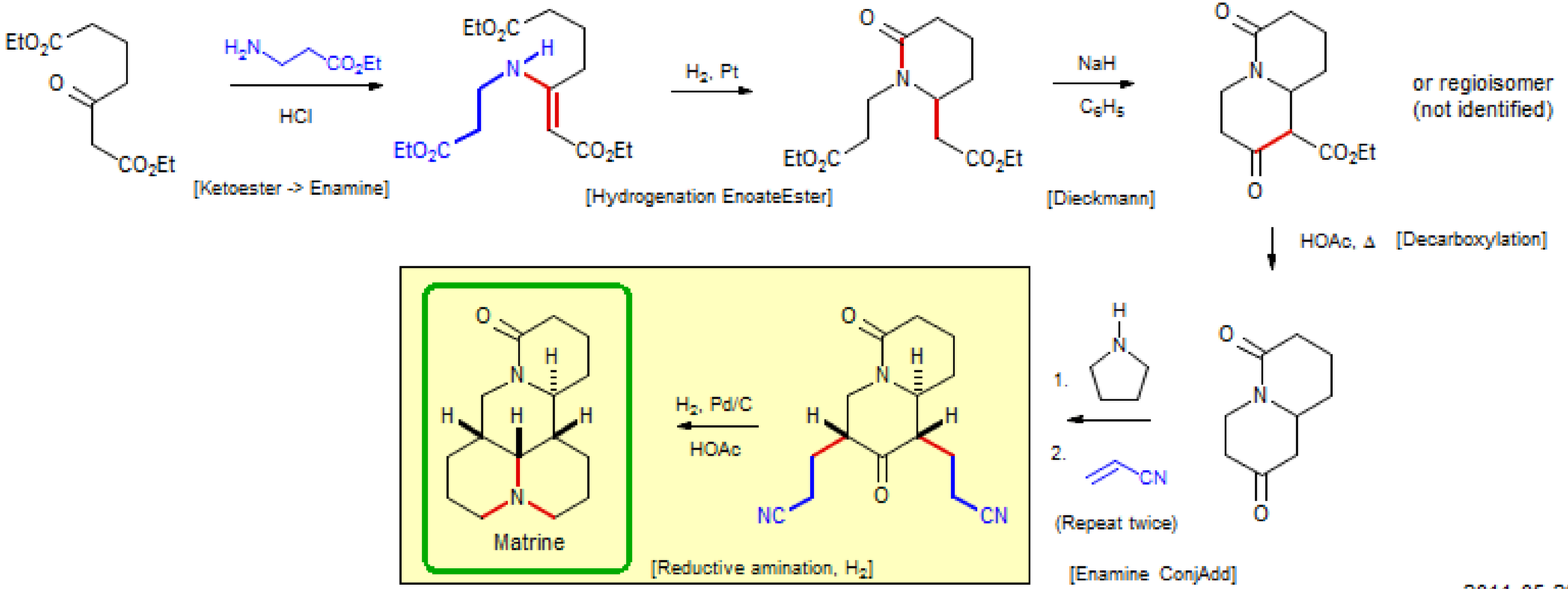


2008-05-17

Matrine

65-02

Mandell, L.; Gresham, J. T.; Freeman, W. J. *J. Am. Chem. Soc.* **1965**, *87*, 8234–8236.

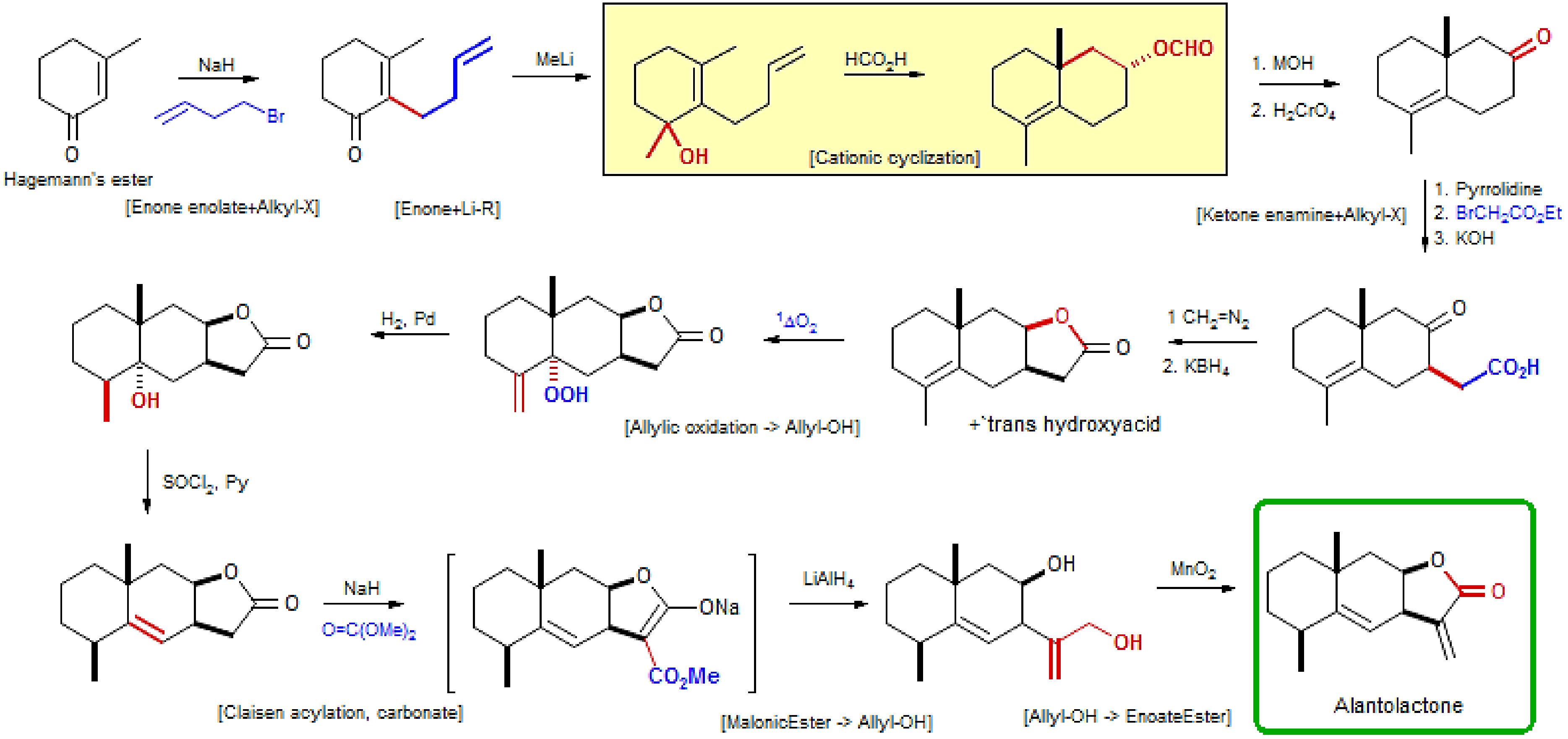


2011-05-29

Alantolactone

65-04

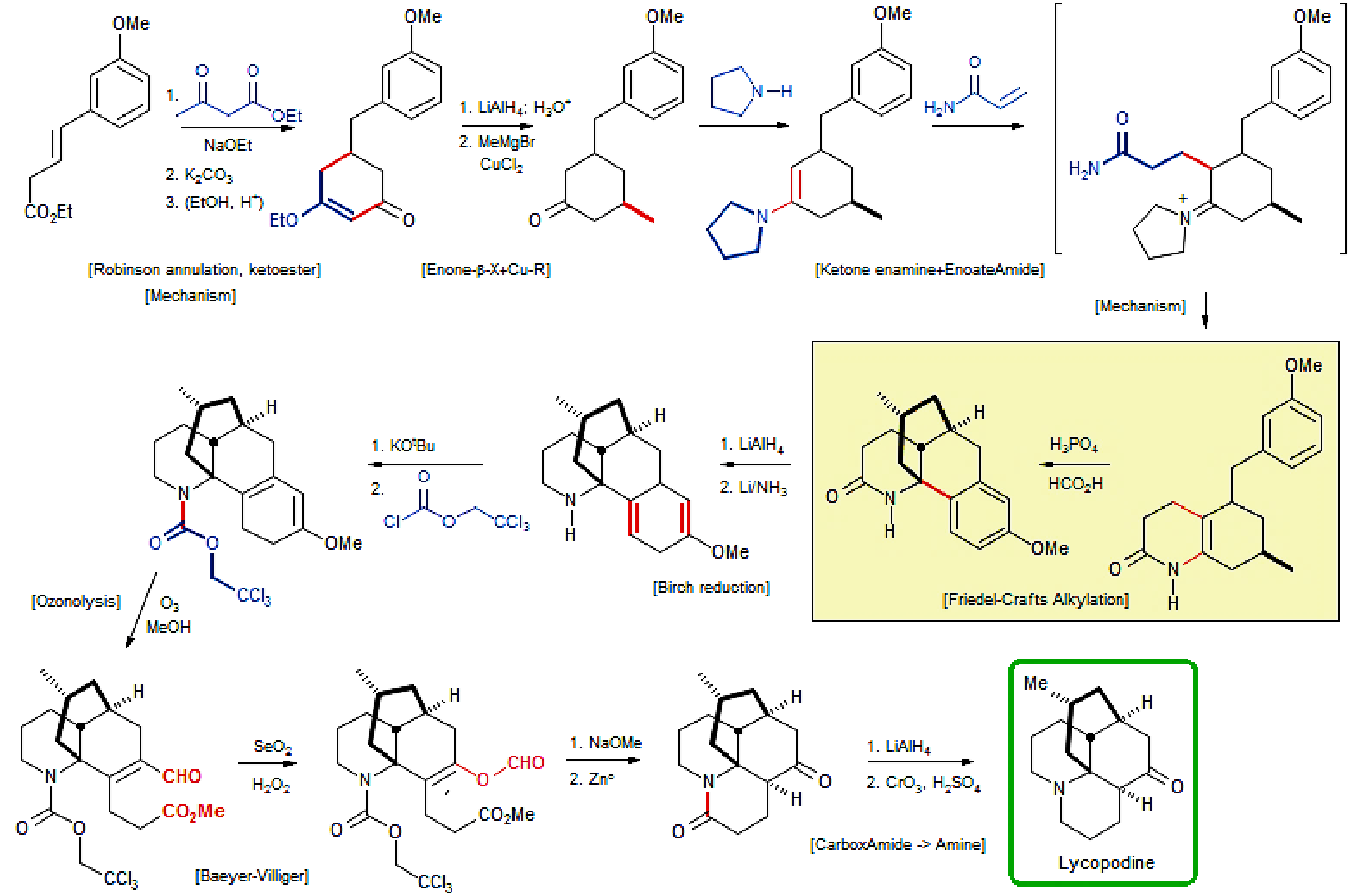
Marshall, J. A.; Cohen, N. *J. Am. Chem. Soc.* **1965**, *87*, 2773-2774.



Lycopodine

68-05

Stork, G.; Kretchmer, R. A.; Schlessinger, R. H. *J. Am. Chem. Soc.* **1968**, *90*, 1647-1648.

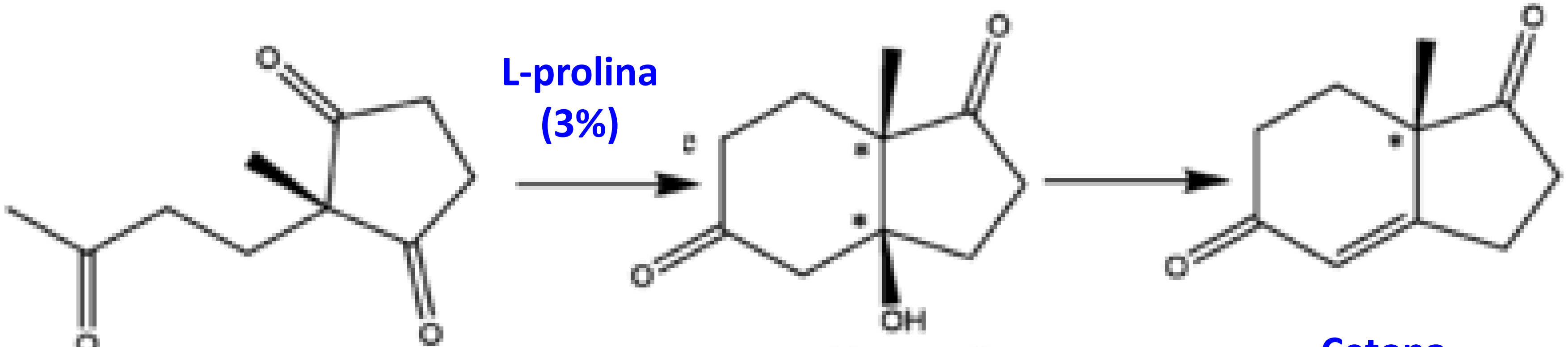


2007-08-20

From Nicolaou *Angew. Chem. Int. Ed.* **2000**, *39*, 44-122

Reacciones de enaminas de cetonas

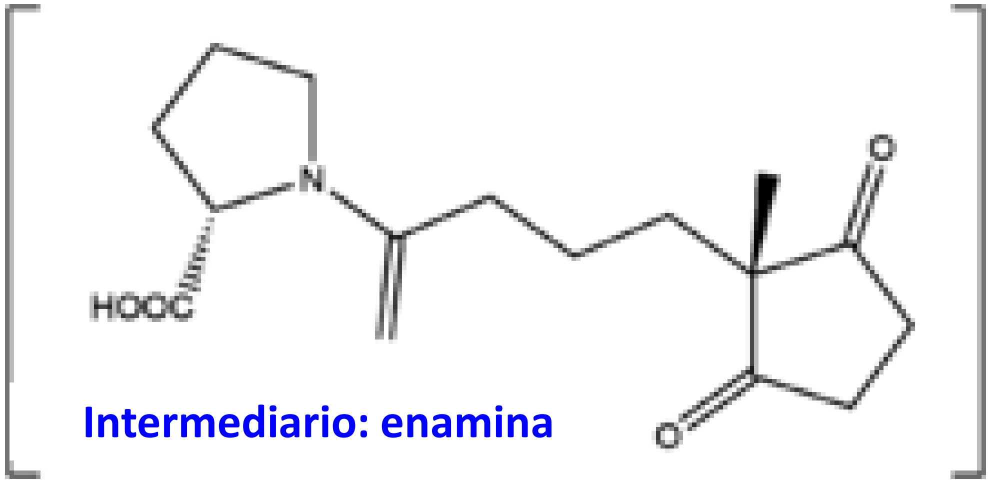
Reacción Hajos–Parrish–Eder–Sauer–Wiechert



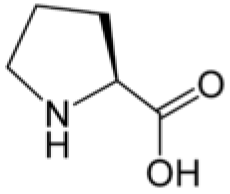
L-prolina (3%)

Intermediario: cetol

Cetona Hajos-Parrish



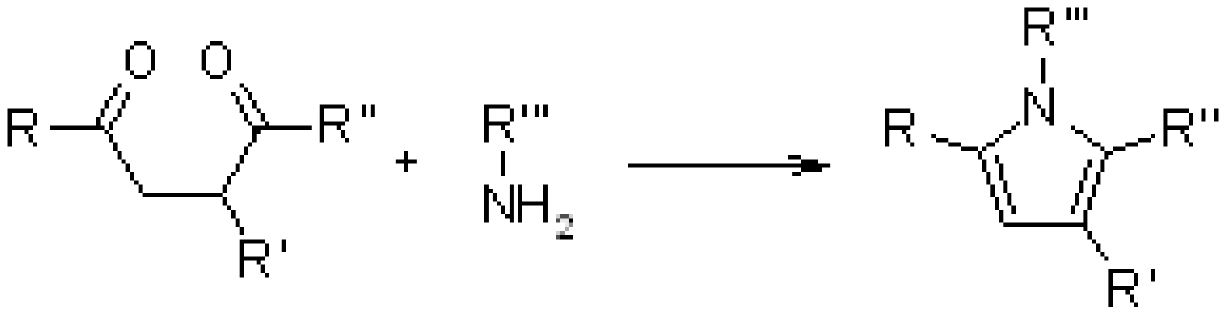
Intermediario: enamina

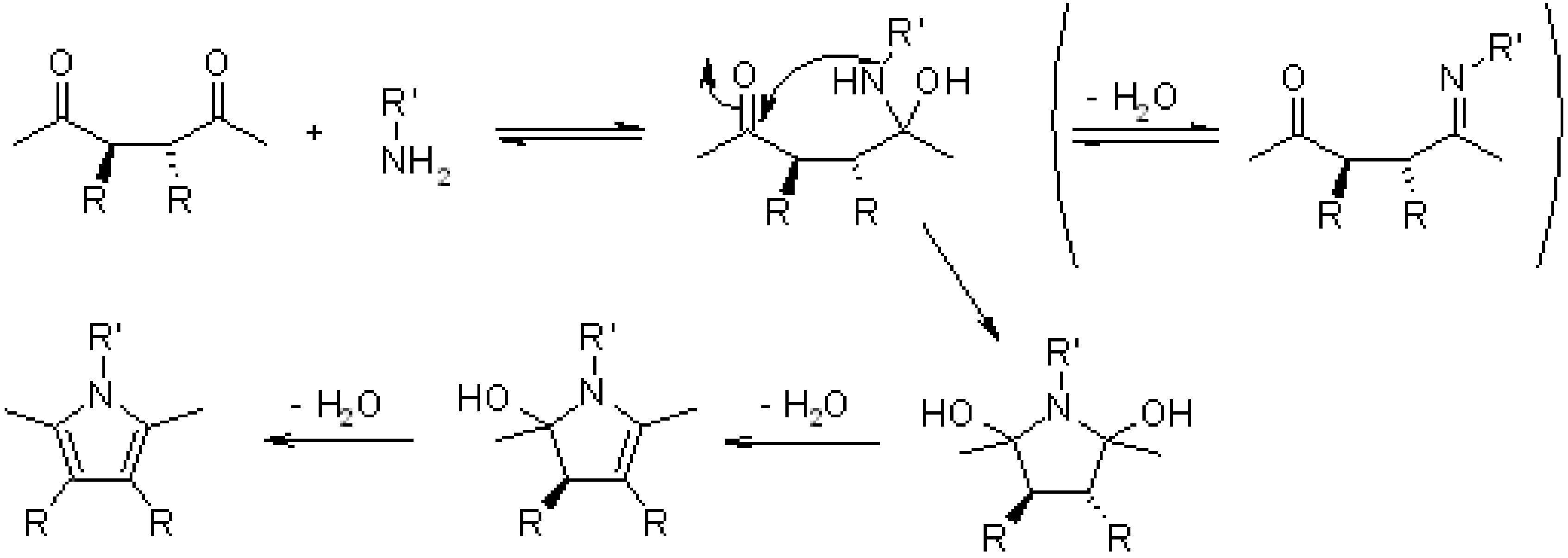


L-prolina

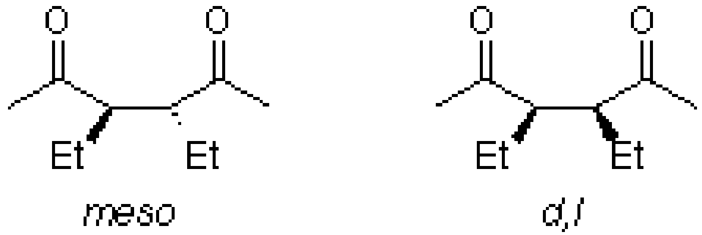
Wang, Zerong (2009). *Comprehensive organic name reactions and reagents*. Hoboken, N.J.: John Wiley.

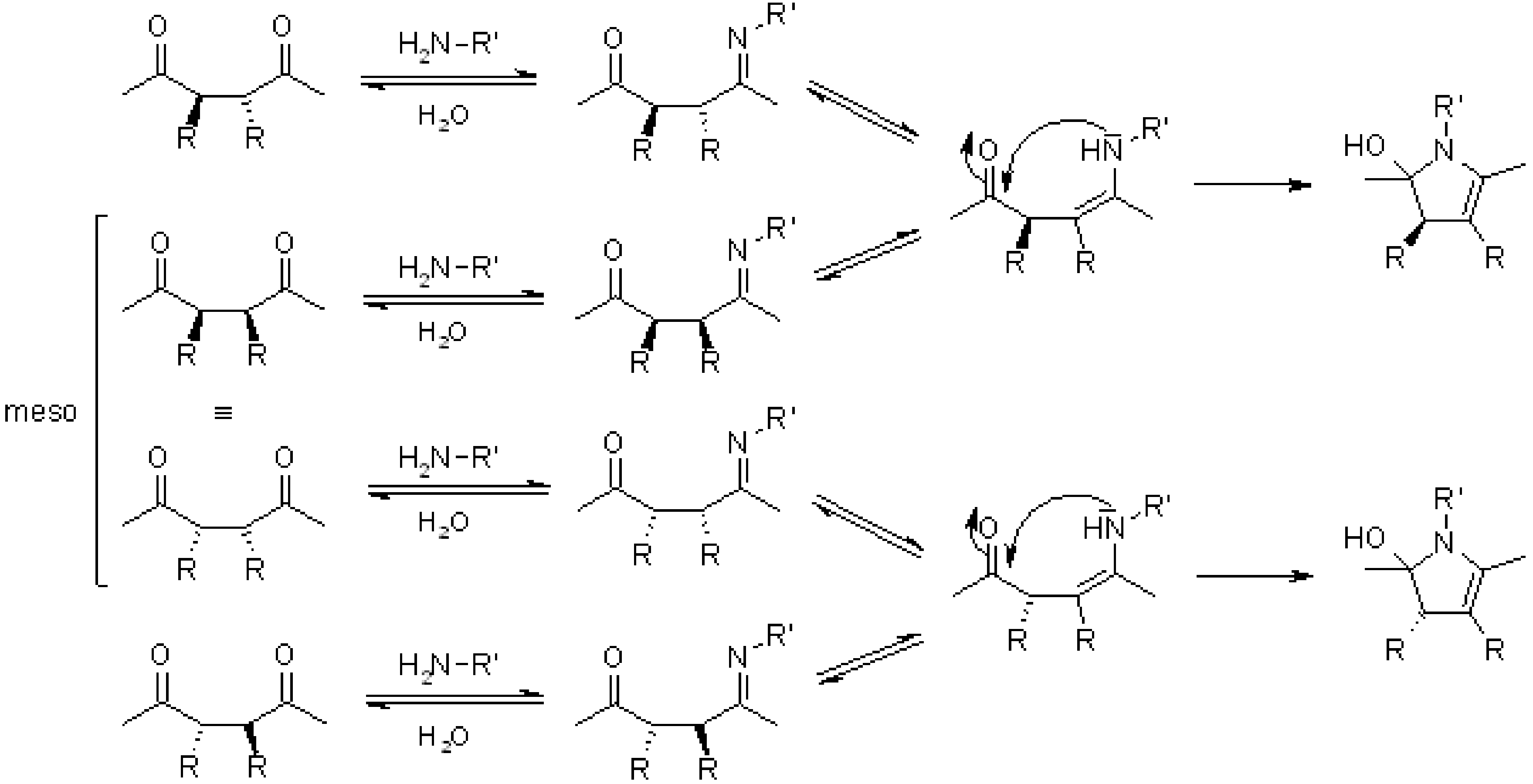
En esta reacción ¿Qué funcionalidad hay en los reactivos y en el producto?





Venkataraman Amarnath has shown (J. Org. Chem., **1991**, *56*, 6924) that *meso*- and dl-3,4-diethyl-2,5-hexanediones cyclize at unequal rates, and that the stereochemical configuration of the unchanged dione is preserved during the reaction. Any mechanism such as the following one that involves the formation of an enamine before the rate-determining step - the cyclization - must be ruled out.

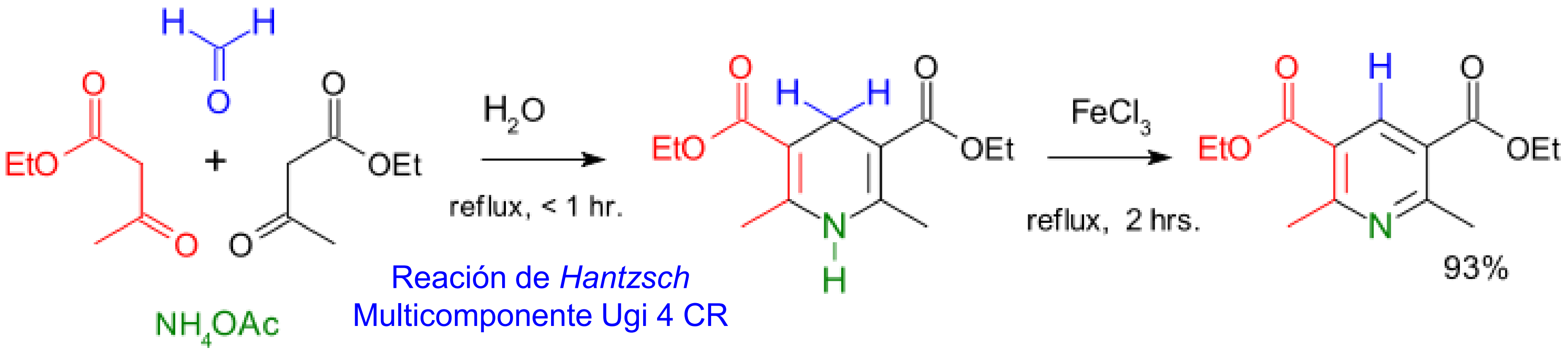




SÍNTESIS DE HANTZSCH PARA 1,4-DIHIDROPIRIDINAS

Oxidación

En esta reacción ¿Qué funcionalidad hay en los reactivos y en el producto?

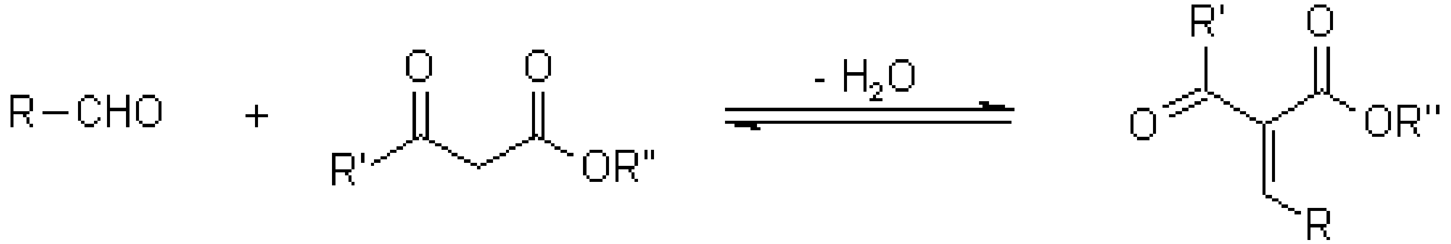


Reación de *Hantzsch*
Multicomponente Ugi 4 CR

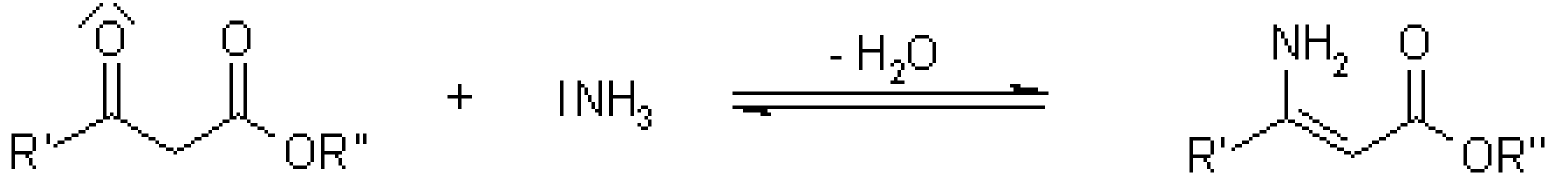
Mecanismo de la síntesis de Hantzsch para obtener 1,4-Dihidropiridinas

Dos intermediarios clave:

1) Producto de la Condensación de Knoevenagel, formación de un compuesto carbonílico α,β-insaturado:



2) Una enamina éster:



3) Adición de Michael, ciclización y deshidratación: