Category

Organo- and Biocatalysis

Key words

cinchona alkaloids benzaldehyde hydrogen cyanide



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Durch Katalysatoren bewirkte asymmetrische Synthese

Biochem. Z. 1912, 687, 7-23.

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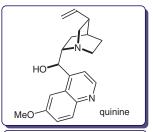
Asymmetrische Synthesen mit Ketenen

Justus Liebigs Ann. Chem. 1960, 634, 9-22.

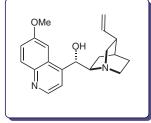
Cinchona Alkaloids in Organic Catalysis

Bredig/Fiske (1912):

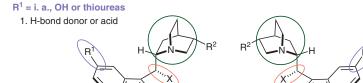
with quinine er ~ 51.5:48.5 with quinidine er ~ 45.5:54.5



Pracejus (1960):



Active sites in cinchona alkaloids and their derivatives:



X = OH1. H-bond donor or acid 2. metal coordination

X = NH₂ or further derivatizations (including inversion of C9-configuration)

1. aminocatalysis

2. H-bond donors (e.g. ureas, squaramides, amides)

Nitrogen of quinuclidine

- 1. metal-binding ability
- 2 Brønsted base
- 3. Lewis base catalyst
- 4. N-alkylation: phase-transfer catalysis

Significance: In 1912, Bredig and Fiske published the first example of asymmetric (nonenzymatic) (organo)catalysis. They reported the addition of HCN to benzaldehyde catalyzed by the pseudoenantiomeric alkaloids quinine and quinidine, with low but reproducible enantioselectivities. About four decades later, Pracejus, for the first time, achieved reasonable enantioselectivities (74% ee) by using O-acetylquinine as an organocatalyst. This groundwork paved the way to a variety of cinchona-alkaloid-catalyzed asymmetric transformations in industry and academia.

Comment: Cinchona alkaloids are among the most privileged asymmetry inducers in the area of enantioselective catalysis. They possess a chiral skeleton that is easily modifiable. In the last century, methodologies were developed in which they were used as chiral bases, as chiral Lewis base catalysts, in ligand-accelerated catalysis, or as quaternized ammonium salts in phase-transfer catalysis, among others. Current research continues to showcase their importance and utility in asymmetric catalysis, for example by incorporating other privileged organic catalophores such as thioureas.

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