Tetrahedron Letters,Vol.29,No.8,pp 851-852,1988
Printed in Great Britain

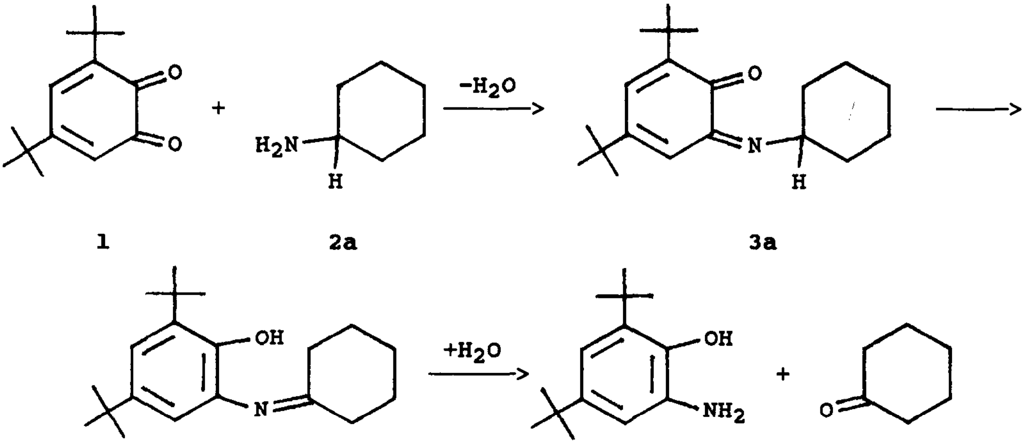
0040-4039/88 $3.00 + .00
Pergamon Journals Ltd.

SPONTANEOUS REARRANGEMENT IN COREY'S REACTION

Robert F.X. Klein, Lisa M. Bargas and Vaclav Horak*
Department of Chemistry, Georgetown University, Washington, D.C. 20057
Mirtha Navarro
Department of Chemistry, Catholic University of Peru, Lima, Peru

Abstract: A ^{1}H-NMR study of the oxidative deamination of sec-alkyl primary amines with 3,5-di-tert-butyl-1,2-benzoquinone confirmed spontaneous rearrangement of the quinone-imines to the respective aromatic Schiff bases.

Corey's oxidative deamination with 3,5-di-tert-butyl-1,2-benzoquinone (1) is the method of choice for preparation of ketones from sec-alkyl primary amines.[1] The reaction involves two steps; condensation of the reactants in MeOH/THF followed by acidic hydrolysis with added aqueous oxalic acid.



1 2a 3a

4a 5 6a

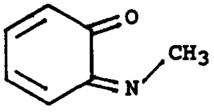
Previous studies did not determine in which step the prototropic rearrangement occurs. Herein we present a ^{1}H-NMR study of the reaction of 1 with several amines (2a-d) which proves rapid spontaneous tautomerization of the quinone-imines (3a-d) to the aromatic Schiff bases (4a-d).[2]

In the course of the ongoing reaction of 1 with cyclohexylamine (2a) (3 h), the two quinonoid ring protons in 1 (δ = 6.965 and 6.230 ppm, Δ = 0.735 ppm) gradually disappeared with concurrent appearance of two new protons with much closer chemical shifts (δ = 6.782 and 6.697 ppm, Δ = 0.085 ppm) quite similar to that of 2-amino-4,6-di-tert-butylphenol (5, δ = 6.905 and 6.788

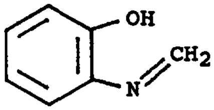
ppm, $\Delta = 0.117$ ppm). The complete ^{1}H-NMR spectra of the product was identical to an authentic sample of 4a synthesized directly from condensation of 5 and cyclohexanone (6a) under identical reaction conditions. Similar results were observed with cycloheptylamine (2b, $\delta = 6.890$ and 6.790 ppm, $\Delta = 0.100$ ppm), 2-butylamine (2c, $\delta = 6.757$ and 6.687 ppm; $\Delta = 0.070$ ppm) and 2-pentylamine (2d, $\delta = 6.714$ and 6.659 ppm, $\Delta = 0.055$ ppm). No evidence of the intermediate quinone-imines (3a-d) was observed, indicating only low concentrations of the initial condensation product. The results confirm that rapid prototropic rearrangement occurs immediately following formation of the quinone-imines.

Unlike similar oxidative deaminations with synthetic pyridoxal analogues,[3] the rearrangement does not require basic catalysis. This was shown by a series of kinetic ^{1}H-NMR runs; the rate of the reaction was unaffected by addition of up to equilmolar quantities of a non-nucleophilic base (DABN).

The rapid, spontaneous nature of the rearrangement suggests that aromatization of the quinone-imine provides a large driving force in the tautomeric equilibrium. Calculation of the relative thermodynamic stabilities of the model systems 6 and 7 by the MNDO-MO method[4,5] confirms that the aromatic Schiff base 7 is strongly favored ($\Delta\Delta H_f = 16.5$ kcals). The large distance between the carbonyl oxygen and the methine σ-bond (3.00 Å in 6), however, probably requires that the transition state involves participation by the additional protic species present in the reaction mixture.



6



7

References

(1) Corey, E.J.; Achiwa, K. J. Am. Chem. Soc. 1969, 91, 1429-32.

(2) *o*-Quinone 1, amines 2a-d, ketones 6a-d and DABN are available from Aldrich. Aminophenol 5 was prepared via nitration and reduction of 2,4-di-*tert*-butylphenol (Aldrich). ^{1}H-NMR's were run on a Bruker AM-300 WB spectrometer (300.133 MHz) in $CDCl_3$ with internal Me_4Si.

(3) (a) Buckley, T.F.; Rapoport, H. J. Am. Chem. Soc. 1982, 104, 4446-50. (b) Babler, J.H.; Invergo, B.J. J. Org. Chem. 1981, 46, 1937-8. (c) Dinizio, S.E.; Watt, D.S. J. Am. Chem. Soc. 1975, 97, 6900-1. (d) Calo, V.; Lopez, L.; Todesco, P.E. J. Chem. Soc., Perk. Trans 1 1972, 1652-3.

(4) Dewar, M.J.S.; Theil, W. J. Am. Chem. Soc. 1977, 99, 4899-907.

(5) MNDO-MO version 3.00 (QCPE publication # 455 (MOPAC)); Stewart, J.P., Frank J. Seiler Res. Lab, U.S. Air Force Academy, Colorodo Springs, CO 80840.

(Received in USA 18 November 1987)