## A New Metal-catalysed Route to 4,5-Dihydro-3H-1-Benzazepines

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A new, short, high-yielding route to 4,5-dihydro-3*H*-1-benzazepines has been developed based on the rhodium-catalysed hydroformylation of readily available *ortho*-propenylbenzeneamines; a comparison with the hydroformylation of the corresponding *ortho*-propenylphenols is made.

The benzazepines are a class of compound of widespread interest to the pharmaceutical industry.<sup>1</sup> 4,5-Dihydro-3*H*-1-benzazepines, however, have not been widely investigated. A multistep route to 4,5-dihydro-3*H*-1-benzazepin-5-ol has been described,<sup>2</sup> but no facile route to these compounds is available.

We now describe a general preparation of this class of compound based on the rhodium-catalysed hydroformylation of *ortho*-propenylbenzeneamines (2) which are readily available in high yield ( $\geq 88\%$ ) from the reaction of *ortho*-acylbenzeneamines (1) with an excess of vinyl magnesium bromide.<sup>3</sup> (Scheme 1). The minor products from these



Scheme 1. Synthesis of dihydrobenzazepines (3): i: CH<sub>2</sub>CHMgBr; ii: H<sub>2</sub>/CO, [Rh(OAc)<sub>2</sub>]<sub>2</sub>, PPh<sub>3</sub>.

**Table 1.** Yields of products from the hydroformylation of *ortho*propenylbenzeneamines (2).<sup>a</sup>

Reactant (2)		Products	
		Ratiob	Isolated vield of
$\mathbb{R}^1$	R <sup>2</sup>	(3):(4)	dihydrobenzazepine (3) (%) <sup>c</sup>
H	н	75:25	69
H	Me	88:12	85
Η	Ph	91:9	79
5-Cl	Ph	91:9	86
4-Me	Ph	87:13	70
Н	4-MeC <sub>6</sub> H <sub>4</sub>	83:17	80

<sup>a</sup> Reactions were carried out in a Parr autoclave using ethyl acetate solutions of the unsaturated amine (2),  $[Rh(OAc)_2]_2$ , and PPh<sub>3</sub> in a ratio of 200:1:4 and H<sub>2</sub>/CO (1:1) at an initial pressure of 2760 kPa for 20 h at 60 °C; <sup>b</sup> Ratios were determined from the <sup>1</sup>H NMR spectra (200 or 300 MHz) of the crude product. <sup>c</sup> Satisfactory spectroscopic and analytical data were obtained for all new compounds.

reactions are the 3-methylquinolines (4) which are readily separated from the dihydrobenzazepines (3) either by acidbase extraction or by chromatography. Yields from reactions of a representative range of substituted *ortho*-propenylbenzeneamines (2) are given in Table 1.

The dihydrobenzazepines (3) were all obtained in good isolated yields ( $\geq 69\%$ ). The amount of 3-methylquinolines (4) formed was relatively insensitive to the substituents on the aromatic ring but was sensitive to steric effects from the substituents at C-1 in the parent unsaturated benzeneamine (2). When R<sup>2</sup> = H, the ratio of (3): (4) was significantly lower (75:25) than for all other reactions in which R<sup>2</sup> = Me or aryl.

The importance of these steric effects was demonstrated in the products obtained from the hydroformylations of 3-phenylprop-1-ene (5), 1,1-diphenylprop-2-en-1-ol [(6);  $R^1$ = H,  $R^2$  = Ph], 2-(1-hydroxy-2-propen-1-yl)phenols [(6);  $R^1$ = OH,  $R^2$  = H, Me, Ph], and 2-(prop-2-enyl)benzeneamine (7)<sup>4</sup> under similar conditions. J. CHEM. SOC., CHEM. COMMUN., 1990



Hydroformylation of (5) gave the terminal and branched chain aldehydes in a ratio of 70:30, in the same range as values quoted for reactions carried out with related rhodium catalysts but under more severe conditions.<sup>5</sup> Hydroformylation of the substituted alkene [(6);  $R^1 = H$ ,  $R^2 = Ph$ ] gave the hemiacetals (8) as the only isolated products (84%). Similarly, hydroformylation of the unsaturated phenols [(6);  $R^1 = OH$ ,  $R^2 = H$ , Me, Ph] gave mixtures of diastereoisomeric hemiacetals [(8);  $R^1 = OH$ ,  $R^2 = H$ , Me, Ph], in good yield. Again, the products resulted from exclusive hydroformylation at the terminal carbon of the alkene. (Scheme 2.)

In contrast, hydroformylation of (7) gave no evidence for the formation of any products from hydroformylation at the terminal alkenyl carbon atom and only the dihydroquinoline (9) was isolated (albeit in modest yield) and characterized by conversion to the well known 3-methylquinoline. It appears, therefore, that the rhodium-catalysed hydroformylations of 2-(2-propen-1-yl)benzeneamines are susceptible to interaction of the amino nitrogen atom with the metal catalyst and such interactions could become dominant in the absence of steric effects from C-1.

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