A Simple Synthesis of Substituted 2-Imino-1,2-dihydropyrimidines From 1-Azabutadienes *via* Diazasilines

José Barluenga,* Miguel Tomás, Alfredo Ballesteros, Vicente Gotor

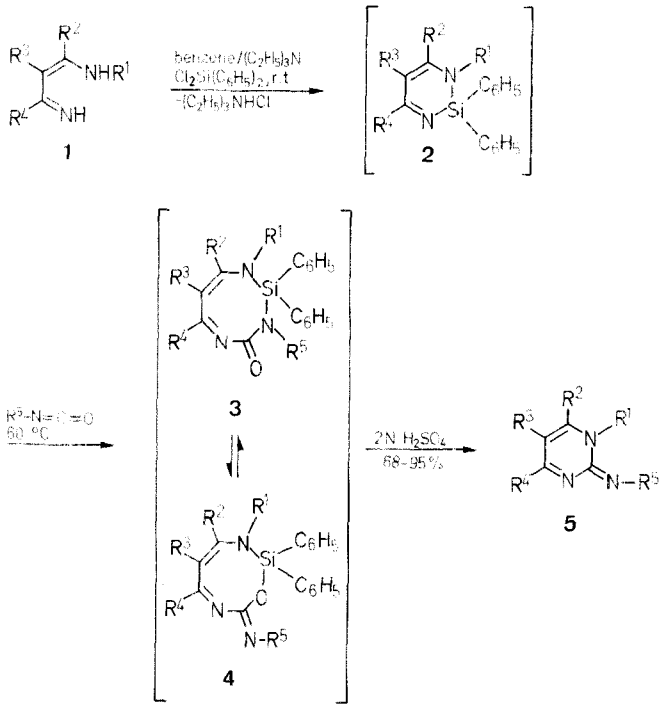
Departamento de Química Orgánica, Facultad de Química, Universidad de Oviedo, E-33071 Oviedo, Spain

1,2-Dihydro-1,3,2-diazasilines, formed on reaction of 4-amino-1-azabutadienes (3-amino-2-propenylideneamines) with dichlorodiphenyl- or dichlorodimethylsilane, react with aliphatic and aromatic isocyanates to give high yields of substituted 2-imino-1,2-dihydropyrimidines.

The general route to 1-alkyl-2-alkylimino-1,2-dihydropyrimidines involves reaction of the parent 2-aminopyrimidines with alkyl halides.[1] Two syntheses of 1-aryl-2-arylimino-1,2-dihydropyrimidines by reacting enaminoaldehydes[2] or enaminoketones[3] with diarylcarbodiimides have been reported. Besides the difficulties associated with the availability of aromatic carbodiimides,[4] this procedure is described only for symmetrical carbodiimides; moreover, when aliphatic carbodiimides or 1,3-disubstituted enaminoketones were employed, the reaction failed.[2]

A few years ago we reported that 4-amino-1-azabutadienes **1** react with isocyanates and isothiocyanates to give pyrimidin-2(1*H*)-ones and, in a few cases, 2-arylimino-1,2-dihydropyrimidines as by-products.[5] Likewise, several examples on the application of species with silicon-nitrogen bonds for the synthesis of heterocyclic compounds are known.[6] Very recently, we described the synthesis of 1,2-dihydro-1,3,2-diazasilines **2** from **1**.[7] Studying the behavior of **2** towards esters of acetylenedicarboxylic acid, we found that the nitrogen-silicon bond is able to add to the activated carbon-carbon triple bond to yield, after rearrangement, 1,5-diazocin-2-(1*H*)-ones.[7] Continuing our study on the reactivity of **2**, we report here an easy, regioselective procedure for preparing substituted 2-imino-1,2-dihydropyrimidines **5** by reaction of diazasilines **2** with aromatic and aliphatic isocyanates.

Thus, treatment of a solution of **2**, formed *in situ* by reaction of **1** with dichlorodiphenylsilane,[7] with different isocyanates at 60 °C for 18 h resulted in the formation of substituted 2-imino-1,2-dihydropyrimidines **5** in high yields (Table 1). While the reaction works well for azabutadienes **1** bearing aliphatic and aromatic substituents, the use of aliphatic isocyanates (R^5 = c-C_6H_{11}) led to low yields of **5** (~ 35% after stirring at 60 °C for 4 days). However, this drawback was easily overcome by employing the more reactive dichlorodimethylsilane (74% yield under the standard conditions; see Table 1, compound **5g**).[10]



Compounds **5** were characterized on the basis of microanalytical spectroscopic (IR, ^{1}H-, and ^{13}C-NMR), and mass spectrometric data (Table 2).

The formation of compounds **5** can be understood as an insertion of the carbon-nitrogen double bond of the isocyanate[8] into the imino nitrogen-silicon bond of **2** to give the intermediate **3**, which in turn can equilibrate to **4**,[9] followed by loss of diphenylsiloxide and intramolecular carbon-nitrogen bond formation.

The synthesis described in this communication provides a facile entry to conveniently substituted 2-imino-1,2-dihydropyrimidines making use of readily available starting materials[11] and mild reaction conditions.

Table 1. 2-Imino-1,2-dihydropyrimidines **5** Prepared

5	R^1	R^2	R^3	R^4	R^5	Yield[a] (%)	m.p. (°C)	Molecular Formula[b] or Lit. m.p. (°C)
a	*c*-C_6H_{11}	H	H	*p*-$CH_3C_6H_4$	*p*-$CH_3C_6H_4$	68	115–116	$C_{24}H_{27}N_3$ (357.5)
b	C_6H_5	C_6H_5	H	C_6H_5	C_6H_5	95	192–193	$C_{28}H_{21}N_3$ (399.5)
c	C_6H_5	C_6H_5	CH_3	C_6H_5	C_6H_5	85	212–214	$C_{29}H_{23}N_3$ (413.5)
d	C_6H_5	C_6H_5	CH_3	*p*-$CH_3C_6H_4$	C_6H_5	78	184–186	$C_{30}H_{25}N_3$ (427.55)
e	C_6H_5	C_6H_5	CH_3	*c*-C_6H_{11}	C_6H_5	78	172–174	$C_{29}H_{29}N_3$ (419.6)
f	*p*-$CH_3C_6H_4$	C_6H_5	CH_3	C_6H_5	C_6H_5	87	194–196	196–198[5]
g	*p*-$CH_3C_6H_4$	C_6H_5	CH_3	*p*-$CH_3C_6H_4$	*c*-C_6H_{11}	74[c]	144–146	$C_{31}H_{33}N_3$ (447.6)
h	*c*-C_6H_{11}	C_6H_5	CH_3	*p*-$CH_3C_6H_4$	C_6H_5	92	176–178	$C_{30}H_{31}N_3$ (433.6)

[a] Overall yield from azabutadienes **1**.
[b] Satisfactory microanalyses obtained: C ±0.25, H ±0.18, N ±0.15.
[c] Dichlorodimethylsilane was used instead of dichlorodiphenylsilane.

Table 2. Spectral Data of Compounds **5**.

5	IR (KBr)[a] ν (cm^{-1})	^{1}H-NMR (80 MHz, $CDCl_3$/TMS_{int})[b] δ (ppm)	^{13}C-NMR (20 MHz, $CDCl_3$/TMS_{int})[c,d] δ (ppm)	MS (70 eV)[e] *m/e* (M^+)
a	1635	1.3–2.2 (m, 10H, $5CH_2$); 2.3 (s, 3H, CH_3); 2.4 (s, 3H, CH_3); 2.8 (m, 1H, CH); 6.4 (d, 1H, CH); 7.1–8.0 (m, 9H, $8H_{arom}$, CH)	163.79 (s); 148.33 (s); 141.94 (d); 95.98 (d)	357
b	1625	6.4 (s, 1H, CH); 6.9–8.0 (m, $20H_{arom}$)	165.78 (s); 158.67 (s); 151.04 (s); 99.63 (d)	399
c	1630	1.75 (s, 3H, CH_3); 6.7–7.6 (m, $20H_{arom}$)	171.33 (s); 155.21 (s); 150.80 (s); 107.23 (s)	413
d	1625	1.7 (s, 3H, CH_3); 2.3 (s, 3H, CH_3); 6.7–7.5 (m, $19H_{arom}$)	171.00 (s); 156.08 (s); 150.71 (s); 106.72 (s)	427
e	1610	0.98–2.1 (m, 10H, $5CH_2$); 1.8 (s, 3H, CH_3); 2.7 (m, 1H, CH); 6.4–7.6 (m, $15H_{arom}$)	177.61 (s); 154.27 (s); 151.22 (s); 107.43 (s)	419
f	1620	1.8 (s, 3H, CH_3); 2.3 (s, 3H, CH_3); 7.0–7.8 (m, $19H_{arom}$)	170.91 (s); 156.40 (s); 150.84 (s); 106.64 (s)	427
g	1630	1.1–2.0 (m, 10H, $5CH_2$); 1.7 (s, 3H, CH_3); 2.2 (s, 3H, CH_3); 2.4 (s, 3H, CH_3); 4.0 (m, 1H, CH); 6.7–7.8 (m, $13H_{arom}$)	169.01 (s); 155.35 (s); 150.11 (s); 103.50 (s)	447
h	1620	0.9–2.0 (m, 10H, $5CH_2$); 1.7 (s, 3H, CH_3); 2.3 (s, 3H, CH_3); 3.2 (m, 1H, CH); 6.7–7.8 (m, $14H_{arom}$)	168.50 (s); 157.36 (s); 149.58 (s); 106.80 (s)	433

[a] Recorded on a Perkin-Elmer 298 spectrophotometer.
[b] Recorded on a Varian FT-80A spectrometer.
[c] Given for the ring-carbon atoms.
[d] Recorded on a Varian FT-80A spectrometer.
[e] Recorded on a Hewlett-Packard 5987A spectrometer.

Substituted 2-Imino-1,2-dihydropyrimidines 5; General Procedure:
To a solution of **1** (5 mmol) and triethylamine (1.7 ml, 12 mmol) in benzene (40 ml) is slowly added under argon a solution of dichlorodiphenylsilane or dichlorodimethylsilane (6 mmol) in benzene (20 ml). The mixture is stirred overnight at room temperature, and then the precipitated triethylammonium chloride filtered. The filtrate is heated with the corresponding isocyanate (6 mmol) at 60 °C for 18 h, and the resulting mixture hydrolzyed with 2 normal sulfuric acid (80 ml) and extracted with dichloromethane (2 × 50 ml). The organic layer is discarded, and the aqueous layer treated with 3 normal potassium hydroxide until basic, extracted with dichloromethane (3 × 40 ml) and dried with sodium sulfate. Evaporation of the solvents gives compounds **5** in almost pure form. They are further purified by recrystallization from ethanol.

Received: 13 October 1986

(1) Brown, D.J., Harper, J.S. *J. Chem. Soc.* **1963**, 1276.
Brown, D.J., Paddon-Row, M.N. *J.Chem. Soc. C.* **1967**, 1928.
Goerdeler, J., Roth, W. *Chem Ber.* **1963**, *96*, 534.
Stewart, R., Lee, T.W.S. *J. Org. Chem.* **1982**, *47*, 2075.
(2) Skoetsch, C., Breitmaier, E. *Chem. Ber.* **1978**, *111*, 2003.
(3) Katoh, A., Sagane, M., Omote, Y., Kashima, C. *Synthesis* **1983**, 409.
(4) Campbell, T.W., Monagle, J.J. *Org. Synth. Coll. Vol. V* **1973**, 501
Rajagopalau, P., Advani, B.G., Talaty, C.N. *Org. Synth. Coll. Vol. V* **1973**, 504.
(5) Barluenga, J., Rubio, V., Gotor, V. *J. Org. Chem.* **1980**, *45*, 2592.
(6) Basha, F.Z., De Ferrandis, J.F. *Tetrahedron Lett.* **1984**, *25*, 5271.
Shanzer, A. *Angew. Chem.* **1980**, *92*, 325; *Angew. Chem. Int. Ed. Engl.* **1980**, *19*, 327.
Schwartz, E., Gottlieb, H.E., Frolow, F., Shanzer, A. *J. Org. Chem.* **1985**, *50*, 5469.
(7) Barluenga, J., Tomás, M., Ballesteros, A., Gotor, V., Krüger, C., Tsay, Y.-H. *Angew. Chem.* **1986**, *98*, 190; *Angew. Chem. Int. Ed. Engl.* **1986**, *25*, 181.
(8) For addition of silylamines to isocanates, see:
Klebe, J.F., Busch, J.B., Jr., Lyons, J.E. *J. Am. Chem. Soc.* **1964**, *86*, 4400.
Arrieta, A., Palomo, C. *Synthesis* **1982**, 1050.
(9) Fukui, M., Itoh, K., Ishii, Y. *J. Chem. Soc. Perkin Trans. 2* **1972**, 1043..
(10) Condensation of **1** with dicyclohexylcarbodiimide, which would give rise to the corresponding dihydropyrimidines, does not take place even at temperatures higher than 100 °C.
(11) For preparation of 1-azabutadienes **1**, see:
Hoberg, H., Barluenga, J. *Synthesis* **1970**, 142.
Wittig, G., Fisher, S., Tanaka M. *Liebigs Ann. Chem.* **1973**, 1075.