A New Synthesis of 5-Vinylpyrimidines[1]

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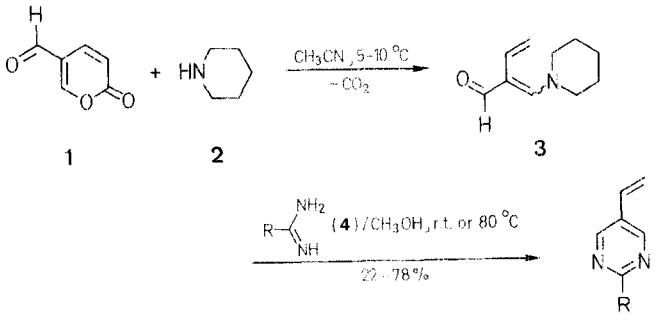
5-Vinylpyrimidines are prepared by the reaction of 5-formyl-2-pyrones with amidines.

Vinyl heterocyles have proved to be valuable monomers for technical applications; for example polymers of 5-vinylpyrrolidone serve as blood plasma substitutes, N-vinylcarbazol forms polymers with excellent insulating properties[2,3] and various polyvinylpyridines find use in the rubber, textile and pharmaceutical industries[4].

Polyvinylpyrimidines, despite showing interesting electrical and biological properties, have been little studied, due to the relative inaccessibility of the monomeric vinylpyrimidines[5]. Syntheses available till now involve building a vinyl group onto already formed pyrimidines[6,7,8].

This paper reports a simple one-pot synthesis of 2-substituted 5-vinylpyrimidines by the reaction of an amidine **4** with 1-vinyl-2-piperidylacrolein **3**. This new acrolein derivative **3** can easily be obtained by the reaction of piperidine with 5-formyl-2-pyrone[9] at 5°–25°. After mixing the reaction components a spontaneous development of carbon dioxide takes place, and after 3 hours the reaction is complete. The solution contains the acrolein derivative **3** in nearly pure form and can be used without isolation for 5-vinylpyrimidine synthesis. Thus reaction of an acetonitril solution of **3** with a range of amidine bases prepared with sodium methoxide in methanol from the corresponding salts gives directly 2-substituted 4-vinylpyrimidines in 22–78% yield. This easy, direct access to a range of 4-vinylpyrimidines opens the way for a more intensive study of the properties of the corresponding polymers. For example the polymers of **5k** and **5l** form palladium complexes with useful catalytic properties[10].



2-Vinyl-3-piperidyl-2-propenal 3:

Piperidine (**2**; 0.85 g, 0.01 mol) diluted with acetonitril (1 ml) is added over 5 min to a solution at 5–10 °C of freshly distilled **1** (1.24 g, 0.01 mol) in acetonitril (10 ml). The evolution of carbon dioxide is complete in about 3 hours. An acetonitrile solution of nearly pure **3** remains. Due to partial decomposition of the latter on longer standing or distillation, the acetonitrile solution is always freshly prepared and directly used for 5-vinylpyrimidine **5** synthesis.

Bulb-to-bulb distillation (Büchi apparatus): b.p. 190 °C/0.025 torr.

$C_{10}H_{15}NO$	calc.	C 72.69	H 9.15	N 8.48
(162.5)	found	72.70	9.30	8.50

^{1}H-NMR ($CDCl_3$/TMS_{int}): δ = 5.50 (dd, 1 H, J = 17 Hz, 3 Hz); 5.10 (dd, 1 H, J = 11 Hz, 3 Hz); 6.38 (m, 1 H, J = 17 Hz, 11 Hz); 6.68 (s, 1 H); 8.93 ppm (d, 1 H, J = 1 Hz).

Table. 5-Vinylpyrimidines **5a–m** Prepared

5a	R	Molecular Formula[d]	Reaction Conditions [h]/[°C]	Purification Method[b]	Yields [%]	m.p. [°C][c] b.p. [°C]/torr	^{1}H-NMR ($CDCl_3$/TMS) δ [ppm]
a	$-NH_2$	$C_6H_7N_3$ (121.1)	12/25	C	78	136	5.15 (d, 1H, J = 10 Hz); 5.57 (d, 1H, J = 18 Hz); 6.48 (dd, 1H); 8.31 (s, 2H)
b	$-N(CH_3)_2$	$C_8H_{11}N_3$ (149.2)	20/25	C	68	67	3.21 (s, 6H); 5.10 (d, 1H, J = 11 Hz); 5.57 (d, 1H, J = 18 Hz); 6.50 (dd, 1H); 8.36 (s, 2H)
c	$-CH_2CH(CH_3)_2$	$C_{10}H_{14}N_2$ (162.2)	20/25	D	77	140/11	1.04 (d, 6H); 2.32 (m, 1H); 2.88 (d, 2H); 5.43 (d, 1H, J = 18 Hz); 5.85 (d, 1H, J = 18); 6.64 (dd, 1H); 8.70 (s, 2H)
d	$4\text{-}CH_3C_6H_4$	$C_{13}H_{12}N_2$ (196.2)	20/80	A–B	75	98	2.42 (s, 3H); 5.43 (d, 1H, J = 11 Hz); 5.88 (d, 1H, J = 18 Hz); 6.66 (dd, 1H); 7.26 (d, 2H); 8.33 (d, 2H); 8.78 (s, 2H)
e	$3\text{-}CF_3C_6H_4$	$C_{13}H_9F_3N_2$ (250.2)	24/25	A	70	108	5.47 (d, 1H, J = 11 Hz); 5.90 (d, 1H, J = 18 Hz); 6.67 (dd, 1H); 7.63 (m, 2H); 8.69 (m, 2H); 8.72 (s, 2H)
f	$2\text{-}ClC_6H_4$	$C_{12}H_9ClN_2$ (216.6)	72/25	A	35	62	5.48 (d, 1H, J = 11 Hz); 5.93 (d, 1H, J = 18 Hz); 6.67 (dd, 1H); 7.40 (m, 3H); 7.90 (m, 1H); 8.86 (s, 2H)
g	$4\text{-}n\text{-}C_8H_{17}\text{—}C_6H_4$	$C_{20}H_{26}N_2O$ (310.4)	36/80	B	62	66	0.80–2 (m, 15H); 4.00 (t, 2H); 5.39 (d, 1H, J = 11); 5.84 (d, 1H, J = 18); 6.64 (dd, 1H); 6.95 (d, 2H); 8.36 (d, 2H); 8.75 (s, 2H)
h	$4\text{-}O_2N\text{—}C_6H_4$	$C_{12}H_9N_3O_2$ (227.2)	18/80	A–C	27	210[e]	5.55 (d, 1H, J = 11); 6.01 (d, 1H, J = 18); 6.75 (dd, 1H); 8.29 (d, 2H); 8.65 (d, 2H); 8.91 (s, 2H)
i	$3,5\text{-}(NO_2)_2\text{—}C_6H_3$	$C_{12}H_8N_4O_4$ (272.2)	5/80	A–B	22	141	5.62 (d, 1H, J = 11); 6.04 (d, 1H, J = 18); 6.77 (dd, 1H); 8.90 (s, 2H); 9.07 (t, 1H); 9.58 (d, 2H)
j	1-naphtyl	$C_{16}H_{12}N_2$ (232.2)	20/25	A	70	71	5.52 (d, 1H, J = 10); 6.00 (d, 1H, J = 18); 6.74 (dd, 1H); 7.5 (m, 3H); 7.94 (m, 2H); 8.08 (dd, 1H); 8.67 (m, 1H); 8.94 (s, 2H)
k	2-pyridyl	$C_{11}H_9N_3$ (183.7)	12/80	A–C	34	103	5.53 (d, 1H, J = 11); 5.98 (d, 1H, J = 18); 6.73 (dd, 1H); 7.39 (m, 1H); 7.86 (m, 1H); 8.56 (m, 1H); 8.89 (m, 1H); 8.94 (s, 2H)
l	2-pyrimidyl	$C_{10}H_8N_4$ (184.1)	3/80	A–C	42	149	5.51 (d, 1H, J = 11); 5.95 (d, 1H, J = 18 Hz; 6.69 (dd, 1H); 7.32 (t, 1H); 8.92 (m, 4H)
m	4,6-dimethyl-2-pyrimidyl	$C_{12}H_{12}N_4$ (212.2)	3/80	A–C	60	232	2.69 (s, 6H); 5.57 (d, 1H, J = 11 Hz); 6.01 (d, 1H, J = 18 Hz); 6.79 (dd, 1H); 7.16 (s, 1H); 9.03 (s, 2H)

[a] Method for preparation of amidines used: **5h, i, *k*, l, m**[11]; **5d, e, g**[12]; **5c, f**[13]; **5j**[14], **5a, b**[15]

[b] Purification Methods:
A Chromatography on silica gel: Eluent for **5d, f, h, j** $CHCl_3$/Me_2CO, 19:1; **5i** $CHCl_3$; **5e** $CHCl_3$/Me_2CO, 9:1; **5k** $CHCl_3$/MeOH, 9:1; **5l, m** $CHCl_3$/MeOH, 19:1.
B Cristillization: **5d, g, i** in EtOH.
C Sublimation [°C]/[torr]: **5a** $130/10^{-2}$; **5b** $43/10^{-2}$; **5h** $100/10^{-2}$; **5k** $90/10^{-2}$; **5l** $180/10^{-2}$; **5m** $160/10^{-3}$.
D Distillation.

[c] Uncorrected, measured with a Dr. Tottoli apparatus.

[d] Satisfactory microanalyses are obtained: C ±0.30, H ±0.14, N ±0.15.

[e] Decomposition.

5-Vinylpyrimidines 5; General Procedure:
A solution of freshly prepared **3** (0.01 mol) in acetonitrile is added to a methanolic solution of an amidine [prepared from amidine hydrochloride or hydrobromide (0.01 mol) and a 1.25 M methanolic solution of sodium methoxide (100 ml, 0.125 mol) in methanol (8 ml)]. The reaction mixture is stirred either at room temperature or heated at 80 °C for the time given in the Table. The cooled reaction mixture is filtered from the inorganic solid, the solvent removed *in vacuo*, and the product isolated from the residue by the methods given in the Table.

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