A Novel Transformation of Imidazolines into 2,4,6-Trisubstituted Pyrimidine Derivatives[1]

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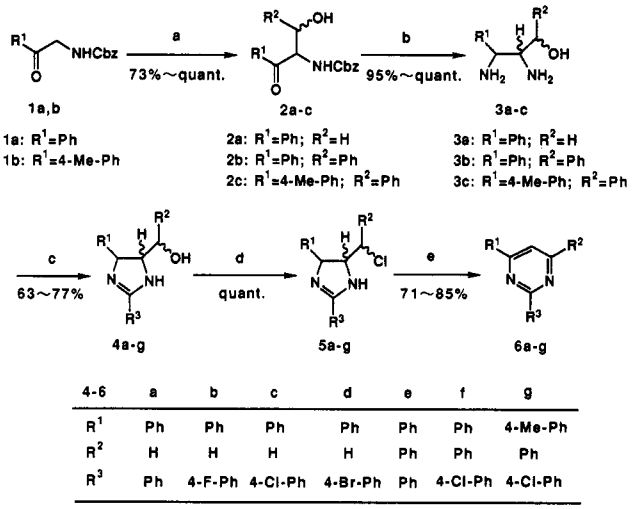
2,5-Diaryl-4-(chloromethyl)imidazoline derivatives **5a–g**, obtained from *N*-acyl-α-amino ketone derivatives **1**, were rearranged with sodium hydride in dimethylformamide. Spontaneous air oxidation led to 2,4-di- and 2,4,6-triarylpyrimidine derivatives **6a–g** in good yields.

C-Alkyl- or *C*-arylpyrimidines are an important class of heterocycles, and their syntheses have obtained much attention. Three methods classified as follows have been reported with regard to the direct synthesis of these pyrimidines. The first method is based on the condensation of 1,3-diketones or their derivatives with amidines or aldehydes in the presence of ammonium salts.[2] The second method is composed of a condensation of an α,β-unsaturated ketone with an amidine followed by oxidation.[3] The third method uses nitriles as a starting material.[4] They have been widely used and a variety of pyrimidines can be synthesized. There are, however, some disadvantages in the preparation of the starting materials concerning yield and procedure. In addition, it is difficult to obtain trisubstituted pyrimidines having varying substituents. Therefore, more convenient and versatile synthetic methods are still in demand.

Meanwhile, as part of our investigation to develop novel drugs from amino acids, we have synthesized various heterocyclic compounds with pharmaceutical activity. These include oxazole,[5] thiazole,[5b] imidazole,[6] and imidazoline derivatives[7] synthesized by using α-*C*-acylamino acids or α-amino ketones **1** as the common intermediates which are readily obtained from α-amino acids by our procedure.[8]

In this study, we focused on the rearrangement of 4-functionalized imidazoline derivatives (**5**) to give pyrimidines. The functionalized imidazolines were readily obtained from α-amino ketones **1**. Because the ring expansion can be conducted on a system in which a fused three-membered ring is involved,[9] we selected the 4-(chloromethyl)imidazoline derivatives **5** as the key intermediates. This enabled the formation of fused aziridine derivatives upon treatment with base.

Scheme I[a]



4-6	a	b	c	d	e	f	g
R^1	Ph	Ph	Ph	Ph	Ph	Ph	4-Me-Ph
R^2	H	H	H	H	Ph	Ph	Ph
R^3	Ph	4-F-Ph	4-Cl-Ph	4-Br-Ph	Ph	4-Cl-Ph	4-Cl-Ph

[a]Key: (a) R^2CHO, $NaN(TMS)_2$; (b) (1) NH_2OH, (2) H_2/Pd–C, (c) R^3–C(=NH·HCl)–OEt; (d) $SOCl_2$; (e) NaH, DMF.

Results and Discussion

The key intermediates, 2,5-disubstituted 4-(chloromethyl)imidazoline derivatives **5a–d**, were synthesized as shown in Scheme I. Aldol condensation of (*N*-(benzyloxycarbonyl)amino)methyl aryl ketones **1a,b**[7] with an aldehyde using sodium bis(trimethylsilyl)amide as the base yielded β-hydroxy ketones **2b,c** in high yields. The use of paraformaldehyde and potassium carbonate in 2-propanol was effective in the case of the hydroxymethyl derivative **2a**. Hydroxyimidation of **2a–c** followed by catalytic hydrogenation of the oximes yielded β-hydroxyethylenediamine derivatives **3a–c**. Condensation of the diamines

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Scheme II

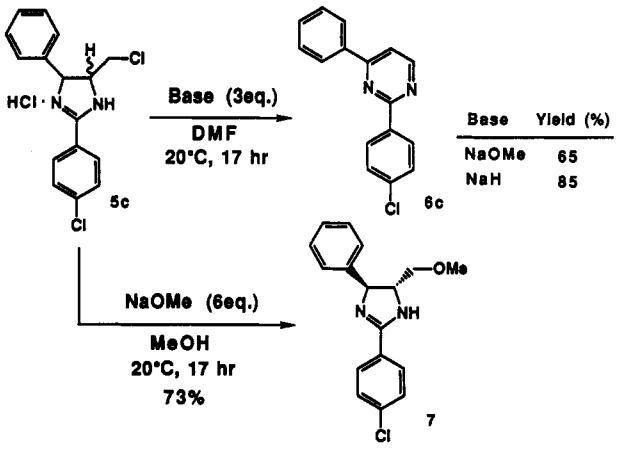


Table I. Preparation of 2,4-Di- and 2,4,6-Trisubstituted Pyrimidines by the Ring-Expansion Reaction

product	R^1	R^2	R^3	yield (%)	mp[c] (°C)
6a[a]	Ph	H	Ph	80	74–75 (lit.[2b] 71)
6b[a]	Ph	H	4-FPh	71	75–76
6c[a]	Ph	H	4-ClPh	85	115–117
6d[a]	Ph	H	4-BrPh	81	101–103
6e[b]	Ph	Ph	Ph	73	184–185 (lit.[2c] 185–186)
6f[b]	Ph	Ph	4-ClPh	81	219–220
6g[b]	4-MePh	Ph	4-ClPh	85	174–175

[a] Hydrochlorides of **5** were reacted with 3 equiv of sodium hydride. [b] 2 equiv of sodium hydride was used as a base. [c] Melting points were not corrected.

3a–c with ethyl imidates followed by chlorination of **4a–g** with thionyl chloride afforded the desired imidazoline derivatives **5a–g** in good yields as mixtures of diastereomers.

Initially, the ring expansion reaction was investigated using 4-(chloromethyl)-2-(4-chlorophenyl)-5-phenylimidazoline hydrochloride (**5c**) (*cis*/*trans* = 1/1). The imidazoline (**5c**) was treated with 3 equiv of base (sodium methoxide or, more effectively, sodium hydride) in dimethylformamide at ambient temperature for 17 h to afford the desired 2-(4-chlorophenyl)-5-phenylpyrimidine (**6c**) in good yield (Scheme II).

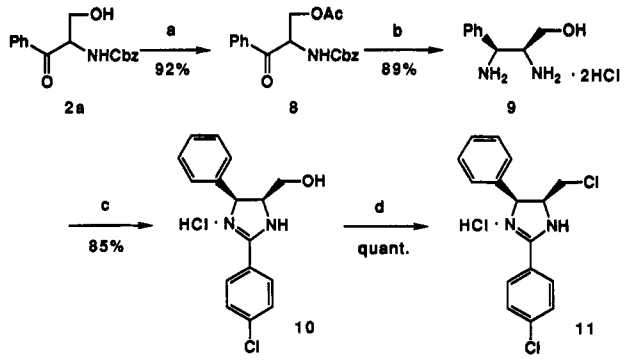
Alternatively, reaction of **5c** with sodium methoxide in methanol resulted in the substitution product **7** in good yield. This is in contrast to the reaction in which dimethylformamide was used as a solvent.

Other 4-(chloromethyl)imidazoline derivatives (**5a,b,d–g**) were similarly treated with sodium hydride (2 equiv, 3 equiv, in the case of hydrochloride) in dimethylformamide at 20 °C for 17 h to afford the expected 2,4-disubstituted or 2,4,6-trisubstituted pyrimidine derivatives **6a,b,d–g** in good yields (Scheme I, Table I). The structures of the products (**6a–g**) were confirmed by IR, NMR, mass spectra, and melting points. In the case of **6a** and **6e**, these values were found to be identical with the reported values.[2b,c]

To determine the reaction mechanism and stereochemistry of this ring expansion, we utilized *cis*- and *trans*-4-(chloromethyl)-2-(4-chlorophenyl)-5-phenylimidazoline hydrochloride (**11**, **14**) as starting material and investigated the reaction pathway. The syntheses of **11** and **14** are outlined in Schemes III and IV.

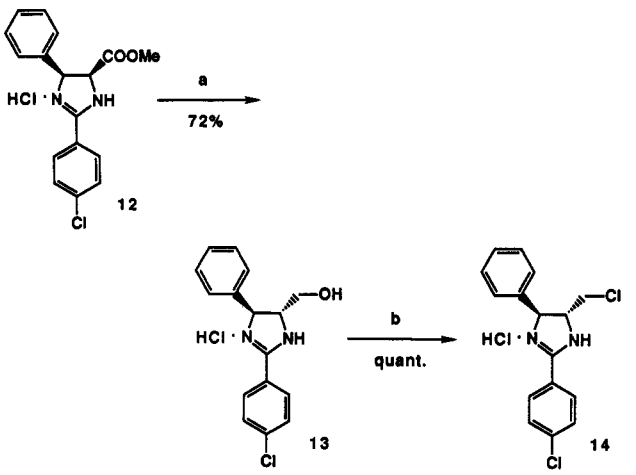
erythro-Diamine **9** was obtained as an intermediate for the synthesis of **11**. Hydrogenation of the oxime from hydroxy ketone **2a** provided a 1:1 mixture of diamine **3a**.

Scheme III[a]



[a] Key: (a) Ac_2O, DMAP, Et_3N; (b) (1) NH_2OH, (2) H_2/Pd–C; (3) HCl; (c) Ar–C(=NH·HCl)–OEt; (d) $SOCl_2$.

Scheme IV[a]



[a] Key: (a) $Ca(BH_4)_2$; (b) $SOCl_2$.

Acetylation of **2a** followed by hydroxyimidation and catalytic hydrogenation stereoselectively yielded the *erythro*-diamine **9** in good yield. Diamine **9** was condensed with ethyl imidate followed by chlorination to afford the *cis*-imidazoline derivative **11**.

The *trans*-imidazoline derivative **14** was prepared by the chlorination of the corresponding *trans*-4-(hydroxymethyl) derivative **13**. This was synthesized effectively from *cis*-2-(4-chlorophenyl)-4-(methoxycarbonyl)-5-phenylimidazoline hydrochloride (**12**)[7] through epimerization and reduction using calcium borohydride.

We then isolated some intermediates from the ring-expansion reaction. *cis*-Aziridino[1,2-*c*]-2-imidazoline derivative **15** was isolated as crystals from a reaction mixture obtained in which **11** was reacted with 2 equiv of sodium hydride in dimethylformamide. Furthermore, *trans*-aziridino[1,2-*c*]-2-imidazoline derivative **16** was obtained as crystals from the same reaction using **14** (Scheme V). The structures of **15** and **16** were fully confirmed by IR, NMR, mass spectra, and elemental analyses. X-ray analysis was also performed on **16** as shown in Figure 1. The ^{13}C-NMR of **15** and **16** showed carbon–proton coupling constants ($^1J_{CH}$) at 172.5 and 172.6 Hz and 169.3 and 175.8 Hz, respectively. These were assigned as the methylene of the aziridine ring, which were typical values for the three-membered ring.[10] To our knowledge, this is the first

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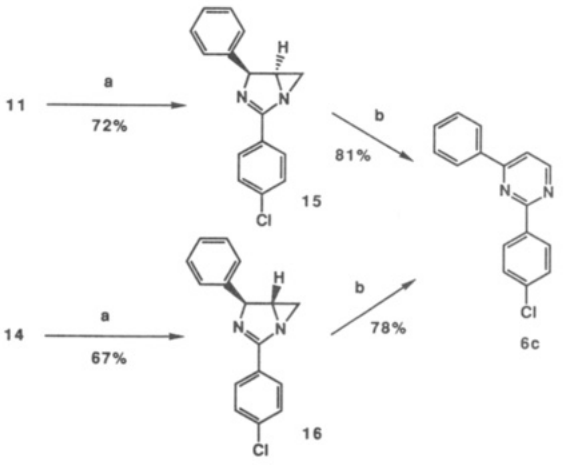
Scheme V[a]



[a] Key: (a) NaH (2 equiv), DMF, 20 °C, 17 h; (b) NaH (1 equiv), DMF, 20 °C, 4 h.

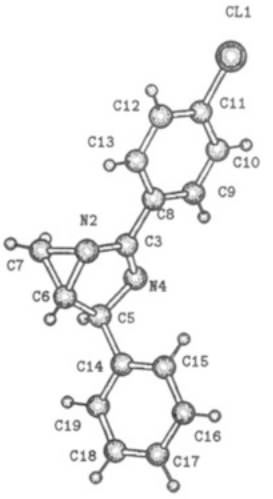


Figure 1. Perspective view of compound **16**.

isolation of a highly strained aziridino[1,2-*c*]-2-imidazoline intermediate.

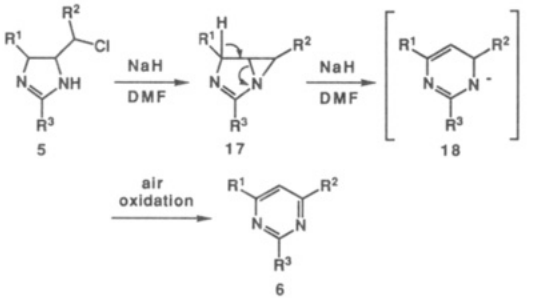
Aziridine derivatives **15** and **16** were subsequently treated with 1 equiv of sodium hydride in dimethylformamide and were readily converted to pyrimidine **6c** in good yield (Scheme V).

These results cofirm that the aziridino[1,2-*c*]-2-imidazolines **15** and **16** are the intermediates in this ring-expansion reaction. Furthermore, the ring expansion reaction could be conducted for *cis*- and *trans*-isomers of the imidazoline derivatives **11** and **14**.

This unique formation of pyrimidines **6** from 4-(chloromethyl)imidazoline derivatives **5** can be interpretated as following three steps (Scheme VI): (1) intramolecular alkylation of **5** to give aziridino[1,2-*c*]-2-imidazolines **17**, (2) base-induced β-eliminative ring expansion of **17** to 1,6-dihydropyrimidines **18**, and (3) air oxidation of **18** to give pyrimidines **6**.

Related methods to the present study were reported. The first method involves an insertion reaction of dichlorocarbene to imidazole derivatives at 550 °C.[11] It is of little preparative value because of a lack of regioselectivity and low yields of the pyrimidines. The second one is based

Scheme VI



on a base-induced rearrangement of 1,3-diazabicyclo[3.1.0]-hex-3-enes.[12] However, the synthesis of the starting materials requires tedious procedures.

It should be noted that the present reaction provides a novel and useful methodology to prepare a variety of 2,4,6-trisubstituted pyrimidine derivatives.

Experimental Section

Melting points were measured using a Yamato melting point apparatus and are uncorrected. The IR spectra were recorded on a Perkin-Elmer 1640 infrared spectrophotometer. The NMR spectra were obtained using a Bruker AC-200 NMR spectrometer with tetramethylsilane as an internal standard. The mass spectra were taken on a Hitachi M-2000A spectrometer at an ionizing potential of 70 eV. X-ray analysis was carried out using Rigaku AFC-5R diffractometer. Column chromatography was carried out on silica gel (Kieselgel 60, 230–400 mesh, E. Merck).

1-((Benzyloxycarbonyl)amino)-2-hydroxyethyl Phenyl Ketone (2a). To a solution of (*N*-(benzyloxycarbonyl)amino)-methyl phenyl ketone (**1a**) (31.86 g, 0.118 mol) in 2-propanol (640 mL) was added paraformaldehyde (9.2 g) and potassium carbonate (5.7 g, 0.041 mol). After the mixture was stirred at 25 °C for 30 min and at 60 °C for 2 h, insoluble materials were filtered off and the filtrate was evaporated *in vacuo*. The residue was partitioned between $CHCl_3$ and water, and the aqueous layer was extracted with $CHCl_3$. The combined extracts were washed with water, dried over $MgSO_4$, and evaporated. The residue was purified by silica gel chromatography (*n*-hexane:$CHCl_3$:AcOEt = 5:5:1) to afford **2a** as colorless crystals (26 g, 73.4%): mp 96–97 °C; IR (Nujol) ν 3380, 1680 cm^{-1}; ^1H-NMR ($CDCl_3$) δ 2.55–3.10 (brs, 1 H, O*H*), 3.70–4.20 (m, 2 H, methylene), 5.09 (s, 2 H, benzyl), 5.24–5.47 (m, 1H, methine), 6.15 (d, J = 7.5 Hz, 1 H, N*H*), 7.00–8.07 (m, 10 H, Ph); MS *m/z* 297 ($M^+ - 2$). Anal. Calcd for $C_{17}H_{17}NO_4$: C, 68.22; H, 5.73; N, 4.68. Found: C, 68.01; H, 5.62; N, 4.57.

1-((Benzyloxycarbonyl)amino)-2-hydroxy-2-phenylethyl Phenyl Ketone (2b). To a mixture of (*N*-(benzyloxycarbonyl)amino)methyl phenyl ketone (**1a**) (10 g, 0.0372 mol) in THF (100 mL) was added sodium bis(trimethylsilylamide) (1 M in THF) (74.3 mL) at −50 °C. After the mixture was stirred at −50 °C for 30 min, benzaldehyde (7.88 g, 0.0743 mol) was added, and the mixture was warmed to −40 °C for 1 h. The mixture was poured into 10% aqueous citric acid (200 mL) and twice extracted with AcOEt. The combined extracts were washed with water, dried over $MgSO_4$, and evaporated. The residue was purified by silica gel chromatography using a mixture of *n*-hexane and AcOEt (3:1) as the eluent to afford **2b** as a viscous oil (14 g, quantitative (quant)): IR (Nujol) ν 1684 cm^{-1}; ^1H-NMR ($CDCl_3$) δ 3.01 (s) and 4.25 (d, J = 6.6 Hz) (1 H, O*H*), 4.90–5.15 (m, 2 H, benzyl), 5.15–5.30 (m, 1 H, PhC*H*OH), 5.40–5.55 and 5.70–5.80 (m, 1H, COC*H*NH), 5.80–5.95 (m, 1 H, N*H*); MS *m/z* 376 ($M^+ + 1$). Anal. Calcd for $C_{23}H_{21}NO_4$: C, 73.58; H, 5.64; N, 3.73. Found: C, 73.87; H, 5.72; N, 3.78.

1-((Benzyloxycarbonyl)amino)-2-hydroxy-2-phenylethyl 4-Methylphenyl Ketone (2c). This compound was prepared according to the method for the synthesis of **2b** in 90.9% yield: mp 100–102 °C; IR (KBr) ν 1684 cm^{-1}; ^1H-NMR ($CDCl_3$)

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δ 2.41 and 2.42 (s, 3 H, Me), 3.07 (s) and 4.36 (d, J = 6.6 Hz) (1 H, O*H*), 4.88–5.13 (m, 2H, benzyl), 5.15–5.28 (m, 1H, PhC*H*OH), 5.40–5.52 and 5.65–5.75 (m, 1 H, COC*H*NH), 5.79–5.95 (m, 1H, N*H*), 7.00–7.60 and 7.82–8.10 (m, 14 H, Ph, 4-Me*Ph*); MS m/z 390 (M^+ + 1). Anal. Calcd for $C_{24}H_{23}NO_4$: C, 74.02; H, 5.95; N, 3.60. Found: C, 73.88; H, 5.99; N, 3.63.

General Procedure for the Synthesis of β-Hydroxyethylenediamines 3. 1-(Hydroxymethyl)-2-phenylethylenediamine Hydrochloride (3a). A mixture of **2a** (25 g, 0.084 mol), hydroxylamine hydrochloride (11.6 g, 0.17 mol), and pyridine (24 mL) in ethanol (250 mL) was refluxed for 7 h. The solvent was removed by evaporation, and the residue was dissolved in AcOEt, washed with water, dried over $MgSO_4$, and evaporated to afford crude oxime which was used without further purification. The oxime obtained was dissolved in ethanol (500 mL), and to the solution was added concd HCl (13.3 mL, 0.16 mol) and 10% palladium on carbon (12.5 g). The mixture was subjected to hydrogenation using a Parr apparatus (3.5 atm) at room temperature for 5 h. After removal of the catalyst by filtration, the filtrate was concentrated *in vacuo*. The solid was collected and washed with ether to afford colorless fine crystals of **3a** (19.2 g, 95.1%): mp 240–243 °C dec; IR (Nujol) ν 3380, 1595 cm^{-1}; ^{1}H-NMR (DMSO-d_6) δ 3.10–4.00 (m, 3H, methylene, methine), 4.60–4.80 (m, 1 H, benzyl), 7.20–7.85 (m, 5 H, phenyl), 8.20–9.60 (brs, 6 H, NH_3). Anal. Calcd for $C_9H_{16}N_2OCl_2$: C, 45.20; H, 6.74; N, 11.71; Cl, 29.65. Found: C, 45.42; H, 6.76; N, 11.67; Cl, 29.74. The compounds obtained by this method are listed below.

1-(1-Hydroxybenzyl)-2-phenylethylenediamine (3b): yield quant; viscous oil; IR (Nujol) ν 1602 cm^{-1}; ^{1}H-NMR ($CDCl_3$) δ 2.85–3.20 and 3.35–3.75 (m, 1 H, methine), 3.88–4.05 and 4.26–4.42 (m, 1 H, PhC*H*), 4.05–4.15 and 4.55–4.87 (m, 1 H, PhC*H*OH), 7.15–7.55 (m, 10 H, Ph). Anal. Calcd for $C_{15}H_{18}N_2O$: C, 74.35; H, 7.49; N, 11.56. Found: C, 74.85; H, 7.84; N, 11.96.

1-(1-Hydroxybenzyl)-2-(4-methylphenyl)ethylenediamine (3c): yield 96% viscous oil; IR (Nujol) ν 1585 cm^{-1}; ^{1}H-NMR ($CDCl_3$) δ 3.00–3.27 and 3.45–3.75 (m, 1 H, methine), 3.83–3.88, 4.22–4.25 and 4.77–4.80 (m, 1 H, PhC*H*), 4.07–4.13, 4.60–4.76, and 4.82–4.95 (m, 1 H, PhC*H*OH). Anal. Calcd for $C_{16}H_{20}N_2O$: C, 74.97; H, 7.86; N, 10.93. Found: C, 75.34; H, 7.98; N, 10.55.

General Procedure for the Synthesis of Imidazolines 4. 2,5-Diphenyl-4-(hydroxymethyl)imidazoline Hydrochloride (4a). A mixture of **3a** (300 mg, 1.25 mmol), ethyl benzimidate (243 mg, 1.31 mmol), and triethylamine (278 mg, 2.75 mmol) was refluxed for 3 h. After the solution was evaporated *in vacuo*, the residue was dissolved in $CHCl_3$ and 10% aqueous sodium hydroxide (10 ml). The phases were separated, and the aqueous layer was extracted with $CHCl_3$. The combined organic layer was washed with water, dried over $MgSO_4$, and evaporated. The free amine obtained was dissolved in ethanol and treated with 20% HCl in ethanol and then evaporated. Crystallization from acetone and ether afforded colorless crystals of **4a** (277 mg, 76.9%): mp 233–235 °C; IR (Nujol) ν 3280, 1620, 1600 cm^{-1}; ^{1}H-NMR (DMSO-d_6) δ 3.00–3.20 and 3.62–3.85 (m, 2 H, methylene), 3.20–3.55 and 5.00–5.32 (brs, 1 H, O*H*), 3.98–4.22 and 4.40–4.83 (m, 1 H, methine) 5.28 (d, J = 7.5 Hz) and 5.63 (d, J = 12 Hz) (1 H, benzyl), 7.15–7.40 (m, 5 H, Ph), 7.40–7.85 and 8.05–8.28 (m, 5 H, Ph), 11.0–11.5 (brs, N*H*); MS m/z 252 (M^+ – HCl). Anal. Calcd for $C_{16}H_{17}N_2OCl$: C, 66.55; H, 5.93; N, 9.70; Cl, 12.28. Found: C, 66.46; H, 5.85; N, 9.66; Cl, 12.46. The compounds obtained by this procedure are listed below.

2-(4-Fluorophenyl)-4-(hydroxymethyl)-5-phenylimidazoline hydrochloride (4b): yield 62.5%; mp 239.5–240 °C; IR (Nujol) ν 3310, 1625, 1610 cm^{-1}; ^{1}H-NMR (DMSO-d_6) δ 3.00–3.30 and 3.55–3.85 (m, 2 H, methylene), 4.50–4.85 and 3.97–4.20 (m, 1 H, methine), 4.90–5.70 (m, 1 H, O*H*), 5.27 (d, J = 7.5 Hz) and 5.82 (d, J = 12 Hz) (1 H, benzyl), 7.32 and 7.42 (s, 5 H, Ph), 7.35–7.80 and 8.10–8.60 (m, 4 H, 4-F-Ph), 11.0–11.7 (m, 2 H, N*H*); MS m/z 270 (M^+ – HCl). Anal. Calcd for $C_{16}H_{16}N_2OClF$: C, 62.65; H, 5.26; N, 9.13; Cl, 11.56; F, 6.19. Found: C, 62.55; H, 5.10; N, 9.09; Cl, 11.51; F, 6.38.

2-(4-Chlorophenyl)-4-(hydroxymethyl)-5-phenylimidazoline hydrochloride (4c): yield 74.6%; mp 205–210 °C; IR (Nujol) ν 3350, 3340, 1615, 1600 cm^{-1}; ^{1}H-NMR (DMSO-d_6) δ 3.05–3.27 and 3.70–3.90 (m, 2 H, methylene), 4.00–4.30 and 4.50–4.90 (m, 1 H, methine), 5.35 (d, J = 7.5 Hz) and 5.72 (d, J = 12 Hz) (1 H, benzyl), 7.43 and 7.47 (s, 5 H, Ph), 7.82 and 8.32 (A_2B_2q, J = 9 Hz, 4 H, 4-Cl-Ph), 11.25–11.60 (brs, 2 H, N*H*); MS m/z 287 (M^+ – HCl). Anal. Calcd for $C_{16}H_{16}N_2OCl_2$: C, 59.46; H, 4.99; N, 8.67; Cl, 21.94. Found: C, 59.34; H, 4.94; N, 8.58; Cl, 21.88.

2-(4-Bromophenyl)-4-(hydroxymethyl)-5-phenylimidazoline hydrochloride (4d): yield 76.9%; mp 223–226 °C; IR (Nujol) ν 3320, 1620, 1600 cm^{-1}; ^{1}H-NMR (DMSO-d_6) δ 3.02–3.30 and 3.62–3.90 (m, 2 H, methylene), 3.20–3.55 and 5.00–5.32 (brs, 1 H, O*H*), 4.45–4.90 and 4.00–4.30 (m, 1 H, methine), 5.36 (d, J = 7.5 Hz) and 5.81 (d, J = 12 Hz) (1 H, benzyl), 7.42 and 7.45 (s, 5 H, Ph), 7.93 and 8.25 (A_2B_2q, J = 9 Hz, 4 H, 4-Br-Ph), 11.2–11.9 (brs, 2 H, N*H*); MS m/z 331 (M^+ – HCl). Anal. Calcd for $C_{16}H_{16}N_2OBrCl$: C, 52.27; H, 4.39; N, 7.62; Br, 21.73; Cl, 9.64. Found: C, 51.99; H, 4.42; N, 7.46; Br, 21.45; Cl, 9.48.

4-(1-Hydroxybenzyl)-2,5-diphenylimidazoline hydrochloride (4e): yield 69.5%; mp 255–258 °C; IR (KBr) ν 1621 cm^{-1}; ^{1}H-NMR (DMSO-d_6) δ 4.25–4.40 and 4.45–4.55 (m, 1 H, PhC*H*OH), 4.90–5.25 (m, 1 H, methine), 5.48 (d, J = 11 Hz) and 5.75 (d, J = 12 Hz) (1 H, PhC*H*N), 5.63 and 5.90 (brs, 1 H, O*H*), 6.80–7.90 and 8.02–8.30 (m, 15 H, Ph), 10.56, 10.95, and 11.30 (s, 2 H, N*H*); MS m/z 328 (M^+ – HCl). Anal. Calcd for $C_{22}H_{21}N_2OCl$: C, 72.42; H, 5.80; N, 7.68; Cl, 9.72. Found: C, 72.32; H, 5.81; N, 7.72; Cl, 9.77.

2-(4-Chlorophenyl)-4-(1-hydroxybenzyl)-5-phenylimidazoline hydrochloride (4f): yield 70.5%; mp 195–198 °C; IR (KBr) ν 1622 cm^{-1}; ^{1}H-NMR (DMSO-d_6) δ 4.25–4.38 and 4.42–4.55 (m, 1 H, PhC*H*OH), 4.92–5.23 (m, 1 H, methine), 5.48 (d, J = 11 Hz) and 5.75 (d, J = 12 Hz) (1 H, PhC*H*N), 5.66 and 5.90 (brs, 1 H, O*H*), 6.80–7.98 and 8.05–8.35 (m, 14 H, Ph, 4-ClPh), 10.69, 11.02 and 11.17 (brs, 2 H, N*H*); MS m/z 363 (M^+ – HCl). Anal. Calcd for $C_{22}H_{20}N_2OCl_2$: C, 66.17; H, 5.05; N, 7.02; Cl, 17.76. Found: C, 66.28; H, 5.15; N, 7.06; Cl, 17.92.

2-(4-Chlorophenyl)-4-(1-hydroxybenzyl)-5-(4-methylphenyl)imidazoline (4g): yield 69.9%; mp 195–198 °C; IR (KBr) ν 1608 cm^{-1}; ^{1}H-NMR ($CDCl_3$) δ 2.25–2.40 (m, 3 H, Me), 4.30–4.42 (m, 1 H, PhC*H*OH), 4.64–4.82 (m, 1 H, methine), 5.10–5.28 and 5.53–5.57 (m, 1 H, PhC*H*N), 5.20–5.45 (brs, 1 H, O*H*), 6.65–7.55 and 7.70–8.00 (m, 13 H, Ph, 4-MePh, 4-ClPh); MS m/z 377 (M^+). Anal. Calcd for $C_{23}H_{22}N_2OCl_2$: C, 66.83; H, 5.37; N, 6.78; Cl 17.15. Found: C, 66.54; H, 5.38; N, 6.79; Cl, 17.19.

General Procedure for the Chlorination of Imidazolines 4. 2,5-Diphenyl-4-(chlorophenyl)imidazoline Hydrochloride (5a). A mixture of imidazoline hydrochloride **4a** (200 mg, 0.69 mmol) and thionyl chloride (3 mL) was refluxed for 4 h and evaporated *in vacuo*. The residue was crystallized from ethanol and ether to afford **5a** as colorless crystals (210 mg, quant): mp 210–215 °C; IR (KBr) ν 3420, 1615 cm^{-1}; ^{1}H-NMR (DMSO-d_6) δ 3.35–3.65 and 4.05–4.25 (m, 2 H, methylene), 4.40–4.75 and 4.85–5.20 (m, 1H, methine), 5.32 (d, J = 7 Hz) and 5.85 (d, J = 12 Hz) (1H, benzyl), 7.15–7.50 (m, 5H, Ph), 7.60–8.00 and 8.20–8.40 (m, 5 H, Ph), 11.50–12.00 (brs, 2 H, N*H*); MS m/z 271 (M^+ – HCl). Anal. Calcd for $C_{16}H_{16}N_2Cl_2$: C, 62.55; H, 5.25; N, 9.12.; Cl, 23.08. Found: C, 62.27; H, 5.10, N, 8.94; Cl, 22.80. The compounds obtained by this method are listed below.

4-(Chloromethyl)-2-(4-fluorophenyl)-5-phenylimidazoline hydrochloride (5b): yield quant; mp 220–225 °C; IR (Nujol) ν 3400, 1610 cm^{-1}; ^{1}H-NMR (DMSO-d_6) δ 3.37–3.70 and 4.05–4.25 (m, 2 H, methylene), 4.40–4.70 and 4.85–5.25 (m, 1H, methine), 5.32 (d, J = 7 Hz) and 5.85 (d, J = 12 Hz) (1H, benzyl) 7.47 (s, 5H, Ph), 7.45–7.80 and 8.30–8.60 (m, 4 H, 4-F-Ph), 11.6–12.0 (brs, 2 H, N*H*); MS m/z 289 (M^+ – HCl). Anal. Calcd for $C_{16}H_{15}N_2Cl_2F$: C, 59.09; H, 4.65; N, 8.61; Cl, 21.80; F, 5.84. Found: C, 59.04; H, 4.60; N, 8.55; Cl, 21.71; F, 5.85.

4-(Chloromethyl)-2-(4-chlorophenyl)-5-phenylimidazoline hydrochloride (5c): yield quant; mp 228–232 °C, IR (Nujol) ν 3350, 1615, 1598 cm^{-1}; ^{1}H-NMR (DMSO-d_6) δ 3.35–3.60 and 4.05–4.30 (m, 2 H, methylene), 3.55–4.00 and 4.40–4.70 (m, 1H, methine), 5.34 (d, J = 7.5 Hz) and 5.85 (d, J = 12 Hz) (1H, benzyl), 7.48 (s, 5H, Ph), 7.80 and 8.40 (A_2B_2q, J = 9 Hz, 4 H, 4-ClPh), 11.7–12.3 (brs, N*H*); MS m/z 305 (M^+ – HCl). Anal. Calcd for $C_{16}H_{15}N_2Cl_3$: C, 56.25; H, 4.43; N, 8.20; Cl, 31.13. Found: C, 56.42; H, 4.44; N, 8.11; Cl, 30.66.

2-(4-Bromophenyl)-4-(chloromethyl)-5-phenylimidazoline hydrochloride (5d): yield quant; mp 223–227 °C; IR (KBr) ν 3400, 1615 cm^{-1}; ^{1}H-NMR (DMSO-d_6) δ 3.25–3.50 and 4.05–4.20 (m, 2 H, methylene), 4.45–4.70 and 4.85–5.20 (m, 1H, methine),

5.32 (d, J = 7 Hz) and 5.85 (d, J = 12 Hz) (1H, benzyl), 7.48 (s, 5H, Ph), 7.97 and 8.30 (A_2B_2q, J = 9 Hz, 4 H, 4-BrPh), 11.6–12.0 (brs, 2 H, N*H*); MS m/z 350 (M^+ – HCl). Anal. Calcd for $C_{16}H_{15}N_2BrCl_2$: C, 49.77; H, 3.92; N, 7.26; Br, 20.69; Cl, 18.36. Found: C, 49.54; H, 3.82; N, 7.17; Br, 20.74; Cl, 18.31.

General Procedure for the Chlorination of 4-(1-Hydroxybenzyl)imidazolines 5e–g. 4-(1-Chlorobenzyl)-2,5-diphenylimidazoline (5e). A mixture of imidazoline hydrochloride **4e** (500 mg, 1.37 mmol) and thionyl chloride (1 mL) in CH_2Cl_2 (10 mL) was stirred at room temperature for 17 h and evaporated. The residue was treated with saturated aqueous sodium bicarbonate and $CHCl_3$. The $CHCl_3$ layer was washed with water, dried over $MgSO_4$, and evaporated. The residue was purified by silica gel chromatography using a mixed solvent system of $CHCl_3$ and methanol (10:1) as an eluent to afford **5e** as a viscous oil (455 mg, quant): IR (Nujol) ν 1616 cm^{-1}; ^{1}H-NMR ($CDCl_3$) δ 4.30–4.45 (m, 1 H, methine), 4.65–4.85 (m, 1 H, benzyl), 4.90–5.05 (m, 1 H, PhC*H*Cl), 5.30–5.55 (brs, 1 H, N*H*), 7.00–7.97 (m, 15 H, Ph); MS m/z 347 (M^+). Anal. Calcd for $C_{22}H_{19}N_2Cl$: C, 76.18; H, 5.52; N, 8.08; Cl, 10.22. Found: C, 76.22; H, 5.80; N, 8.24; Cl, 10.44. The compounds obtained by this procedure are listed below.

4-(1-Chlorobenzyl)-2-(4-chlorophenyl)-5-phenylimidazoline (5f): yield quant; viscous oil; IR (Nujol) ν 1615 cm^{-1}; ^{1}H-NMR ($CDCl_3$) δ 4.35–4.45 (m, 1 H, methine), 4.65–4.75 (m, 1 H, benzyl), 4.90–5.05 (m, 1 H, PhC*H*Cl), 5.25–5.55 (brs, 1 H, N*H*), 6.75–6.90 and 7.00–7.90 (m, 14 H, Ph, 4-Cl-Ph); MS m/z 380 (M^+ – 1). Anal. Calcd for $C_{22}H_{18}N_2Cl_2$: C, 69.30; H, 4.76; N, 7.35; Cl, 18.60. Found: C, 69.52; H, 4.78; N, 7.36; Cl, 18.57.

4-(1-Chlorobenzyl)-2-(4-chlorophenyl)-5-(4-methylphenyl)-imidazoline (5g): yield quant; viscous oil; IR (Nujol) ν 1611 cm^{-1}; ^{1}H-NMR ($CDCl_3$) δ 2.20–2.40 (m, 3 H, Me), 4.00–4.17 (m, 1 H, methine), 4.62–4.80 (m, 1 H, benzyl), 4.87 (s, 1 H, N*H*), 4.85–5.02 (m, 1 H, PhC*H*Cl), 6.65–8.00 (m, 13 H, Ph, 4-ClPh, 4-MePh); MS m/z 394 (M^+ – 1). Anal. Calcd for $C_{23}H_{20}N_2Cl_2$: C, 69.88; H, 5.10; N, 7.09; Cl, 17.94. Found: C, 70.02; H, 5.08; N, 7.13; Cl, 18.20.

General Procedure for the Synthesis of Pyrimidine 6. 2,4-Diphenylpyrimidine (6a). To a solution of **5a** (306 mg, 1.0 mmol) in DMF (3 mL) was added sodium hydride (63.6% on paraffin, 75 mg, 2.0 mmol) at –20 °C. The mixture was gradually warmed to 20 °C, stirred for 17 h, and poured into ice–water. The product was twice extracted with ether. The combined extracts were washed with water, dried over $MgSO_4$, and evaporated. The residue was purified by silica gel chromatography using a solvent system of *n*-hexane:AcOEt = 100:1 as the eluent to afford **6a** as colorless crystals (186 mg, 80%): mp 74–75 °C (lit.[2b] mp 71 °C); IR (Nujol) ν 1560 cm^{-1}; ^{1}H-NMR ($CDCl_3$) δ 7.20–7.45, 7.95–8.20 and 8.25–8.55 (m, 10 H, Ph), 7.45 (d, J = 6 Hz, 1 H, PhC=C*H*–), 8.66 (d, J = 6 Hz, 1 H, –C*H*=N–); MS m/z 232 (M^+). Anal. Cacld for $C_{16}H_{12}N_2$: C, 83.73; H, 5.21; N, 12.06. Found: C, 82.71; H, 5.07; N, 12.12. The compounds obtained by this method are listed below.

2-(4-Fluorophenyl)-4-phenylpyrimidine (6b): yield 71%; mp 75–76 °C; IR (Nujol) ν 1570 cm^{-1}; ^{1}H-NMR ($CDCl_3$) δ 6.90–7.18 and 8.30–8.55 (m, 4 H, 4-FPh), 7.25–7.50 and 7.90–8.20 (m, 5 H, Ph), 7.34 (d, J = 5 Hz, 1 H, PhC=C*H*–), 8.61 (d, J = 5 Hz, 1 H, –C*H*=N–); MS m/z 250 (M^+). Anal. Calcd for $C_{16}H_{11}N_2F$: C, 76.79; H, 4.43; N, 11.19; F, 7.59. Found: C, 76.82; H, 4.36; N, 11.39; F, 7.37.

2-(4-Chlorophenyl)-4-phenylpyrimidine (6c): yield 85%; mp 115–117 °C; IR (Nujol) ν 1580 cm^{-1}; ^{1}H-NMR ($CDCl_3$) δ 7.10–7.70 and 7.90–8.15 (m, 5 H, Ph), 7.35 and 8.42 (A_2B_2q, J = 9 Hz, 4 H, 4-ClPh), 7.37 (d, J = 5 Hz, 1 H, PhC=C*H*–), 8.61 (d, J = 5 Hz, 1 H, –C*H*=N–); MS m/z 266 (M^+). Anal. Calcd for $C_{16}H_{11}N_2Cl$: C, 72.05; H, 4.16; N, 10.50; Cl, 13.29. Found: C, 71.70; H, 4.05; N, 10.46; Cl, 13.50.

2-(4-Bromophenyl)-4-phenylpyrimidine (6d): yield 81%; mp 101–103 °C; IR (Nujol) ν 1580 cm^{-1}; ^{1}H-NMR ($CDCl_3$) δ 7.27–7.60 and 7.90–8.20 (m, 5 H, Ph), 7.48 and 8.28 (A_2B_2q, J = 9 Hz, 4 H, 4-BrPh), 7.37 (d, J = 6 Hz, 1 H, PhC=C*H*–), 8.62 (d, J = 6 Hz, 1 H, –C*H*=N–); MS m/z 310 (M^+). Anal. Calcd for $C_{16}H_{11}N_2Br$: C, 61.76; H, 3.56; N, 9.00; Br, 25.68. Found: C, 61.96; H, 3.48; N, 9.22; Br, 25.37.

2,4,6-Triphenylpyrimidine (6e): yield 73%; mp 184–185 °C (Lit.[2c] mp 185–187 °C); IR (KBr) ν 1571 cm^{-1}; ^{1}H-NMR ($CDCl_3$) δ 7.45–7.65 (m, 10 H, Ph), 8.00 (s, 1 H, –C*H*=), 8.20–8.35 and 8.65–8.80 (m, 5 H, Ph); MS m/z 308 (M^+). Anal. Calcd for $C_{22}H_{16}N_2$: C, 85.69; H, 5.23; N, 9.08. Found: C, 85.78; H, 5.31; N, 9.05.

2-(4-Chlorophenyl)-4,5-diphenylpyrimidine (6f): yield 81%; mp 219–220 °C; IR (KBr) ν 1566 cm^{-1}; ^{1}H-NMR ($CDCl_3$) δ 7.55–7.80 and 8.45–8.62 (m, 10 H, Ph), 7.68 and 8.68 (A_2B_2q, J = 9 Hz, 4 H, 4-ClPh), 8.57 (s, 1 H, –C*H*=); MS m/z 342 (M^+). Anal. Calcd for $C_{22}H_{15}N_2Cl$: C, 77.08; H, 4.41; N, 8.17; Cl, 10.34. Found: C, 77.22; H, 4.48; N, 8.07; Cl, 10.31.

2-(4-Chlorophenyl)-4-(4-methylphenyl)-5-phenylpyrimidine (6g): yield 85%; mp 174–175 °C; IR (KBr) ν 1567 cm^{-1}; ^{1}H-NMR ($CDCl_3$) δ 2.47 (s, 3 H, Me), 7.37 and 8.18 (A_2B_2q, J = 8 Hz, 4 H, 4-MePh), 7.50 and 8.67 (A_2B_2q, J = 8 Hz, 4 H, 4-ClPh), 7.50–7.60 and 8.25–8.30 (m, 5 H, Ph), 8.00 (s, 1 H, –C*H*=); MS m/z 356 (M^+). Anal. Calcd for $C_{23}H_{17}N_2Cl$: C, 77.41; H, 4.80; N, 7.85; Cl, 9.94. Found: C, 77.68; H, 4.86; N, 7.91; Cl, 10.01.

***trans*-2-(4-Chlorophenyl)-4-(methoxymethyl)-5-phenylimidazoline (7).** To a solution of **5c** (340 mg, 1 mmol) in methanol (3 mL) was added sodium methoxide in methanol (4.8 *N*) (1.25 mL, 6 mmol). The reaction mixture was stirred at room temperature for 24 h. After evaporation of the solvent, the residue was dissolved in $CHCl_3$ and water. The $CHCl_3$ layer was separated and washed with water, dried over $MgSO_4$, and evaporated *in vacuo*. The residue was purified by silica gel chromatography using a mixed solvent of $CHCl_3$ and methanol (10:1) as the eluent to afford **7** as colorless crystals (219 mg, 73%): mp 135–136 °C; IR (Nujol) ν 1610 cm^{-1}; ^{1}H-NMR ($CDCl_3$) δ 3.38 (s, 3 H, MeO), 3.55 (d, J = 6 Hz, 2 H), 3.85–4.20 (m, 1 H, methine), 4.75 (d, J = 7.5 Hz, 1 H, benzyl), 7.25 (s, 5 H, Ph), 7.30 and 7.72 (A_2B_2q, J = 9 Hz, 4 H); MS m/z 300 (M^+). Anal. Calcd for $C_{17}H_{13}N_2Cl$: C, 67.88; H, 5.70; N, 9.31; Cl, 11.79. Found: C, 67.92; H, 5.44; N, 9.33; Cl, 11.52.

2-Acetoxy-1-((benzyloxycarbonyl)amino)ethyl Phenyl Ketone (8). To a mixture of **2a** (2.99 g, 0.01 mol), acetic anhydride (1.53 g, 0.015 mol), and triethylamine (3.03 g, 0.03 mol) in THF (15 mL) was added (dimethylamino)pyridine (10 mg). The reaction mixture was stirred at room temperature for 1 h. After the addition of methanol (10 mL), the mixture was stirred at 20 °C for 1 h and concentrated *in vacuo*. The product was extracted with $CHCl_3$, and the organic layer was washed with water, dried over $MgSO_4$, and concentrated *in vacuo*. The residue was purified by silica gel chromatography using $CHCl_3$ as the eluent to afford **8** as colorless crystals (3.14 g, 92%): mp 69–69.5 °C; IR (Nujol) ν 3380, 1740, 1680 cm^{-1}; ^{1}H-NMR ($CDCl_3$) δ 1.93 (s, 3 H, methyl), 4.20 (q, J = 13.5 Hz, 6 Hz) and 4.55 (q, J = 13.5 Hz, 4.5 Hz) (2 H, methylene), 5.13 (s, 2 H, benzyl), 5.45–5.76 (m, 1 H, methine), 5.90–6.20 (brd, J = 7.5 Hz, 1 H, N*H*), 7.20–8.25 (m, 10 H, Ph); MS m/z 341 (M^+). Anal. Calcd for $C_{19}H_{19}NO_5$: C, 66.85; H, 5.61; N, 4.10. Found: C, 66.72; H, 5.68; N, 4.12.

***erythro*-1-(Hydroxymethyl)-2-phenylethylenediamine Dihydrochloride (9).** A mixture of **8** (1.16 g, 3.4 mmol), hydroxylamine hydrochloride (473 mg, 6.8 mmol), and pyridine (970 mg, 13.6 mmol) in ethanol (20 mL) was refluxed for 5 h and evaporated *in vacuo*. The product was extracted with AcOEt, and the extract was washed with water, dried over $MgSO_4$, and evaporated. The residue was dissolved in ethanol (40 mL), and concd HCl (0.78 mL) and 10% palladium on carbon (820 mg) were added. The mixture was hydrogenated with a Parr apparatus (3.5 atm) at room temperature for 5 h. After removal of the catalyst by filtration, the filtrate was concentrated *in vacuo*. The residue was dissolved in concd HCl (1 mL) and water (6 mL) and refluxed for 5 h, and then the mixture was concentrated *in vacuo*. Crystallization was carried out in ether to afford colorless crystals of **9** (726 mg, 89%): mp 275 °C dec; IR (Nujol) ν 1595 cm^{-1}; ^{1}H-NMR (DMSO-d_6) δ 3.10–4.00 (m, 3 H, methylene, methine), 4.60–4.80 (m, 1 H, benzyl), 7.30–7.80 (m, 5 H, Ph), 8.40–9.50 (br, 6 H, NH_3). Anal. Calcd for $C_9H_{16}N_2OCl_2$: C, 45.20; H, 6.74; N, 11.71; Cl, 29.65. Found: C, 45.36; H, 6.69; N, 11.85; Cl, 29.46.

***cis*-2-(4-Chorophenyl)-4-(hydroxymethyl)-5-phenylimidazoline Hydrochloride (10).** This compound was prepared from **9** according to the method used for the synthesis of **4a** in 85% yield: mp 228–230 °C; IR (Nujol) ν 1615, 1600 cm^{-1}; ^{1}H-NMR (TFA-d_1) δ 3.72 (d, J = 6 Hz, 2 H, methylene), 4.85–5.20 (m, 1 H, methine), 5.83 (d, J = 12 Hz, 1 H, benzyl), 7.20–7.62 (m, 5 H, Ph), 7.68 and 8.02 (A_2B_2q, J = 9 Hz, 4 H); MS m/z 287 (M^+ – HCl).

Anal. Calcd for $C_{16}H_{16}N_2OCl_2$: C, 59.46; H, 4.99; N, 8.67; Cl, 21.94. Found: C, 59.48; H, 5.02; N, 8.73; Cl, 22.02.

***cis*-4-(Chloromethyl)-2-(4-chlorophenyl)-5-phenylimidazoline Hydrochloride (11).** This compound was prepared from **10** according to the method used for the synthesis of **5a** in quantitative yield: mp 248.5–249.5 °C; IR (Nujol) ν 1620 cm^{-1}; ^{1}H-NMR (DMSO-d_6) δ 3.35–3.60 (m, 2 H, methylene), 3.55–4.00 (m, 1 H, methine), 5.85 (d, J = 12 Hz, 1 H, benzyl), 7.48 (s, 5 H, Ph), 7.80 and 8.40 (A_2B_2q, J = 9 Hz, 4 H, 4-ClPh), 11.65–12.30 (brs, 2 H, N*H*); MS m/z 305 (M$^+$ – HCl). Anal. Calcd for $C_{16}H_{15}N_2Cl_3$: C, 56.25; H, 4.42; N, 8.20; Cl, 31.13. Found: C, 56.42; H, 4.47; N, 8.23; Cl, 31.22.

***trans*-2-(4-Chlorophenyl)-4-(hydroxymethyl)-5-phenylimidazoline Hydrochloride (13).** To a solution of calcium chloride (54 mg, 0.483 mmol) in ethanol (1.2 mL) was added a solution of sodium borohydride (48 mg, 1.27 mmol) in ethanol (1.84 mL) at –20 °C, and the mixture was stirred at –20 °C for 30 min. Then a solution of **12** (170 mg, 0.483 mmol) was added dropwise at –20 °C, and the mixture was warmed to 15 °C with stirring over 4 h. After acetic acid (1 mL) was added, the mixture was concentrated *in vacuo*. Into the residue were added chloroform and 2 *N* NaOH (5 mL). The chloroform layer was washed with water, dried over $MgSO_4$, and evaporated *in vacuo*. The residue was treated with 10% HCl–MeOH and crystallized by adding acetone and ether to afford colorless crystals of **13** (112 mg, 71.6%): mp 198–202 °C; IR (Nujol) ν 1620 cm^{-1}; ^{1}H-NMR (DMSO-d_6) δ 3.70–3.90 (m, 2 H, methylene), 4.00–4.30 (m, 1 H, methine), 5.35 (d, J = 7.5 Hz, 1 H, benzyl), 7.47 (s, 5 H, Ph), 7.82 and 8.32 (A_2B_2q, J = 9 Hz, 4 H), 11.25–11.60 (brs, 2 H, N*H*); MS m/z 287. Anal. Calcd for $C_{16}H_{16}N_2OCl_2$: C, 59.46; H, 4.99; N, 8.67; Cl, 21.94. Found: C, 59.10; H, 4.88; N, 8.50; Cl, 22.21.

***trans*-4-(Chloromethyl)-2-(4-chlorophenyl)-5-phenylimidazoline Hydrochloride (14).** This compound was prepared according to the method used for the synthesis of **5a** in quantitative yield: mp 213–215 °C; IR (Nujol) ν 1610 cm^{-1}; ^{1}H-NMR (DMSO-d_6) δ 4.05–4.30 (m, 2 H, methylene), 4.40–4.70 (m, 1 H, methine), 5.34 (d, J = 7.5 Hz, 1 H, benzyl), 7.48 (s, 5 H, Ph), 7.80 and 8.40 (A_2B_2q, J = 9 Hz, 4 H, 4-ClPh), 11.65–12.30 (brs, 2 H, N*H*); MS m/z 305 (M$^+$ – HCl). Anal. Calcd for $C_{16}H_{15}N_2Cl_3$: C, 56.25; H, 4.42; N, 8.20; Cl, 31.13. Found: C, 56.11; H, 4.31; N, 8.11; Cl, 31.02.

***cis*-2-(4-Chlorophenyl)-5-phenylaziridino[1,2-*c*]-2-imidazoline (15).** To a solution of **11** (342 mg, 1 mmol) in DMF (6 mL) was added sodium hydride (63.2% on paraffin, 76 mg, 2 mmol) at –20 °C. The mixture was stirred at 20 °C for 17 h and poured into ice–water. The product was extracted with ether, washed with water, dried over $MgSO_4$, and evaporated *in vacuo*. The residue was purified by silica gel chromatography using a mixed solvent system of *n*-hexane and AcOEt (4:1) as the eluent to afford colorless crystals (193 mg, 72%): mp 96–98 °C; IR (KBr) ν 1611 cm^{-1}; ^{1}H-NMR ($CDCl_3$) δ 1.54 (d, J = 9 Hz) and 2.17 (d, J = 5 Hz) (1H each, methylene), 3.32–3.41 (m, 1 H, methine), 5.78 (d, J = 7 Hz, 1 H, benzyl), 7.26–7.45 (m, 5 H, Ph), 7.43 and 8.12 (A_2B_2q, J = 12 Hz, 4 H, 4-Cl-Ph); ^{13}C-NMR ($CDCl_3$) δ 34.02, 43.53, 72.95, 75.76, 77.02, 78.31, 126.75, 127.19, 128.47, 128.65, 130.05, 137.63, 140.41, 173.58; MS m/z 269 (M$^+$). Anal. Calcd for $C_{16}H_{13}N_2Cl$: C, 71.51; H, 4.88; N, 10.42; Cl, 13.19. Found: C, 71.53; H, 4.99; N, 10.38; Cl, 13.16.

***trans*-2-(4-Chlorophenyl)-5-phenylaziridino[1,2-*c*]imidazoline (16).** This compound was prepared according to the method for the synthesis of **15** in 67% yield: mp 90–93 °C; IR (KBr) ν 1613 cm^{-1}; ^{1}H-NMR ($CDCl_3$) δ 1.68–1.71 (m) and 2.45 (d, J = 5 Hz), (1H each, methylene), 3.10–3.15 (m, 1 H, methine), 5.43 (d, J = 2 Hz, 1 H, benzyl), 7.26–7.45 (m, 5 H, Ph), 7.43 and 8.13 (A_2B_2q, J = 12 Hz, 4 H, 4-Cl-Ph); ^{13}C-NMR ($CDCl_3$) δ 37.82, 46.74, 74.62, 75.80, 77.08, 78.36, 127.07, 127.83, 128.62, 128.79, 130.23, 137.63, 141.66, 173.55; MS m/z 269 (M$^+$). Anal. Calcd for $C_{16}H_{13}N_2Cl$: C, 71.51; H, 4.88; N, 10.42; Cl, 13.19. Found: C, 70.49; H, 4.90; N, 10.43; Cl, 13.30.

Conversion of Aziridine Derivative 15 to the Pyrimidine (6c). To a solution of **15** (269 mg, 1 mmol) in DMF (3 mL) was added sodium hydride (62.5% on paraffin, 38.4 mg, 1 mmol) at –20 °C, and the mixture was stirred at 20 °C for 4 h and the poured into ice–water. The product was twice extracted with ether. The combined extracts were washed with water three times, dried over $MgSO_4$, and evaporated *in vacuo*. The residue was purified by silica gel chromatography using a mixed solvent system of *n*-hexane:AcOEt = 100:1 to afford **6c** as colorless crystals (217 mg, 81.4%). The physicochemical data of the product were identical with **6c** obtained from **5c**.

The *trans*-derivative **16** afforded **6c** in 78% yield by the same procedure for the synthesis of **6c** from *cis*-derivative **15**.

X-ray Analysis of Compound 16. Plate colorless transparent crystal, a = 9.463(1) Å, b = 10.532(1) Å, c = 8.316(1)Å, α = 94.15(1)°, β = 113.78(1)°, γ = 63.69(1)°, U = 674.2(2) Å^3, space group P-1, Z = 2, D = 1.324 g/cm^3, F(100) = 280, μ(Cu Kα) = 23.931 cm^{-1}, monochrometer graphite, no. of ref data = 1768 (without F_o = 0.1651), final R value = 0.0580 (R_w = 0.0640).

The structure was solved by the direct method using MULTAN80[13], the refinement was carried out with full-matrix least-squares method, and scattering factors were taken from *International Tables for X-ray Crystallography*.[14,15]

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(13) Main, P.; German, G.; Woolfson, M. M. *MULTAN80, A Computer Program* for *Automatic Analysis of Phase Problem*; University of York, England.

(14) *International Tables for X-ray Crystallography*; Kynoch Press: Birmingham (England), 1984; Vol. VI.

(15) The author has deposited atomic coordinates for **16** with the Cambridge Crystallographic Data Centre. The coordinates can be obtained, upon request, from the Director, Cambridge Crystallographic Data Centre, 12 Union Road, Cambridge, CB2 1EZ, UK.