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Preparation of diamines by lithiation–substitution of imidazolidines and pyrimidines

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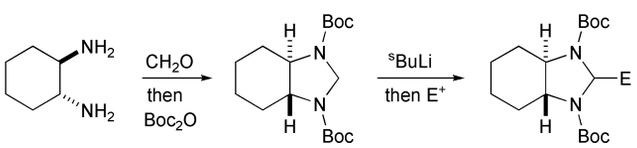
The synthesis of chiral 1,2-diamines and 1,3-diamines was achieved from the unsubstituted diamines by way of *N*-*tert*-butoxycarbonyl (Boc) substituted imidazolidines (tetrahydroimidazoles) and pyrimidines (hexahydro-1,3-diazines), which were treated with *sec*-butyllithium to effect deprotonation α- to the *N*-Boc group, followed by addition of an electrophile to give substituted products that could be hydrolysed under acidic conditions to give the substituted 1,2- or 1,3-diamines. Use of the chiral ligand (−)-sparteine promoted asymmetric deprotonation of the imidazolidine substrates to give, after hydrolysis, enantiomerically enriched 1,2-diamines.

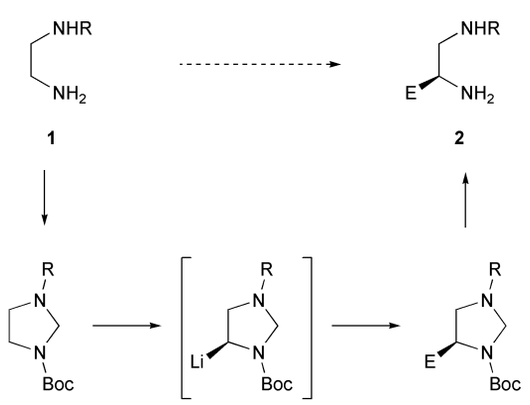
Introduction

Diamines, especially 1,2-diamines are an important class of compounds in organic chemistry.[1] They are present in many natural products and medicinal compounds (for example in biotin or as *kappa* receptor agonists). In addition, they are valuable for the synthesis of heterocyclic compounds, as part of chiral auxiliaries and for use as catalysts, especially for catalytic asymmetric synthesis.[2] A variety of methods are known for their formation, such as the reductive coupling of imines, reduction or organometallic additions to imines, amination of alkenes, ring-opening of aziridines, electrophilic amination or functional group interconversion of diols or β-amino-alcohols.[1]

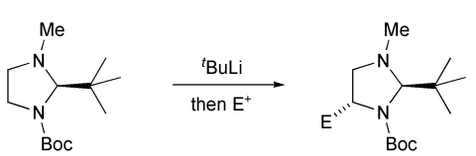
We were attracted to the possibility of developing a new asymmetric synthesis of chiral diamines from α-amino-organolithium compounds.[3] Ideally, any simple 1,2-diamine **1** would be converted to the desired substituted chiral 1,2-diamine **2** by a short and operationally simple set of steps (Scheme 1). We reasoned that this should be possible by way of the lithiated imidazolidines **3**, based on previous work in our group.[4,5] In particular, we have developed a method to prepare imidazolidines in one step[4] and discovered that deprotonation at C-2, between the two nitrogen atoms was possible, as outlined in Scheme 2.[5] This chemistry provided a new acyl anion equivalent, although the stabilization of the intermediate organolithium species afforded by the second *N*-Boc group was not thought to be significant.[6] Therefore, we were interested in studying unsymmetrical imidazolidines in which a Boc group is attached to only one of the two nitrogen atoms. Seebach and co-workers have reported one such approach (Scheme 3), in which deprotonation of the imidazolidine **4** occurs on treatment with *tert*-BuLi to give, after electrophilic quench, the diastereomerically pure derivatives **5**.[7] Based on this work, and that by Beak and co-workers with *N*-Boc-pyrrolidine,[8] an asymmetric deprotonation of the unsubstituted imidazolidine **3** (R = alkyl) should be feasible using a chiral base. Imidazolidine **3** has similarity to *N*-Boc-pyrrolidine, a substrate that is well-known to undergo asymmetric deprotonation with *sec*-BuLi and (−)-sparteine **6**.[8] This methodology allows a direct and convenient route to enantioenriched 2-lithio- and hence 2-substituted pyrrolidines. The chiral ligand (−)-sparteine **6** promotes asymmetric deprotonation of the *pro-S* hydrogen atom of *N*-Boc-pyrrolidine with very high selectivity, although the corresponding asymmetric transformation of *N*-Boc-piperidine is very low-yielding.[9] Proton abstraction of the imidazolidine **3** (R = alkyl) would be expected to occur adjacent to the *N*-Boc group at C-5 rather than at C-2 (between the two nitrogen atoms), due to the reduced acidity of the protons α- to the tertiary amine group.[10] In this paper, we report successful asymmetric lithiation–substitution reactions of imidazolidines **3**, with a selection of R groups (including that reported in a preliminary communication with R = ^{i}Pr),[11] together with results using a pyrimidine substrate.



Scheme 2



Scheme 1



Scheme 3

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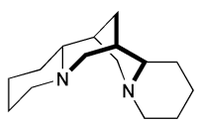
Table 1 Formation of racemic imidazolidines **7**

Entry	E^+	E	**7**, Yield (%)[a]
1	Me_3SiCl	Me_3Si	49 (79)
2	Bu_3SnCl	Bu_3Sn	49 (70)
3	$Ph_2MeSiCl$	Ph_2MeSi	44 (81)
4	MeI	Me	42 (69)
5	PhNCO	CONHPh	32 (55)
6	Ph_2CO	$C(OH)Ph_2$	35[b] (64)
7	CH_2=$CHCH_2Br$	CH_2=$CHCH_2$	42 (68)
8	$PhCH_2Br$	$PhCH_2$	41 (82)

[a] Yield in brackets refers to yield based on recovered **3**. [b] Using Et_2O as solvent.



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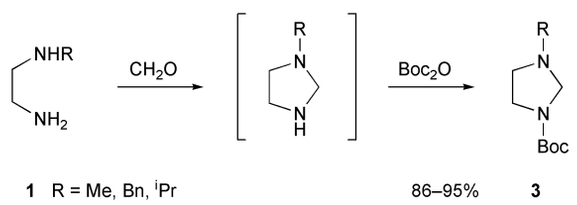
Results and discussion

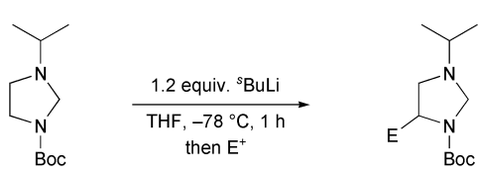
The imidazolidines **3**, R = Me, CH_2Ph and ^{i}Pr were prepared in one-pot from the corresponding commercially available *N*-alkyl-ethylenediamines **1**, R = Me, CH_2Ph and ^{i}Pr using conditions reported previously.[4] This was achieved by condensation of the ethylenediamine with paraformaldehyde at room temperature using potassium carbonate and magnesium sulfate as dehydrating agents, followed by addition of di-*tert*-butyl dicarbonate to give the imidazolidines **3** in high yield (Scheme 4).



1 R = Me, Bn, ^{i}Pr 86–95% **3**

Scheme 4

The lithiation–substitution of the imidazolidines **3** was first investigated in the absence of a chiral ligand. Treatment of the imidazolidine **3**, R = ^{i}Pr, with *sec*-BuLi in THF at −78 °C for 1 hour, followed by addition of Me_3SiCl gave the imidazolidine **7**, E = $SiMe_3$ (49%), with no trace of the 2-substituted isomer (Scheme 5). The imidazolidine **7**, E = $SiMe_3$, was isolated together with substantial amounts (typically 30–50%) of recovered starting material, **3**, R = ^{i}Pr. The yield of the product **7** did not improve using excess *sec*-BuLi, longer reaction times or by inverse or *in situ* quench. Slightly lower yields of the product **7** were obtained in the presence of the additive TMEDA or using the solvent Et_2O.



3, R = ^{i}Pr **7**

Scheme 5

Using the conditions outlined in Scheme 5, a selection of different electrophiles was added to give a range of imidazolidines **7**, shown in Table 1. In all cases moderate yields (up to 49%) were obtained, together with recovered starting material **3**, R = ^{i}Pr.

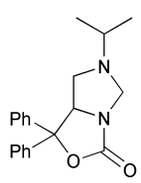
With benzophenone as the electrophile and THF as the solvent, the product obtained was the imidazolidine **8** (50% yield).

Table 2 Formation of enantioenriched imidazolidines **7**

Entry	E^+	E	**7**, Yield (%)[a]	**7**, er
1	Me_3SiCl	Me_3Si	40 (77)	93 : 7
2	Bu_3SnCl	Bu_3Sn	40 (66)	94 : 6
3	$Ph_2MeSiCl$	Ph_2MeSi	44 (88)	94 : 6
4	MeI	Me	44 (76)	92 : 8
5	PhNCO	CONHPh	20 (49)	86 : 14
6	Ph_2CO	$C(OH)Ph_2$	50 (86)	92 : 8
7	CH_2=$CHCH_2Br$	CH_2=$CHCH_2$	40 (69)	50 : 50
8	$PhCH_2Br$	$PhCH_2$	41 (73)	50 : 50

[a] Yield in brackets refers to yield based on recovered **3**.

However, using the solvent Et_2O gave the product **7**, E = $C(OH)Ph_2$ (Table 1, entry 6). With ethyl chloroformate as the electrophile, none of the product **7**, E = CO_2Et was formed and instead the di-addition product **9** was obtained (29% yield), together with recovered starting material, **3**, R = ^{i}Pr (62%).



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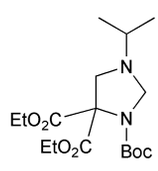

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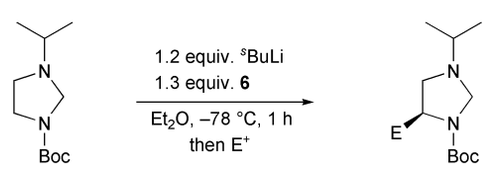
To investigate the lithiation–substitution reaction further, a sample of the imidazolidine **3**, R = ^{i}Pr in D_8-THF was cooled to −78 °C and *sec*-BuLi was added. Prior to addition of the *sec*-BuLi, signals for the two rotamers of the imidazolidine were clearly visible (ratio 1 : 1) by ^{1}H or ^{13}C NMR spectroscopy. Addition of one equivalent of *sec*-BuLi resulted in the immediate disappearance of only one set of these signals, together with the appearance of a set of broad signals.[12] No change to the NMR spectra was observed after long reaction times, on addition of further *sec*-BuLi or on warming to −40 °C (above which temperature significant decomposition occurred). This experiment indicates that only one of the two rotamers of the imidazolidine **3** undergoes deprotonation, and hence explains the limitation (to 50%) in the yield of the substituted products **7**–**9**. Presumably, only the rotamer of the imidazolidine **3** in which the carbonyl oxygen atom is located *cis* to C-5 of the imidazolidine undergoes reaction with *sec*-BuLi. This result has implications for the deprotonation of other unsymmetrical carbamates or carboxylic amides, the yield of which may be limited by the slow rotation about the *N*–CO bond.

Treatment of the imidazolidine **3**, R = ^{i}Pr with *sec*-BuLi and the chiral ligand (−)-sparteine **6** in Et_2O at −78 °C for 1 hour, followed by addition of Me_3SiCl gave the imidazolidine **7**, E = $SiMe_3$ (40%), together with recovered imidazolidine **3**, R = ^{i}Pr (50% yield) (Scheme 6, Table 2). The enantiomer ratio (er) (93 : 7) of the product **7**, E = $SiMe_3$ was determined by NMR spectroscopy on the ring-opened Mosher amide derivative (see below). The high enantioselectivity is in line with results on the asymmetric deprotonation of related substrates with *sec*-BuLi and the chiral ligand (−)-sparteine **6**.[8,13] Quenching with other electrophiles gave similar yields and, in most cases, high enantioselectivities (Table 2). The enantiomer ratios



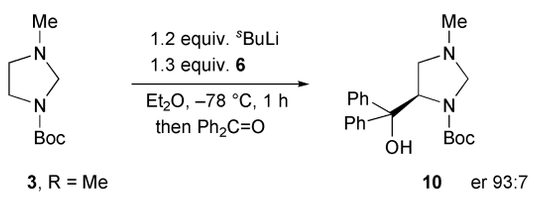
3, R = ^{i}Pr **7**

Scheme 6

were determined by NMR spectroscopy on the ring-opened Mosher amide derivatives (see below) or by chiral HPLC (Gilson 231 XL column, type AD). A single recrystallization of the imidazolidine **7**, E = $C(OH)Ph_2$ gave essentially enantiopure material. Racemic products were obtained using allyl or benzyl bromide as the electrophile, probably as a result of a single electron transfer process.

Evidence that the asymmetry arises from an asymmetric deprotonation (rather than an asymmetric substitution) was obtained by treating the racemic stannane **7**, E = $SnBu_3$ with *n*-BuLi and (−)-sparteine in Et_2O, followed by quenching with Me_3SiCl. This gave the product **7**, E = $SiMe_3$ (59% yield) as a racemate, indicating that no dynamic resolution occurs under these conditions. The configurational stability of the intermediate organolithium species was confirmed by treating the enantioenriched stannane **7**, E = $SnBu_3$ (er 94 : 6) with *n*-BuLi in Et_2O at −78 °C in the absence of (−)-sparteine for 1 h, followed by quenching with Me_3SiCl to give the product **7**, E = $SiMe_3$ (63% yield, er 93 : 7). The absolute configuration of the products is likely to be that shown in Scheme 6, which is consistent with that determined for the asymmetric deprotonation of *N*-Boc-pyrrolidine.[8] This was verified for the product **7**, E = $C(OH)Ph_2$ by single crystal X-ray diffraction.[11]

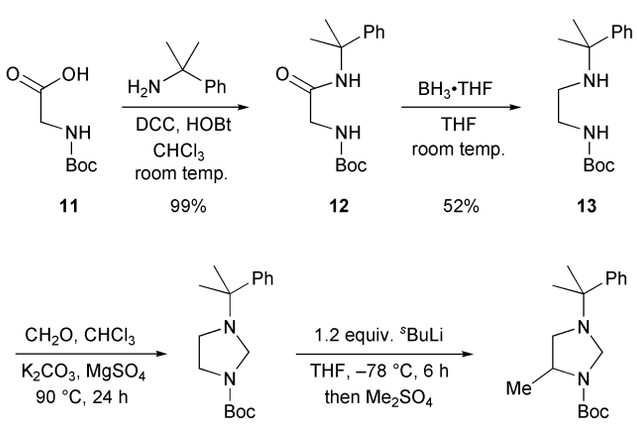
Attempts to effect the deprotonation of the imidazolidine **3**, R = CH_2Ph using *sec*-BuLi in THF or in Et_2O and (−)-sparteine **6** at −78 °C, resulted in a mixture of unidentifiable products. However, the corresponding *N*-methyl compound **3**, R = Me did provide the desired substituted product **10** (Scheme 7). The product **10** was formed in similar yield (40%, together with recovered imidazolidine **3**, R = Me, 42%) to the *N*-^{i}Pr analogue **7**, and with the same level of enantioselectivity (er 93 : 7, determined by chiral HPLC, assumed to have predominantly the *R*-configuration).



3, R = Me **10** er 93:7

Scheme 7

A brief attempt was made to prepare some other substituted imidazolidines using this chemistry. Condensation of *N*-Boc glycine **11** with cumylamine and dicyclohexylcarbodiimide–hydroxybenzotriazole gave the amide **12** in quantitative yield (Scheme 8). This carboxylic amide was sluggish to reduce, but a reasonable yield (52%, together with 39% recovered amide **12**) of the amine **13** was obtained using borane·THF complex. Imidazolidine formation proceeded smoothly to give directly



11 99% **12** 52% **13**

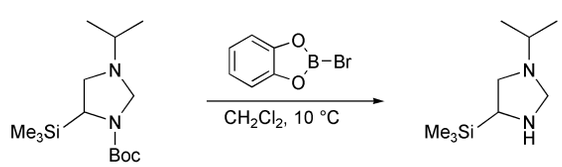
85% **14** 48% **15**

Scheme 8

the *N*-Boc compound **14**. With this new imidazolidine in hand, it was subjected to lithiation–substitution. Using *sec*-BuLi in THF at −78 °C for 1 h (compare with conditions in Scheme 5), followed by quenching with dimethyl sulfate, gave the product **15**, but in only 24% yield, together with recovered imidazolidine **14** (69%). Increasing the time to 6 h, gave an improved yield (48%) of the product **15** (together with **14**, 50%). The ^{1}H NMR spectrum of the imidazolidine **14** showed the presence of both rotamers in approximately equal amounts, and the modest yield of the product **15** indicates that, like the *N*-^{i}Pr analogue, only one rotamer is undergoing deprotonation. Unfortunately, subjecting the imidazolidine **14** to the asymmetric lithiation conditions using *sec*-BuLi in Et_2O and (−)-sparteine, resulted in only recovered starting material **14**. Warming the reaction mixture to −40 °C likewise gave only recovered **14**, whereas at −20 °C decomposition occurred. It appears that the increased steric bulk at *N*-3 of the imidazolidine disfavours proton abstraction.

Similar results were obtained using the corresponding imidazolidine with a *tert*-butyl substituent at *N*-3, which could be prepared in the same way as the *N*-cumyl compound **14** and lithiated with *sec*-BuLi in THF (in the absence of sparteine) and quenched with benzophenone (36% yield, 58% recovered starting imidazolidine), but did not lithiate in the presence of (−)-sparteine **6**.

The results described above illustrate some of the scope and limitations of this chemistry. Formation of the substituted imidazolidines **7** and **10** was successful in enantiomerically enriched form. For the formation of chiral 1,2-diamines, we needed to hydrolyse these imidazolidines. Treatment of the imidazolidine **7**, E = $SiMe_3$ with trifluoroacetic acid (TFA) or *B*-bromocatechol borane[14] in CH_2Cl_2 gave the unstable imidazolidine **16** (Scheme 9). Although the Mosher amide could be prepared from this racemic imidazolidine [using α-methoxy-α-(trifluoromethyl)phenylacetyl chloride in CH_2Cl_2 and Et_3N] in good yield, this amide was formed as a 1.2 : 1 ratio of diastereomers and this method could not therefore be used for the determination of enantiopurity from enantioenriched imidazolidines.



7, R = ^{i}Pr 80% **16**

Scheme 9

Treatment of the imidazolidine **7**, E = $SiMe_3$ with malonic acid and pyridine,[15] heating under reflux in EtOH, gave the carbamate **17**, in which the imidazolidine had been opened, but the *tert*-butoxycarbonyl group remained intact (Table 3). Similarly, the imidazolidines **7**, E = $SiMePh_2$, Me, CONHPh and $CH_2CH{=}CH_2$ all hydrolysed to the carbamates **18**–**21** (Table 3). These carbamates were treated with TFA in CH_2Cl_2 at room temperature to give the desired diamine products **22**–**26** (Table 3). These diamines could be accessed in one step by heating the imidazolidines **7** with TFA, but the yields (unoptimized) were lower than the two-step procedure. The Mosher amides **27**, E = $SiMe_3$, $SiMePh_2$, Me, CONHPh and $CH_2CH{=}CH_2$ were formed in high yield from the diamines **22**–**26** and the ratio of the diastereomers of **27** (1 : 1 from the racemic diamines), as determined by ^{1}H and ^{19}F NMR spectroscopy, was used to determine the enantiomer ratios given in Table 2.

Similar chemistry was applied to the homologous pyrimidine **28**, prepared in one step from *N*-isopropyl-1,3-diaminopropane with paraformaldehyde, followed by addition of di-*tert*-butyl dicarbonate (Scheme 10). Treatment of the pyrimidine **28** with *sec*-BuLi in THF at −78 °C for 5 hours, followed by addition of

Table 3 Hydrolysis of imidazolidines 7 using malonic acid then TFA

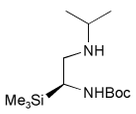
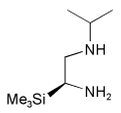
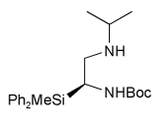
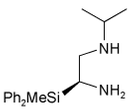
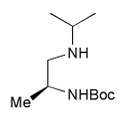
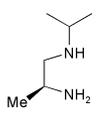
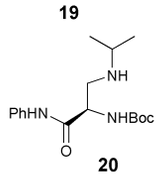
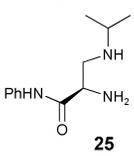
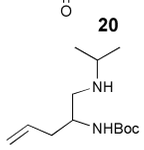
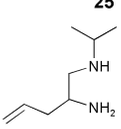
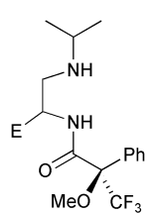
Product	Yield (%)	Product	Yield (%)
 **17**	85	 **22**	92
 **18**	67	 **23**	99
 **19**	95	 **24**	69
 **20**	82	 **25**	89
 **21**	96	 **26**	87

Table 4 Formation of racemic pyrimidines **29**

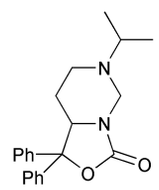
Entry	E^+	E	**29**, Yield (%)
1	Me_3SiCl	Me_3Si	60
2	Bu_3SnCl	Bu_3Sn	64
3	$Ph_2MeSiCl$	Ph_2MeSi	64
4	CH_2=$CHCH_2Br$	CH_2=$CHCH_2$	42
5	PhSSPh–MeI	PhS	39
6	Ph_2CO	[a]	57 [a]

[a] Product is **30**.

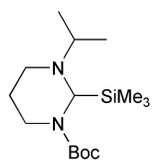


27, E = $SiMe_3$, $SiMePh_2$, Me, CONHPh, CH_2CH=CH_2

Me_3SiCl gave the expected 6-substituted product **29**, E = $SiMe_3$ (Scheme 10, Table 4). Yields were best with 2–2.5 equivalents of *sec*-BuLi and with TMEDA as a co-solvent. Addition of other electrophiles gave a selection of the 6-substituted pyrimidines **29** (Table 4). Using the electrophile benzophenone, the product **30** was obtained, in which cyclization of the intermediate alkoxide onto the carbamate had occurred. Yields of the products **29** (and **30**) greater than 50% could be obtained under these conditions, suggesting that there is an uneven distribution of the two rotamers of **28** (verified by NMR spectroscopy), slightly in favour of that with the carbonyl oxygen atom pointing towards C-6. Small amounts of the pyrimidine **28** were recovered even with 2.5 equivalents of *sec*-BuLi. These results suggest that, like the imidazolidine substrates **3**, proton abstraction is disfavoured at C-2, between the two nitrogen atoms. However, in one case at higher concentration (0.3 M rather than 0.16 M, therefore also implying less polar solvent since *sec*-BuLi was added as a solution in cyclohexane), a low yield (28%) of the 2-substituted product **31** was obtained.

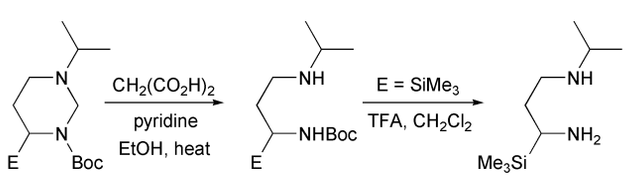


30



31

Attempted asymmetric deprotonation of the pyrimidine substrate **28**, using *sec*-BuLi and the chiral ligand (−)-sparteine **6** in Et_2O, followed by addition of Me_3SiCl gave only trace amounts of the desired product **29**, E = $SiMe_3$. Some product (up to 37% yield) was obtained using (−)-sparteine in THF, rather than Et_2O, although this was found to be racemic, as judged by the formation of a 1 : 1 mixture of diastereomers of the Mosher amides formed from the diamine **33** (Scheme 11). In the same way as the imidazolidine substrates, hydrolysis of the pyrimidine ring was possible using malonic acid and pyridine, to give the ring-opened derivates **32** (carried out for E = $SiMe_3$ and CH_2CH=CH_2) (Scheme 11). Subsequent treatment with TFA gave the diamine **33**. This procedure therefore provides a method to prepare substituted 1,3-diamines.

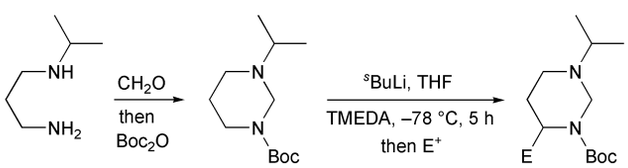


29 86–100% **32** 100% **33**

Scheme 11

Conclusion

Chiral substituted 1,2- and 1,3-diamines can be prepared starting from unsubstituted 1,2- and 1,3-diamines. The unsubstituted diamines can be converted into imidazolidines or pyrimidines in one pot and these cyclic derivatives undergo successful lithiation–substitution α- to the *N*-Boc group. Asymmetric lithiation of the imidazolidine substrates occurs in the presence of the chiral ligand (−)-sparteine, thereby leading to highly enantiomerically enriched products. Both rotamers of the *N*-Boc imidazolidines and pyrimidines are present in solution at low temperature, but only one rotamer permits successful lithiation of these unsymmetrical substrates and this limits the yields of the substituted products. The imidazolidines and pyrimidines can be hydrolysed to give the acyclic substituted diamine products.



28 **29**

Scheme 10

Experimental

General

IR spectra were recorded as liquid films on NaCl plates unless otherwise stated, using a Nicolet FT-IR Magna 550

spectrometer. Optical rotations were recorded on an AA-1000 polarimeter using a cell of either 0.5 or 0.1 dm path length and are recorded in 10^{-1} deg cm^2 g^{-1}. Elemental analyses were recorded on a Carlo Erba EA1110 elemental analyser. ^{1}H NMR spectra were recorded on a Bruker AC 300 MHz or a Bruker DRX 400 MHz spectrometer using the residual solvent peak as an internal reference. Chemical shifts are given in parts per million. Coupling constants, J, are given in Hz. ^{13}C NMR spectra are recorded on the above spectrometers operating at 75 or 100 MHz respectively and are proton decoupled. Additional analysis by DEPT, COSY, NOESY or HMQC experiments were performed where necessary. Mass spectra were recorded on a Kratos Profile HV3 or a Micromass Quattro II spectrometer or a ThermoQuest AS2000 GCMS machine, using electron impact (EI), chemical ionisation (CI), electrospray (ES) or field ionisation (FI) techniques. Accurate mass measurements were performed on the Kratos Profile spectrometer, a Finnigan MAT 900 XLT spectrometer or a Micromass Autospec spectrometer.

Petrol refers to light petroleum (bp 40–60 °C). Tetrahydrofuran (THF) and diethyl ether (Et_2O) were distilled from sodium–benzophenone. (−)-Sparteine and *N*,*N*,*N*′,*N*′-tetramethylethylenediamine (TMEDA) were distilled from calcium hydride. Flash column chromatography was performed on silica gel 60H (230–400 mesh) (Merck 9385). Thin layer chromatography was performed on Kieselgel 60F$_{254}$ 0.25 mm plates, and visualised by UV irradiation at 254 nm or potassium permanganate dip.

3-Isopropylimidazolidine-1-carboxylic acid *tert*-butyl ester 3, R = ^{i}Pr

N-Isopropylethylenediamine (7.66 g, 9.32 mL, 75.0 mmol) was added to a suspension of paraformaldehyde (2.25 g, 75.0 mmol), K_2CO_3 (35 g, 253 mmol) and $MgSO_4$ (35 g, 290 mmol) in $CHCl_3$ (250 mL) under nitrogen at room temperature. After stirring for 18 h, di-*tert*-butyl dicarbonate (16.37 g, 75.0 mmol) was added and the mixture was stirred for a further 18 h. The mixture was filtered, evaporated, saturated brine (75 mL) was added, and the mixture was extracted with CH_2Cl_2 (3 × 75 mL). The combined extracts were dried (Na_2SO_4), evaporated and purified by column chromatography on silica gel, eluting with petrol–EtOAc (1 : 1), to give the imidazolidine **3**, R = ^{i}Pr (15.3 g, 95%) as an oil; R_f 0.16 [petrol–EtOAc (1 : 1)]; ν_{max} (film)/cm^{-1} 1700 (C=O); δ_H(400 MHz, $CDCl_3$, *rotamers*) 3.97 & 3.89 (2H, s, NCH_2N), 3.42–3.35 (2H, m, CH_2CH_2-NBoc), 2.78–2.74 (2H, m, CH_2CH_2NBoc), 2.40–2.34 [1H, m, NC*H*$(CH_3)_2$], 1.39 [9H, s, $C(CH_3)_3$], 1.05 [6H, d, *J* 6.5, NCH-$(CH_3)_2$]; δ_C(100 MHz, $CDCl_3$, *rotamers*) 153.5, 153.4, 79.6, 79.4, 66.7, 66.6, 53.3, 53.2, 51.1, 50.3, 44.9, 44.4, 28.4, 28.3, 21.4; Found (ES): MH$^+$, 215.1761. $C_{11}H_{23}N_2O_2$ requires *MH*, 215.1759; *m*/*z* (CI) 215 (56%, MH$^+$), 159 (100, MH$^+$ − C_4H_8) (Found: C, 61.9; H, 10.5; N, 12.85. $C_{11}H_{22}N_2O_2$ requires C, 61.65; H, 10.35; N, 13.05%).

3-Benzylimidazolidine-1-carboxylic acid *tert*-butyl ester 3, R = Bn

In the same way as the imidazolidine **3**, R = ^{i}Pr, *N*-benzylethylenediamine (5.0 mL, 33.3 mmol), paraformaldehyde (1.0 g, 33.3 mmol) and di-*tert*-butyl dicarbonate (7.26 g, 33.28 mmol) gave, after purification by column chromatography on silica gel, eluting with petrol–EtOAc (7 : 3), the imidazolidine **3**, R = Bn (7.87 g, 90%) as plates; mp 40.0–41.5 °C (from hexane–EtOAc); R_f 0.19 [petrol–EtOAc (4 : 1)]; ν_{max} (KBr)/cm^{-1} 1690 (C=O); δ_H(400 MHz, $CDCl_3$, *rotamers*) 7.33–7.27 (5H, m, Ar–H), 4.00 & 3.96 (2H, s, NCH_2N), 3.64 (2H, s, $PhCH_2N$), 3.47–3.39 (2H, m, BocNCH_2CH_2), 2.85–2.82 (2H, m, BocNCH$_2$CH_2), 1.44 [9H, s, $C(CH_3)_3$]; δ_C(100 MHz, $CDCl_3$, *rotamers*) 153.6, 138.0, 137.9, 128.8, 128.7, 128.5, 127.4, 79.7, 79.5, 68.0, 67.9, 58.2, 58.1, 52.8, 52.1, 44.4, 43.8, 28.4; Found (ES): MH$^+$, 263.1756. $C_{15}H_{23}N_2O_2$ requires *MH*, 263.1759; *m*/*z* (CI) 263 (60%, MH$^+$), 207 (100, MH$^+$ − C_4H_8) (Found: C, 68.55; H, 8.75; N, 10.55. $C_{15}H_{22}N_2O_2$ requires C, 68.65; H, 8.45; N, 10.7%).

3-Methylimidazolidine-1-carboxylic acid *tert*-butyl ester 3, R = Me

In the same way as the imidazolidine **3**, R = ^{i}Pr, *N*-methylethylenediamine (1.0 mL, 11.5 mmol), paraformaldehyde (0.34 g, 11.48 mmol) and di-*tert*-butyl dicarbonate (2.51 g, 11.48 mmol) gave, after purification by column chromatography on silica gel, eluting with EtOAc, the imidazolidine **3**, R = Me (1.84 g, 86%) as an oil; R_f 0.08 (EtOAc); ν_{max} (film)/cm^{-1} 1700 (C=O); δ_H(400 MHz, $CDCl_3$, 60 °C, *rotamers*) 3.84 (2H, s, NCH_2N), 3.35–3.32 (2H, m, BocNCH_2CH_2), 2.73–2.70 (2H, m, BocNCH$_2$CH_2), 2.29 (3H, s, N–CH_3), 1.37 [9H, s, $C(CH_3)_3$]; δ_C(100 MHz, $CDCl_3$, 60 °C, *rotamers*) 153.4, 79.4, 79.1, 69.5, 54.5, 44.2, 40.0, 28.3; Found (ES): MH$^+$, 187.1448. $C_9H_{19}N_2O_2$ requires *MH*, 187.1446; *m*/*z* (CI) 187 (5%, MH$^+$), 131 (100, MH$^+$ − C_4H_8).

(5*RS*)-3-Isopropyl-5-trimethylsilylimidazolidine-1-carboxylic acid *tert*-butyl ester 7, E = SiMe$_3$

To the imidazolidine **3**, R = ^{i}Pr (1.0 g, 4.67 mmol) in dry THF (25 mL) under nitrogen at −78 °C was added *sec*-BuLi (4.3 mL, 5.6 mmol, 1.3 M in cyclohexane) dropwise over a period of 5 min. After 1 h, Me_3SiCl (0.89 mL, 6.99 mmol) was added slowly and the mixture was retained at −78 °C for a further 4 h before being allowed to warm to room temperature. Saturated $NaHCO_{3(aq)}$ (30 mL) was added, the mixture was extracted with Et_2O (3 × 30 mL) and the combined extracts were dried (Na_2SO_4), evaporated and purified by column chromatography on silica gel, eluting with petrol–EtOAc (5 : 1), to give recovered starting material **3**, R = ^{i}Pr (0.38 g, 38%) and the imidazolidine **7**, E = $SiMe_3$ (0.66 g, 49%) as an oil; R_f 0.44 [petrol–EtOAc (1 : 1)]; ν_{max} (film)/cm^{-1} 1700 (C=O); δ_H(400 MHz, $CDCl_3$, 60 °C, *rotamers*) 4.25–4.23 (1H, m, NC*H*^{A}H^{B}N), 3.68–3.61 (1H, m, NCH^A*H*^{B}N), 3.32–3.28 (1H, m, C*H*$SiMe_3$), 3.01–2.97 (1H, m, ^{i}PrNC*H*^{A}H^{B}CH), 2.62–2.56 (1H, m, ^{i}PrNCH^A*H*^{B}CH), 2.44–2.37 (1H, m, NC*H*Me_2), 1.45 [9H, s, $C(CH_3)_3$], 1.08 [6H, d, *J* 6.0, $CH(CH_3)_2$], 0.08 [9H, s, $Si(CH_3)_3$]; δ_C(100 MHz, $CDCl_3$, 60 °C, *rotamers*) 153.0, 79.3, 67.6, 53.2, 52.8, 47.1, 28.5, 21.4, −2.4; Found (CI): MH$^+$, 287.2150. $C_{14}H_{31}N_2O_2Si$ requires *MH*, 287.2155; *m*/*z* (CI) 287 (95%, MH$^+$), 231 (100, MH$^+$ − C_4H_8) (Found: C, 58.93; H, 10.86; N, 9.76. $C_{14}H_{30}N_2O_2Si$ requires C, 58.69; H, 10.55; N, 9.78%).

(5*S*)-3-Isopropyl-5-trimethylsilylimidazolidine-1-carboxylic acid *tert*-butyl ester 7, E = SiMe$_3$

To (−)-sparteine (2.84 g, 2.79 mL, 12.13 mmol) in dry Et_2O (25 mL) under nitrogen at −78 °C was added *sec*-BuLi (8.6 mL, 11.20 mmol, 1.3 M in cyclohexane). After 30 min, the mixture was transferred *via* a cannula to a solution of the imidazolidine **3**, R = ^{i}Pr (2.0 g, 9.33 mmol) in dry Et_2O (25 mL) under nitrogen at −78 °C. The mixture was stirred at −78 °C for 2 h, and then Me_3SiCl (1.78 mL, 14.00 mmol) was added, ensuring that the temperature did not rise above −70 °C. The resulting mixture was maintained at −78 °C for a further 4 h and then saturated $NaHCO_{3(aq)}$ (50 mL) was added. The mixture was extracted with Et_2O (3 × 50 mL) and the combined extracts were dried (Na_2SO_4), evaporated and purified by column chromatography on silica gel, eluting with petrol–EtOAc (5 : 1), to give recovered starting material **3**, R = ^{i}Pr (0.96 g, 48%) and the imidazolidine (*S*)-**7**, E = $SiMe_3$ (1.07 g, 40%); $[\alpha]_D^{23}$ +40.4 (*c* 1.1 in $CHCl_3$). Other spectroscopic data as above for (5*RS*)-**7**, E = $SiMe_3$. The enantiomer ratio was determined to be 93 : 7 by ^{1}H and ^{19}F NMR analysis of the Mosher amide **27**, E = $SiMe_3$.

(5*RS*)-3-Isopropyl-5-tributylstannylimidazolidine-1-carboxylic acid *tert*-butyl ester 7, E = $SnBu_3$

In the same way as the imidazolidine (*RS*)-**7**, E = $SiMe_3$, the imidazolidine **3**, R = ^{i}Pr (1.0 g, 4.67 mmol), *sec*-BuLi (4.3 mL, 5.6 mmol, 1.3 M in cyclohexane) and Bu_3SnCl (1.89 mL, 7.0 mmol) gave, after purification by column chromatography on silica gel, eluting with petrol–EtOAc (95 : 5), the recovered starting material **3**, R = ^{i}Pr (0.30 g, 30%) and the imidazolidine **7**, E = $SnBu_3$ (1.16 g, 49%) as an oil; R_f 0.41 [petrol–EtOAc (4 : 1)]; ν_{max} (film)/cm^{-1} 1685 (C=O); δ_H(400 MHz, $CDCl_3$, *rotamers*) 4.22 (0.7H, d, *J* 5.5, NC*H*^{A}H^{B}N), 4.09 (0.3H, d, *J* 5.5, NC*H*^{A}H^{B}N), 3.88 (0.3H, d, *J* 5.5, NCH^A*H*^{B}N), 3.64 (0.7H, d, *J* 5.5, NCH^A*H*^{B}N), 3.45–3.41 (1H, m, CH_2C*H*NBoc), 3.20–3.17 (0.7H, m, C*H*^{A}H^BCH_2NBoc), 3.05–2.97 (0.3H, m, C*H*^{A}-H^BCH_2NBoc), 2.85–2.80 (0.3H, m, CH^A*H*^{B}CH_2NBoc), 2.58–2.53 (0.7H, m, CH^A*H*^{B}CH_2NBoc), 2.44–2.40 [1H, m, NC*H*-$(CH_3)_2$], 1.51–1.46 (6H, m, 3 × CH_2), 1.42 [9H, s, $C(CH_3)_3$], 1.31–1.28 (6H, m, 3 × CH_2), 1.11 [6H, d, *J* 6.0, NCH(CH_3)$_2$], 0.91–0.85 (15H, m, 3 × CH_2 & 3 × CH_3); δ_C(100 MHz, $CDCl_3$, *rotamers*) 153.0, 152.8, 79.7, 79.0, 67.2, 66.8, 55.8, 55.3, 53.4, 53.1, 46.1, 45.1, 29.1, 28.5, 27.7, 21.6, 13.6, 9.8; Found (CI): MH$^+$, 505.2820. $C_{23}H_{49}N_2O_2{}^{120}Sn$ requires *MH*, 505.2816; *m*/*z* (CI) 505 (55%, MH$^+$), 447 (100, M$^+$ − C_4H_9) (Found: C, 54.8; H, 9.75; N, 5.3. $C_{23}H_{48}N_2O_2Sn$ requires C, 54.9; H, 9.6; N, 5.55%).

(5*S*)-3-Isopropyl-5-tributylstannylimidazolidine-1-carboxylic acid *tert*-butyl ester 7, E = $SnBu_3$

In the same way as the imidazolidine (*S*)-**7**, E = $SiMe_3$, the imidazolidine **3**, R = ^{i}Pr (2.0 g, 9.33 mmol), (−)-sparteine (2.84 g, 2.79 mL, 12.13 mmol), *sec*-BuLi (8.60 mL, 11.20 mmol, 1.3 M in cyclohexane) and Bu_3SnCl (3.78 mL, 14.00 mmol) gave, after purification by column chromatography on silica gel, eluting with petrol–EtOAc (95 : 5), the recovered starting material **3**, R = ^{i}Pr (0.78 g, 39%) and the imidazolidine (*S*)-**7**, E = $SnBu_3$ (1.88 g, 40%); $[\alpha]_D^{25}$ +89.7 (*c* 1.60 in $CHCl_3$). Other spectroscopic data as above for (5*RS*)-**7**, E = $SnBu_3$. The enantiomer ratio was determined to be 94 : 6 by chiral HPLC using a HP1050 LC system fitted with a Varian RI4 Refractive Index detector with a Chiralpak AD column (250 mm × 4.6 mm id) as the stationary phase with hexane as the mobile phase at a flow rate of 1.0 mL min^{-1}. Injection volume 20 μL of sample prepared in a 1 mg mL^{-1} solution of hexane. Under these conditions, the enantiomers were eluted at 4.30 min (major) and 4.95 min (minor).

(5*RS*)-3-Isopropyl-5-(methyldiphenylsilyl)imidazolidine-1-carboxylic acid *tert*-butyl ester 7, E = $SiMePh_2$

In the same way as the imidazolidine (*RS*)-**7**, E = $SiMe_3$, the imidazolidine **3**, R = ^{i}Pr (1.0 g, 4.67 mmol), *sec*-BuLi (4.3 mL, 5.6 mmol, 1.3 M in cyclohexane) and $Ph_2MeSiCl$ (1.48 mL, 7.0 mmol) gave, after purification by column chromatography on silica gel, eluting with petrol–EtOAc (10 : 1), the recovered starting material **3**, R = ^{i}Pr (0.46 g, 46%) and the imidazolidine **7**, E = $SiMePh_2$ (0.84 g, 44%) as an oil; R_f 0.40 [petrol–EtOAc (1 : 1)]; ν_{max} (film)/cm^{-1} 1695 (C=O); δ_H(400 MHz, $CDCl_3$, *rotamers*) 7.58–7.34 (10H, m, Ar–H), 4.21–4.10 (0.5H, m, NC*H*^{A}H^{B}N), 4.10–3.97 (0.5H, m, NC*H*^{A}H^{B}N), 3.97–3.85 (1.5H, m, NCH^A*H*^{B}N & NCH_2C*H*NBoc), 3.72–3.69 (0.5H, m, NCH^A*H*^{B}N), 2.89–2.85 (1H, m, NC*H*^{A}H^{B}CHNBoc), 2.72–2.69 (1H, m, NCH^A*H*^{B}CHNBoc), 2.37–2.31 (1H, m, NC*H*Me_2), 1.30 & 1.19 [9H, s, $C(CH_3)_3$], 1.03 [3H, d, *J* 6.0, NCH(CH_3)^A-$(CH_3)^B$], 0.98 [3H, d, *J* 6.0, NCH(CH_3)^A(CH_3)^B], 0.70 (3H, br s, $SiCH_3$). δ_C(100 MHz, $CDCl_3$, *rotamers*) 154.0, 153.3, 137.5, 135.8, 135.2, 129.2, 127.7, 79.9, 79.1, 67.4, 53.9, 53.7, 52.7, 46.3, 46.0, 28.3, 28.2, 21.7, 21.6, 21.4, 21.0, −3.8, −4.6; Found (ES): MH$^+$, 411.2472. $C_{24}H_{35}N_2O_2Si$ requires *MH*, 411.2468; *m*/*z* (CI) 411 (38%, MH$^+$), 277 (100, MH$^+$ − C_4H_9 − C_6H_5) (Found: C, 70.5; H, 8.2, N, 6.95. $C_{24}H_{34}N_2O_2Si$ requires C, 70.2; H, 8.35; N, 6.8%).

(5*S*)-3-Isopropyl-5-(methyldiphenylsilyl)imidazolidine-1-carboxylic acid *tert*-butyl ester 7, E = $SiMePh_2$

In the same way as the imidazolidine (*S*)-**7**, E = $SiMe_3$, the imidazolidine **3**, R = ^{i}Pr (2.0 g, 9.33 mmol), (−)-sparteine (2.84 g, 2.79 mL, 12.13 mmol), *sec*-BuLi (8.60 mL, 11.20 mmol, 1.3 M in cyclohexane) and $Ph_2MeSiCl$ (2.96 mL, 14.00 mmol) gave, after purification by column chromatography on silica gel, eluting with petrol–EtOAc (10 : 1), the recovered starting material **3**, R = ^{i}Pr (0.98 g, 49%) and the imidazolidine (*S*)-**7**, E = $SiMePh_2$ (1.69 g, 44%); $[\alpha]_D^{26}$ +12.9 (*c* 1.33 in $CHCl_3$). Other spectroscopic data as above for (5*RS*)-**7**, E = $SiMePh_2$. The enantiomer ratio was determined to be 94 : 6 by ^{1}H and ^{19}F NMR analysis of the Mosher amide **27**, E = $SiMePh_2$.

(5*RS*)-3-Isopropyl-5-methylimidazolidine-1-carboxylic acid *tert*-butyl ester 7, E = Me

In the same way as the imidazolidine (*RS*)-**7**, E = $SiMe_3$, the imidazolidine **3**, R = ^{i}Pr (1.0 g, 4.67 mmol), *sec*-BuLi (4.3 mL, 5.6 mmol, 1.3 M in cyclohexane) and methyl iodide (0.44 mL, 7.0 mmol) gave, after purification by column chromatography on silica gel, eluting with petrol–EtOAc (5 : 1), the recovered starting material **3**, R = ^{i}Pr (0.39 g, 39%) and the imidazolidine **7**, E = Me (0.45 g, 42%) as an oil; R_f 0.18 [petrol–EtOAc (1 : 1)]; ν_{max} (film)/cm^{-1} 1700 (C=O); δ_H(400 MHz, $CDCl_3$, *rotamers*) 4.25–4.22 (0.5H, m, NC*H*^{A}H^{B}N), 4.15–4.00 (0.5H, m, NC*H*^{A}H^{B}N), 3.98–3.76 (2H, m, NCH^A*H*^{B}N & NCH_2C*H*N-Boc), 3.10–1.95 (1H, m, NC*H*^{A}H^{B}CHNBoc), 2.37–2.29 (2H, m, NCH^A*H*^{B}CHNBoc & NC*H*Me_2), 1.43 [9H, s, $C(CH_3)_3$], 1.24–1.16 (3H, m, BocNCHC*H*$_3$), 1.10–1.05 [6H, m, NCH(CH_3)$_2$]; δ_C(100 MHz, $CDCl_3$, *rotamers*) 153.8, 79.4, 67.2, 59.0, 58.2, 53.2, 52.3, 28.5, 21.5, 21.4, 19.8, 19.2; Found (ES): MH$^+$, 229.1918. $C_{12}H_{25}N_2O_2$ requires *MH*, 229.1916; *m*/*z* (CI) 229 (40%, MH$^+$), 171 (100, M$^+$ − C_4H_9) (Found: C, 63.05; H, 11.0; N, 12.05. $C_{12}H_{24}N_2O_2$ requires C, 63.1; H, 10.6; N, 12.25%).

(5*S*)-3-Isopropyl-5-methylimidazolidine-1-carboxylic acid *tert*-butyl ester 7, E = Me

In the same way as the imidazolidine (*S*)-**7**, E = $SiMe_3$, the imidazolidine **3**, R = ^{i}Pr (2.0 g, 9.33 mmol), (−)-sparteine (2.84 g, 2.79 mL, 12.13 mmol), *sec*-BuLi (8.60 mL, 11.20 mmol, 1.3 M in cyclohexane) and MeI (0.88 mL, 14.00 mmol) gave, after purification by column chromatography on silica gel, eluting with petrol–EtOAc (5 : 1), the recovered starting material **3**, R = ^{i}Pr (0.84 g, 42%) and the imidazolidine (*S*)-**7**, E = Me (0.94 g, 44%); $[\alpha]_D^{24}$ +31.5 (*c* 1.03 in $CHCl_3$). Other spectroscopic data as above for (5*RS*)-**7**, E = Me. The enantiomer ratio was determined to be 92 : 8 by ^{1}H and ^{19}F NMR and GCMS analysis of the Mosher amide **27**, E = Me.

(5*RS*)-3-Isopropyl-5-phenylcarbamoylimidazolidine-1-carboxylic acid *tert*-butyl ester 7, E = CONHPh

In the same way as the imidazolidine (*RS*)-**7**, E = $SiMe_3$, the imidazolidine **3**, R = ^{i}Pr (2.0 g, 9.33 mmol), *sec*-BuLi (8.6 mL, 11.2 mmol, 1.3 M in cyclohexane) and phenyl isocyanate (1.5 mL, 14.0 mmol) gave, after purification by column chromatography on silica gel, eluting with petrol–EtOAc (10 : 1), the recovered starting material **3**, R = ^{i}Pr (0.83 g, 42%) and the imidazolidine **7**, E = CONHPh (1.40 g, 45%) as plates; mp 139.0–139.5 °C (from EtOAc); R_f 0.23 [petrol–EtOAc (1 : 1)]; ν_{max} (KBr)/cm^{-1} 1705 (^{t}BuOC=O), 1675 (NHC=O); δ_H(400 MHz, $CDCl_3$, 50 °C) 7.52–7.50 (2H, m, Ar–H), 7.32–7.29 (2H, m, Ar–H), 7.11–7.07 (1H, m, Ar–H), 4.40–4.36 (1H, m, NCH_2-C*H*N), 4.26–4.22 (1H, m, NC*H*^{A}H^{B}N), 4.04–4.03 (1H, m, NCH^A*H*^{B}N), 3.36–3.30 (1H, m, NC*H*^{A}H^{B}CHN), 2.98–2.93 (1H, m, NCH^A*H*^{B}CHN), 2.57–2.50 (1H, m, NC*H*Me_2), 1.48

[9H, s, $C(CH_3)_3$], 1.14–1.12 [6H, m, $NCH(CH_3)_2$]; δ_C(100 MHz, $CDCl_3$, 50 °C) 169.2, 153.5, 137.9, 128.9, 124.1, 119.6, 81.5, 67.2, 60.6, 52.4, 28.3, 21.2; Found (ES): MH^+, 334.2133. $C_{18}H_{28}N_3O_3$ requires *MH*, 334.2131; *m/z* (CI) 334 (91%, MH^+), 278 (100, $MH^+ - C_4H_8$) (Found: C, 64.75; H, 8.2; N, 12.2. $C_{18}H_{27}N_3O_3$ requires C, 64.85; H, 8.15; N, 12.6%).

(5*R*)-3-Isopropyl-5-phenylcarbamoylimidazolidine-1-carboxylic acid *tert*-butyl ester 7, E = CONHPh

In the same way as the imidazolidine (*S*)-**7**, E = $SiMe_3$, the imidazolidine **3**, R = ^{i}Pr (2.0 g, 9.33 mmol), (−)-sparteine (2.84 g, 2.79 mL, 12.13 mmol), *sec*-BuLi (8.60 mL, 11.20 mmol, 1.3 M in cyclohexane) and phenyl isocyanate (3.00 mL, 14.00 mmol) gave, after purification by column chromatography on silica gel, eluting with petrol–EtOAc (10 : 1), the recovered starting material **3**, R = ^{i}Pr (1.18 g, 59%) and the imidazolidine (*R*)-**7**, E = CONHPh (0.62 g, 20%); $[a]_D^{24}$ +63.3 (*c* 1.04 in $CHCl_3$). Other spectroscopic data as above for (5*RS*)-**7**, E = CONHPh. The enantiomer ratio was determined to be 86 : 14 by ^{1}H and ^{19}F NMR analysis of the Mosher amide **27**, E = CONHPh and by chiral HPLC using a Gilson 231 XL system fitted with a Chiralpak AD column (250 mm × 4.6 mm id) as the stationary phase with hexane–EtOH (98 : 2) as the mobile phase at a flow rate of 1.0 mL min^{-1}, detection by UV absorbance at 215 nm. Injection volume 20 μL of sample prepared in a 1 mg mL^{-1} solution of EtOH. Under these conditions, the enantiomers were eluted at 25.72 min (major) and 30.40 min (minor).

(5*RS*)-5-(Hydroxydiphenylmethyl)-3-isopropylimidazolidine-1-carboxylic acid *tert*-butyl ester 7, E = C(OH)Ph_2

To the imidazolidine **3**, R = ^{i}Pr (1.0 g, 4.67 mmol) in dry Et_2O (25 mL) under nitrogen at −78 °C was added *sec*-BuLi (4.3 mL, 5.6 mmol, 1.3 M in cyclohexane) dropwise over a period of 5 min. After 3 h, benzophenone (1.53 g, 7.0 mmol) in dry Et_2O (5 mL) was added slowly and the mixture was retained at −78 °C for a further 4 h before being allowed to warm to room temperature. Saturated $NaHCO_{3(aq)}$ (30 mL) was added, the mixture was extracted with Et_2O (3 × 30 mL) and the combined extracts were dried (Na_2SO_4), evaporated and purified by column chromatography on silica gel, eluting with petrol–EtOAc (10 : 1), to give recovered starting material **3**, R = ^{i}Pr (0.45 g, 45%) and the imidazolidine **7**, E = C(OH)Ph_2 (0.75 g, 40%) as needles; mp 83.5–85.5 °C (from hexane); R_f 0.49 [petrol–EtOAc (1 : 1)]; ν_{max} (film)/cm^{-1} 1695 (C=O); δ_H(400 MHz, $CDCl_3$, 50 °C) 7.62–7.19 (10H, m, Ar–H), 4.86 (1H, m, NCH_2CHN), 4.43 (1H, m, NCH^AH^BN), 3.86 (1H, m, NCH^AH^BN), 3.10 (1H, d, *J* 9.0, NCH^AH^BCHN), 2.68 (1H, d, *J* 9.0, NCH^AH^BCHN), 2.61–2.55 (1H, m, $NCHMe_2$), 1.17 [9H, s, $C(CH_3)_3$], 1.11 [3H, d, *J* 6.5, $NCH(CH_3)^A(CH_3)^B$], 1.03 [3H, d, *J* 6.5, $NCH(CH_3)^A(CH_3)^B$]; δ_C(100 MHz, $CDCl_3$, 50 °C) 153.9, 146.1, 145.2, 144.0, 128.4, 128.0, 127.5, 127.4, 127.0 126.7, 126.6, 126.4, 80.7, 80.1, 67.1, 63.0, 53.2, 52.3, 27.9, 20.9, 20.8; Found (ES): MH^+, 397.2495. $C_{24}H_{33}N_2O_3$ requires *MH*, 397.2491; *m/z* (CI) 397 (64%, MH^+), 323 (100, $MH^+ - C_4H_9 - OH$) (Found: C, 72.45; H, 8.35; N, 6.9. $C_{24}H_{32}N_2O_3$ requires C, 72.7; H, 8.15; N, 7.05%).

(5*R*)-5-(Hydroxydiphenylmethyl)-3-isopropylimidazolidine-1-carboxylic acid *tert*-butyl ester 7, E = C(OH)Ph_2

In the same way as the imidazolidine (*S*)-**7**, E = $SiMe_3$, the imidazolidine **3**, R = ^{i}Pr (2.0 g, 9.33 mmol), (−)-sparteine (2.84 g, 2.79 mL, 12.13 mmol), *sec*-BuLi (8.60 mL, 11.20 mmol, 1.3 M in cyclohexane) and benzophenone (3.06 g, 14.00 mmol) gave, after purification by column chromatography on silica gel, eluting with petrol–EtOAc (10 : 1), the recovered starting material **3**, R = ^{i}Pr (0.84 g, 42%) and the imidazolidine (*R*)-**7**, E = C(OH)Ph_2 (1.85 g, 50%); $[a]_D^{24}$ −129.7 (*c* 4.58 in $CHCl_3$). Other spectroscopic data as above for (5*RS*)-**7**, E = C(OH)Ph_2. The enantiomer ratio was determined to be 92 : 8 by chiral HPLC using a Gilson 231 XL system fitted with a Chiralpak AD column (250 mm × 4.6 mm id) as the stationary phase with hexane–EtOH (98 : 2) as the mobile phase at a flow rate of 1.0 mL min^{-1}, detection by UV absorbance at 215 nm. Injection volume 20 μL of sample prepared in a 1 mg mL^{-1} solution of EtOH. Under these conditions, the enantiomers were eluted at 6.01 min (major) and 7.82 min (minor). A sample was recrystallised from hexane to give (*R*)-**7**, E = C(OH)Ph_2 as needles; $[a]_D^{26}$ −151.1 (*c* 0.55 in $CHCl_3$) and the enantiomer ratio was determined to be >99 : 1 by chiral HPLC.

(5*RS*)-5-Allyl-3-isopropylimidazolidine-1-carboxylic acid *tert*-butyl ester 7, E = allyl

In the same way as the imidazolidine (*RS*)-**7**, E = $SiMe_3$, the imidazolidine **3**, R = ^{i}Pr (1.0 g, 4.67 mmol), *sec*-BuLi (4.3 mL, 5.6 mmol, 1.3 M in cyclohexane) and allyl bromide (0.59 mL, 7.0 mmol) gave, after purification by column chromatography on silica gel, eluting with petrol–EtOAc (10 : 1), the recovered starting material **3**, R = ^{i}Pr (0.38 g, 38%) and the imidazolidine **7**, E = allyl (0.50 g, 42%) as an oil; R_f 0.43 [petrol–EtOAc (1 : 1)]; ν_{max} (film)/cm^{-1} 1700 (C=O); δ_H(400 MHz, $CDCl_3$, *rotamers*) 5.79–5.68 (1H, m, $CH{=}CH_2$), 5.09–5.02 (2H, m, $CH_2{=}CH$), 4.26–4.20 (0.5H, m, NCH^AH^BN), 4.07–4.03 (0.5H, m, NCH^AH^BN), 3.95–3.74 (2H, m, NCH^AH^BN & NCH_2CHN-Boc), 3.00–2.84 (1H, m, $NCH^AH^BCHNBoc$), 2.70–2.45 (2H, m, $NCH^AH^BCHNBoc$ & $CH_2{=}CHCH^AH^BN$), 2.40–2.34 (1H, m, $NCHMe_2$), 2.30–2.20 (1H, m, $CH_2{=}CHCH^AH^BN$), 1.45 [9H, s, $C(CH_3)_3$], 1.08–1.06 [6H, m, $NCH(CH_3)_2$]; δ_C(100 MHz, $CDCl_3$, *rotamers*) 153.7, 153.4, 134.7, 134.6, 117.3, 79.6, 67.3, 56.0, 55.1, 55.8, 53.2, 38.2, 37.4, 28.5, 21.5; Found (ES): MH^+, 255.2070. $C_{14}H_{27}N_2O_2$ requires *MH*, 255.2072; *m/z* (CI) 255 (19%, MH^+), 197 (100, $M^+ - C_4H_9$) (Found: C, 66.15; H, 10.7; N, 11.05. $C_{14}H_{26}N_2O_2$ requires C, 66.1; H, 10.3; N, 11.0%).

In the same way as the imidazolidine (*S*)-**7**, E = $SiMe_3$, attempted preparation of the imidazolidine (*S*)-**7**, E = allyl gave (*RS*)-**7**, E = allyl as determined by ^{1}H and ^{19}F NMR analysis of the Mosher amide **27**, E = allyl.

(5*RS*)-5-Benzyl-3-isopropylimidazolidine-1-carboxylic acid *tert*-butyl ester 7, E = CH_2Ph

In the same way as the imidazolidine (*RS*)-**7**, E = $SiMe_3$, the imidazolidine **3**, R = ^{i}Pr (1.0 g, 4.67 mmol), *sec*-BuLi (4.3 mL, 5.6 mmol, 1.3 M in cyclohexane) and benzyl bromide (0.83 mL, 7.0 mmol) gave, after purification by column chromatography on silica gel, eluting with petrol–EtOAc (10 : 1), the recovered starting material **3**, R = ^{i}Pr (0.5 g, 50%) and the imidazolidine **7**, E = CH_2Ph (0.58 g, 41%) as an oil; R_f 0.36 [petrol–EtOAc (1 : 1)]; ν_{max} (film)/cm^{-1} 1695 (C=O); δ_H(400 MHz, $CDCl_3$, *rotamers*) 7.30–7.16 (5H, m, Ar–H), 4.14–3.90 (3H, m, NCH_2N & ^{i}PrNCH_2CHBn), 3.33–3.18 (1H, m, CH^AH^BPh), 2.73–2.70 (1H, m, CH^AH^BPh), 2.63–2.59 (2H, m, ^{i}PrNCH_2CH), 2.37–2.34 (1H, m, $NCHMe_2$), 1.50 & 1.47 [9H, s, $C(CH_3)_3$], 1.05 [6H, d, *J* 6.5, $NCH(CH_3)_2$]; δ_C(100 MHz, $CDCl_3$, *rotamers*) 153.6, 153.4, 138.8, 129.5, 129.3, 128.5, 126.3, 125.9, 79.8, 67.3, 58.2, 57.8, 55.6, 54.6, 53.4, 53.1, 40.0, 39.0, 28.5, 21.4; Found (ES): MH^+, 305.2230. $C_{18}H_{29}N_2O_2$ requires *MH*, 305.2229; *m/z* (CI) 305 (9%, MH^+), 247 (100, $M^+ - C_4H_9$) (Found: C, 71.25; H, 9.6; N, 9.0. $C_{18}H_{28}N_2O_2$ requires C, 71.0; H, 9.3; N, 9.2%).

In the same way as the imidazolidine (*S*)-**7**, E = $SiMe_3$, attempted preparation of the imidazolidine (*S*)-**7**, E = CH_2Ph gave (*RS*)-**7**, E = CH_2Ph as determined by chiral HPLC using a Gilson 231 XL system fitted with a Chiralpak AD column (250 mm × 4.6 mm id) as the stationary phase with hexane–EtOH (96 : 4) as the mobile phase at a flow rate of 1.0 mL min^{-1}, detection by UV absorbance at 215 nm. Injection volume 20 μL of sample prepared in a 1 mg mL^{-1} solution of EtOH. Under

these conditions, the enantiomers were eluted at 8.49 min and 8.97 min.

(8*RS*)-6-Isopropyl-1,1-diphenyl-tetrahydroimidazo[1,5-*c*]oxazol-3-one 8

In the same way as the imidazolidine (*RS*)-**7**, E = $SiMe_3$, the imidazolidine **3**, R = ^{i}Pr (1.0 g, 4.67 mmol) in dry THF (25 mL), *sec*-BuLi (4.3 mL, 5.6 mmol, 1.3 M in cyclohexane) and benzophenone (1.28 g, 7.0 mmol) in dry THF (5 mL) gave an intense blue colour which, after purification by column chromatography on silica gel, eluting with CH_2Cl_2–EtOAc (10 : 1), gave the recovered starting material **3**, R = ^{i}Pr (0.29 g, 29%) and the oxazolone **8**, (0.75 g, 50%) as needles; mp 117–120 °C (from EtOAc); R_f 0.34 [CH_2Cl_2–EtOAc (4 : 1)]; ν_{max} (KBr)/cm^{-1} 1755 (C=O); δ_H(400 MHz, $CDCl_3$) 7.51–7.29 (10H, m, Ar–H), 4.81–4.78 (1H, m, ^{i}PrNCH$_2$C*H*), 4.29 (1H, d, *J* 8.0, ^{i}PrNC*H*^{A}H^{B}N), 4.06 (1H, d, *J* 8.0, ^{i}PrNCH^A*H*^{B}N), 2.78–2.75 (1H, m, ^{i}PrNC*H*^{A}H^{B}CH), 2.61–2.55 (1H, m, NC*H*Me$_2$), 2.09–2.05 (1H, m, ^{i}PrNCH^A*H*^{B}CH), 1.02–0.98 [6H, m, NCH(CH_3)$_2$]; δ_C(100 MHz, $CDCl_3$) 160.9, 142.8, 139.8, 128.7, 128.5, 128.4, 128.0, 125.9, 125.2, 86.1, 67.6, 67.4, 52.7, 52.0, 21.6, 21.1; Found (CI): MH$^+$, 323.1760. $C_{20}H_{23}N_2O_2$ requires *MH*, 323.1759; *m*/*z* (CI) 323 (100%, MH$^+$) (Found: C, 74.15; H, 6.9; N, 8.55. $C_{20}H_{22}N_2O_2$ requires C, 74.5; H, 6.9; N, 8.7%).

3-Isopropyl-imidazolidine-1,5,5-tricarboxylic acid 1-*tert*-butyl ester 5,5-diethyl ester 9

To the imidazolidine **3**, R = ^{i}Pr (0.5 g, 2.33 mmol) in dry THF (12 mL) under nitrogen at −78 °C was added *sec*-BuLi (2.15 mL, 2.8 mmol, 1.3 M in cyclohexane) dropwise over a period of 5 min. After 1 h, the mixture was transferred *via* a cannula to a pre-cooled (−78 °C) solution of ethyl chloroformate (0.44 mL, 4.66 mmol) in THF (8 mL) and the mixture was retained at −78 °C for a further 4 h before being allowed to warm to room temperature. Saturated $NaHCO_{3(aq)}$ (5 mL) was added, the mixture was extracted with Et_2O (3 × 30 mL) and the combined extracts were dried (Na_2SO_4), evaporated and purified by column chromatography on silica gel, eluting with petrol–EtOAc (10 : 1), to give recovered starting material **3**, R = ^{i}Pr (0.26 g, 52%) and the imidazolidine **9** (0.28 g, 34%) as an oil; R_f 0.56 [petrol–EtOAc (1 : 1)]; ν_{max} (film)/cm^{-1} 1745 (C=O), 1705 (C=O); δ_H(400 MHz, $CDCl_3$, *rotamers*) 4.29–4.12 [6H, m, (OCH_2CH$_3$)$_2$ & NCH$_2$N], 3.35 & 3.32 (2H, s, NCH_2-CNBoc), 2.51–2.45 [1H, m, NC*H*(CH$_3$)$_2$], 1.44 & 1.38 [9H, s, C(CH$_3$)$_3$], 1.24–1.22 [6H, m, (OCH$_2$CH_3)$_2$], 1.02–1.01 [6H, m, NCH(CH_3)$_2$]; δ_C(100 MHz, $CDCl_3$, *rotamers*) 168.1, 168.0, 152.3, 152.2, 80.8, 80.5, 71.2, 71.0, 67.7, 67.5, 62.0, 61.9, 60.9 & 59.5, 52.2, 28.4, 28.1, 21.2, 14.0, 13.9; Found (ES): MH$^+$, 359.2173. $C_{17}H_{31}N_2O_6$ requires *MH*, 359.2182; *m*/*z* (CI) 359 (15%, MH$^+$), 303 (93, MH$^+$ − C_4H_8), 258 (100, M$^+$ − C_3H_7 − C_4H_9) (Found: C, 57.0; H, 8.55; N, 7.8. $C_{17}H_{30}N_2O_6$ requires C, 56.95; H, 8.45; N, 7.8%).

(5*RS*)-5-(Hydroxydiphenylmethyl)-3-methylimidazolidine-1-carboxylic acid *tert*-butyl ester 10

In the same way as the imidazolidine (*RS*)-**7**, E = C(OH)Ph$_2$, the imidazolidine **3**, R = Me (0.5 g, 2.68 mmol) in dry Et_2O (13 mL), *sec*-BuLi (2.5 mL, 3.22 mmol, 1.3 M in cyclohexane) and benzophenone (730 mg, 4.03 mmol) in Et_2O (3 mL) gave, after purification by column chromatography on silica gel, eluting with petrol–EtOAc (5 : 1), the recovered starting material **3**, R = Me (0.25 g, 51%) and the imidazolidine **10**, (0.35 g, 35%) as cubes; mp 123–126 °C (from hexane); R_f 0.28 [petrol–EtOAc (1 : 1)]; ν_{max} (KBr)/cm^{-1} 3360 (O–H), 1695 (C=O); δ_H(400 MHz, $CDCl_3$, 60 °C, *rotamers*) 7.60–7.58 (2H, m, Ar–H), 7.43–7.34 (4H, m, Ar–H), 7.26–7.19 (4H, m, Ar–H), 4.88–4.86 (1H, m, BocNC*H*CH$_2$), 4.35–4.32 (1H, m, NC*H*^{A}H^{B}N), 3.75–3.74 (1H, m, NCH^A*H*^{B}N), 3.06–3.04 (1H, m, BocNCHC*H*^{A}H^B), 2.71–2.67 (1H, m, BocNCHCH^A*H*^{B}), 2.35 (3H, s, N–CH$_3$), 1.19 [9H, s, C(CH$_3$)$_3$]; δ_C(100 MHz, $CDCl_3$, 60 °C, *rotamers*) 154.0, 146.0, 145.1, 128.7, 127.9, 127.6, 127.4, 127.3, 127.1, 126.8, 126.4, 126.2, 125.4, 80.6, 80.1, 70.6, 58.0, 55.8, 38.9, 27.9; Found (ES): MH$^+$, 369.2177. $C_{22}H_{29}N_2O_3$ requires *MH*, 369.2178; *m*/*z* (CI) 369 (100%, MH$^+$) (Found: C, 71.4; H, 7.95; N, 7.5. $C_{22}H_{28}N_2O_3$ requires C, 71.7; H, 7.65; N, 7.6%).

(5*R*)-5-(Hydroxydiphenylmethyl)-3-methylimidazolidine-1-carboxylic acid *tert*-butyl ester 10

In the same way as the imidazolidine (*S*)-**7**, E = $SiMe_3$, the imidazolidine **3**, R = Me (0.5 g, 2.68 mmol), (−)-sparteine (0.82 g, 0.81 mL, 3.49 mmol), *sec*-BuLi (2.50 mL, 3.22 mmol, 1.3 M in cyclohexane) and benzophenone (730 mg, 4.03 mmol) gave, after purification by column chromatography on silica gel, eluting with petrol–EtOAc (5 : 1), the recovered starting material **3**, R = Me (0.21 g, 42%) and the imidazolidine (*R*)-**10** (0.4 g, 40%); $[\alpha]_D^{24}$ −112.1 (*c* 0.78 in $CHCl_3$). Other spectroscopic data as above for (5*RS*)-**10**. The enantiomer ratio was determined to be 93 : 7 by chiral HPLC using a Thermo Separation Products Spectra Series AS300 system fitted with a Chiralcel OD column (250 mm × 4.6 mm id) as the stationary phase with hexane–^{i}PrOH (99.5 : 0.5) as the mobile phase at a flow rate of 1.0 mL min^{-1}, detection by UV absorbance at 234 nm. Injection volume 20 μL of sample prepared in a 1 mg mL^{-1} solution of hexane. Under these conditions, the enantiomers were eluted at 14.76 min (minor) and 16.81 min (major).

[(1-Methyl-1-phenylethylcarbamoyl)methyl]carbamic acid *tert*-butyl ester 12

To *N*-Boc glycine (8.54 g, 48.77 mmol) in $CHCl_3$ (200 mL) under nitrogen was added DCC (10.06 g, 48.77 mmol) and HOBT (6.59 g, 48.77 mmol). The suspension was stirred for 10 min, and then cumylamine (7.00 mL, 48.77 mmol) was added. After 18 h, the solvent was removed *in vacuo*, EtOAc (250 mL) was added and the mixture was stirred for 10 min. The solids were removed by filtration and the mixture was washed with 10% aqueous citric acid solution (100 mL) and 10% $NaHCO_{3(aq)}$ (100 mL). The organic layer was dried (Na_2SO_4), evaporated and purified by column chromatography on silica gel, eluting with CH_2Cl_2–MeOH–NH_3 (20 : 1 : 0.1), to give the amide **12** (14.12 g, 99%) as an oil; R_f 0.64 [CH_2Cl_2–MeOH–NH_3 (10 : 1 : 0.1)]; ν_{max} (film)/cm^{-1} 3320 (N–H), 1670 (C=O); δ_H(400 MHz, $CDCl_3$, *rotamers*) 7.37–7.28 (4H, m, Ar–H), 7.22–7.19 (1H, m, Ar–H), 6.78 (1H, br s, N–H), 5.50 (1H, br s, N–H), 3.70 & 3.68 (2H, s, CH_2), 1.66 [6H, s, CPh(CH_3)$_2$], 1.45 [9H, s, C(CH$_3$)$_3$]; δ_C(100 MHz, $CDCl_3$, *rotamers*) 168.6, 156.4, 146.7, 128.4, 126.7, 126.6, 124.8, 124.7, 80.0, 55.9, 49.0, 29.1, 28.3; Found (ES): MH$^+$, 293.1865. $C_{16}H_{25}N_2O_3$ requires *MH*, 293.1865; *m*/*z* (CI) 293 (100%, MH$^+$) (Found: C, 65.8; H, 8.05; N, 9.5. $C_{16}H_{24}N_2O_3$ requires C, 65.7; H, 8.25; N, 9.6%).

[2-(1-Methyl-1-phenylethylamino)ethyl]carbamic acid *tert*-butyl ester 13

To the amide **12** (7.0 g, 23.9 mmol) in THF (70 mL) under nitrogen at −78 °C was added borane tetrahydrofuran complex (48 mL, 47.8 mmol, 1.0 M in THF). The solution was stirred at −78 °C for 3 h and then at room temperature for 18 h. Methanol (30 mL) was added and the mixture was stirred at room temperature for a further 18 h. Concentration of the mixture *in vacuo* gave an oil. The oil was treated with MeOH (3 × 40 mL) with evaporation to dryness after each addition to remove boric acid as trimethyl borate. Purification by column chromatography on silica gel, eluting with petrol–EtOAc (1 : 1), gave the recovered starting material **12** (2.7 g, 39%) and the carbamate **13** (3.5 g, 52%) as an oil; R_f 0.10 (EtOAc); ν_{max} (film)/cm^{-1} 3345 (N–H), 1705 (C=O); δ_H(400 MHz, $CDCl_3$) 7.43–7.41 (2H, m, Ar–H), 7.33–7.29 (2H, m, Ar–H), 7.26–7.20 (1H, m,

Ar–H), 4.94 (1H, br s, N–H), 3.12–3.11 (2H, m, BocNCH_2-CH_2), 2.44–2.41 (2H, m, BocNCH$_2$CH_2), 1.44 [15H, br s, C(CH$_3$)$_3$ & CPh(CH$_3$)$_2$]; δ_C(100 MHz, CDCl$_3$) 156.1, 147.6, 128.2, 126.3, 125.7, 79.0, 55.6, 42.7, 41.3, 29.6, 28.4; Found (ES): MH$^+$, 279.2073. $C_{16}H_{27}N_2O_2$ requires *MH*, 279.2072; *m*/*z* (CI) 279 (3%, MH$^+$), 119 (100, $^+$CMe$_2$Ph) (Found C, 69.2; H, 9.35; N, 10.25. $C_{16}H_{26}N_2O_2$ requires C, 69.05; H, 9.4; N, 10.05%).

3-(1-Methyl-1-phenylethyl)imidazolidine-1-carboxylic acid *tert*-butyl ester 14

The carbamate **13** (3.0 g, 10.78 mmol) was added to a suspension of paraformaldehyde (0.32 g, 10.78 mmol), K_2CO_3 (5.0 g, 36.18 mmol) and $MgSO_4$ (5.0 g, 41.54 mmol) in $CHCl_3$ (35 mL) under nitrogen in a sealed tube. After 24 h at 90 °C, the mixture was filtered, evaporated, added to saturated brine and extracted with CH_2Cl_2 (3 × 40 mL). The combined organic extracts were dried (Na_2SO_4), evaporated and purified by column chromatography on silica gel, eluting with petrol–EtOAc (4 : 1), to give the imidazolidine **14** (2.66 g, 85%) as needles; mp 76.0–78.0 °C (from hexane–EtOAc); R_f 0.29 [petrol–EtOAc (4 : 1)]; ν_{max} (KBr)/cm^{-1} 1690 (C=O); δ_H(400 MHz, CDCl$_3$, *rotamers*) 7.53–7.50 (2H, m, Ar–H), 7.35 (2H, m, Ar–H), 7.24–7.22 (1H, m, Ar–H), 4.05 & 4.00 (2H, s, NCH$_2$N), 3.41–3.33 (2H, m, NCH$_2$-CH_2NBoc), 2.75–2.71 (2H, m, NCH_2CH$_2$NBoc), 1.44 [15H, s, CPh(CH$_3$)$_2$ & C(CH$_3$)$_3$]; δ_C(100 MHz, CDCl$_3$, *rotamers*) 153.6, 146.9, 146.5, 128.1, 126.6, 126.0, 125.9, 79.5, 79.4, 61.6, 57.1, 57.0, 45.5, 44.9, 44.8, 44.4, 28.5, 24.6, 24.5; Found (ES): MH$^+$, 291.2076. $C_{17}H_{27}N_2O_2$ requires *MH*, 291.2072; *m*/*z* (CI) 291 (5%, MH$^+$), 119 (100, $^+$CMe$_2$Ph).

(5*RS*)-5-Methyl-3-(1-methyl-1-phenylethyl)imidazolidine-1-carboxylic acid *tert*-butyl ester 15

In the same way as the imidazolidine (*RS*)-**7**, E = SiMe$_3$, the imidazolidine **14** (100 mg, 0.34 mmol) in dry THF (1.7 mL) and *sec*-BuLi (0.31 mL, 0.41 mmol, 1.3 M in cyclohexane), followed after 6 h by Me_2SO_4 (0.05 mL, 0.51 mmol) gave, after purification by column chromatography on silica gel, eluting with petrol–EtOAc (10 : 1), the recovered starting material **14** (50 mg, 50%) and the imidazolidine **15** (50 mg, 48%) as an oil; R_f 0.35 [petrol–EtOAc (10 : 1)]; ν_{max} (film)/cm^{-1} 1700 (C=O); δ_H(400 MHz, CDCl$_3$, *rotamers*) 7.53–7.51 (2H, m, Ar–H), 7.33–7.30 (2H, m, Ar–H), 7.26–7.22 (1H, m, Ar–H), 4.10–3.88 (2H, m, NCH$_2$N), 3.79–3.71 (1H, m, BocNCHCH$_2$), 2.85–2.81 (1H, m, BocNCHCH^AH^B), 2.41–2.38 (1H, m, BocNCHCH^AH^B), 1.49 [9H, s, C(CH$_3$)$_3$], 1.42 [6H, s, C(CH_3)$_2$Ph], 1.26–1.22 (3H, m, CH_3CHNBoc); δ_C(100 MHz, CDCl$_3$, *rotamers*) 153.7, 147.1, 128.1, 126.5, 126.0, 79.3, 62.1, 56.7, 52.7, 52.1, 28.5, 25.0, 24.9, 24.0, 23.9, 19.8, 19.3; Found (ES): MH$^+$, 305.2231. $C_{18}H_{29}N_2O_2$ requires *MH*, 305.2229; *m*/*z* (CI) 305 (3%, MH$^+$), 119 (100, $^+$CMe$_2$Ph).

(1*S*)-(2-Isopropylamino-1-trimethylsilylethyl)carbamic acid *tert*-butyl ester 17

To the imidazolidine (*S*)-**7**, E = SiMe$_3$ (500 mg, 1.12 mmol) in EtOH (15 mL) under nitrogen was added pyridine (0.42 mL, 5.25 mmol) and malonic acid (734 mg, 7.00 mmol) and the mixture was heated under reflux. After 2 h, the mixture was cooled, evaporated and the remainder of the pyridine was removed by azeotroping with toluene. Water (10 mL) was added and the mixture was basified to ~ pH 14 with 2 M NaOH(aq) (10 mL). The mixture was extracted with CH_2Cl_2 (3 × 50 mL) and the combined CH_2Cl_2 extracts were dried (Na_2SO_4), evaporated and purified by column chromatography on silica gel, eluting with petrol–EtOAc (1 : 1), to give the carbamate **17** (408 mg, 85%) as an oil; R_f 0.36 [CH_2Cl_2–MeOH–NH$_3$ (10 : 1 : 0.1)]; $[\alpha]_D^{25}$ +20.5 (*c* 1.05 in CHCl$_3$); ν_{max} (film)/cm^{-1} 1685 (C=O); δ_H(400 MHz, CDCl$_3$) 4.43 (1H, br s, N–H), 3.24–3.19 (1H, m, CH$_2$CHSiMe$_3$), 2.81–2.75 (2H, m, NCH_2CHSiMe$_3$), 2.63–2.57 (1H, m, NCHMe$_2$), 1.44 [9H, s, C(CH$_3$)$_3$], 1.04–1.00 [6H, m, NCH(CH_3)$_2$], 0.06 [9H, s, Si(CH$_3$)$_3$]; δ_C(100 MHz, CDCl$_3$) 156.6, 79.0, 48.6, 48.1, 41.5, 28.4, 23.1, 22.7, −3.1; Found (ES): MH$^+$, 275.2152. $C_{13}H_{31}N_2O_2Si$ requires *MH*, 275.2155; *m*/*z* (CI) 275 (100%, MH$^+$), 219 (74, MH$^+$ − C_4H_8) (Found: C, 57.05; H, 11.1; N, 9.85. $C_{13}H_{30}N_2O_2Si$ requires C, 56.9; H, 11.0; N, 10.2%).

(*S*)-[2-Isopropylamino-1-(methyldiphenylsilyl)ethyl]carbamic acid *tert*-butyl ester 18

In the same way as the carbamate **17**, the imidazolidine (*S*)-**7**, E = SiMePh$_2$ (0.5 g, 1.22 mmol), pyridine (0.30 mL, 3.66 mmol) and malonic acid (507 mg, 4.88 mmol), gave after purification by column chromatography on silica gel, eluting with petrol–EtOAc (1 : 1), the carbamate **18** (326 mg, 67%) as an oil; R_f 0.23 [CH_2Cl_2–MeOH–NH$_3$ (10 : 1 : 0.1)]; $[\alpha]_D^{25}$ +18.6 (*c* 1.14 in CHCl$_3$); ν_{max} (film)/cm^{-1} 1695 (C=O); δ_H(400 MHz, CDCl$_3$) 7.60–7.56 (4H, m, Ar–H), 7.39–7.35 (6H, m, Ar–H), 4.46 (1H, br s, N–H), 4.10–3.87 (1H, m, NCH$_2$CHN), 2.90–2.86 (1H, m, NCH^AH^{B}CHN), 2.77–2.71 (1H, m NCHMe$_2$), 2.67–2.62 (1H, m, NCH^AH^BCHN), 1.41 [9H, s, C(CH$_3$)$_3$], 0.97 [3H, d, *J* 6.5, NCH(CH_3)^A(CH$_3$)^B], 0.91 [3H, d, *J* 6.5, NCH(CH$_3$)^A-(CH_3)^B], 0.65 (3H, s, SiCH$_3$); δ_C(100 MHz, CDCl$_3$) 156.4, 135.0, 134.9, 134.6, 134.5, 129.7, 128.0, 79.2, 48.9, 47.8, 39.6, 28.3, 23.1, 22.5, −5.1; Found (CI): MH$^+$, 399.2474. $C_{23}H_{35}N_2O_2Si$ requires *MH*, 399.2468; *m*/*z* (CI) 399 (100%, MH$^+$), 343 (72, MH$^+$ − C_4H_8).

(*S*)-(2-Isopropylamino-1-methylethyl)carbamic acid *tert*-butyl ester 19

In the same way as the carbamate **17**, the imidazolidine (*S*)-**7**, E = Me (0.5 g, 2.19 mmol), pyridine (0.53 mL, 6.57 mmol) and malonic acid (910 mg, 8.76 mmol), gave after purification by column chromatography on silica gel, eluting with petrol–EtOAc (1 : 1), the carbamate **19** (450 mg, 95%) as an oil; R_f 0.32 [CH_2Cl_2–MeOH–NH$_3$ (10 : 1 : 0.1)]; $[\alpha]_D^{24}$ +26.7 (*c* 0.98 in CHCl$_3$); ν_{max} (film)/cm^{-1} 3340 (N–H), 1700 (C=O); δ_H(400 MHz, CDCl$_3$) 4.75 (1H, br s, N–H), 3.67–3.62 (1H, m, NCH$_2$-CHMe), 2.76–2.70 (1H, m, NCHMe$_2$), 2.60–2.50 (2H, m, NCH_2CHMe), 1.39 [9H, s, C(CH$_3$)$_3$], 1.07 (3H, d, *J* 6.5, NCH$_2$-CHCH_3), 0.98 [6H, d, *J* 6.5, NCH(CH_3)$_2$]; δ_C(100 MHz, CDCl$_3$) 155.7, 78.9, 52.4, 48.5, 46.3, 28.4, 22.9, 19.1; Found (ES): MNa$^+$, 239.1728. $C_{11}H_{24}N_2NaO_2$ requires *MNa*, 239.1735; *m*/*z* (CI) 217 (42%, MH$^+$), 160 (100, MH$^+$ − C_4H_9) (Found: C, 61.3; H, 11.55; N, 12.6. $C_{11}H_{24}N_2O_2$ requires C, 61.1; H, 11.2; N, 12.9%).

(*R*)-(2-Isopropylamino-1-phenylcarbamoylethyl)carbamic acid *tert*-butyl ester 20

In the same way as the carbamate **17**, the imidazolidine (*R*)-**7**, E = CONHPh (0.4 g, 1.2 mmol), pyridine (0.29 mL, 3.6 mmol) and malonic acid (500 mg, 4.8 mmol), gave after purification by column chromatography on silica gel, eluting with petrol–EtOAc (1 : 1), the carbamate **20** (317 mg, 82%) as an oil; R_f 0.37 [CH_2Cl_2–MeOH–NH$_3$ (10 : 1 : 0.1)]; $[\alpha]_D^{23}$ −2.1 (*c* 1.01 in CHCl$_3$); ν_{max} (film)/cm^{-1} 3305 (N–H), 1675 (C=O); δ_H(400 MHz, CDCl$_3$) 10.50 (1H, br s, N–H), 7.52–7.49 (2H, m, Ar–H), 7.32–7.28 (2H, m, Ar–H), 7.10–7.06 (1H, m, Ar–H), 5.79 (1H, br s, N–H), 4.13–4.08 (1H, m, NCH$_2$CHN), 3.29–3.26 (1H, m, NCH^AH^{B}CHN), 2.91–2.85 (1H, m, NCHMe$_2$), 2.69–2.63 (1H, m, NCH^AH^BCHN), 1.47 [9H, s, C(CH$_3$)$_3$], 1.16–1.11 [6H, m, NCH(CH_3)$_2$]; δ_C(100 MHz, CDCl$_3$, *rotamers*) 169.5, 156.0, 138.1, 129.0, 124.0, 119.7, 119.6, 80.0, 53.5, 52.5, 48.9, 48.7, 28.3, 23.2, 22.8; Found (ES): MH$^+$, 322.2127. $C_{17}H_{28}N_3O_3$ requires *MH*, 322.2130; *m*/*z* (CI) 322 (100%, MH$^+$) (Found: C, 63.6; H, 8.6; N, 13.0. $C_{17}H_{27}N_3O_3$ requires C, 63.55; H, 8.5; N, 13.05%).

(*RS*)-[1-(Isopropylaminomethyl)but-3-enyl]carbamic acid *tert*-butyl ester 21

In the same way as the carbamate **17**, the imidazolidine (*RS*)-**7**, E = allyl (0.4 g, 1.57 mmol), pyridine (0.38 mL, 4.72 mmol) and malonic acid (660 mg, 6.29 mmol), gave after purification by column chromatography on silica gel, eluting with petrol–EtOAc (1 : 1), the carbamate **21** (370 mg, 96%) as an oil; R_f 0.34 [CH_2Cl_2–MeOH–NH_3 (10 : 1 : 0.1)]; ν_{max} (film)/cm^{-1} 3340 (N–H), 1700 (C=O); δ_H(400 MHz, $CDCl_3$) 5.79–5.72 (1H, m, H_2C=C*H*), 5.08–5.01 (2H, m, H_2C=CH), 4.70 (1H, br s, N–H), 3.68–3.60 (1H, m, NCH_2CH), 2.77–2.70 (1H, m, NC*H*Me_2), 2.65–2.56 (2H, m, NCH_2CH), 2.24–2.21 (2H, m, H_2C=CHCH_2), 1.41 [9H, s, $C(CH_3)_3$], 1.00 [6H, d, *J* 6.0, $NCH(CH_3)_2$]; δ_C(100 MHz, $CDCl_3$) 155.7, 134.6, 117.4, 79.0, 50.0, 48.5, 37.6, 28.4, 23.1, 23.0; Found (ES): MH^+, 243.2067. $C_{13}H_{27}N_2O_2$ requires *MH*, 243.2072; *m*/*z* (CI) 243 (86%, MH^+), 187 (100, $MH^+ - C_4H_8$) (Found: C, 64.65; H, 11.15; N, 11.45. $C_{13}H_{26}N_2O_2$ requires C, 64.45; H, 10.8; N, 11.55%).

(*S*)-N^2-Isopropyl-1-trimethylsilylethane-1,2-diamine 22

To a solution of the carbamate **17** (200 mg, 0.73 mmol) in CH_2Cl_2 (10 mL) at room temperature was added TFA (1.1 mL, 14.58 mmol). After 3 h, water (10 mL) was added and the mixture was basified to ~ pH 14 with 2 M NaOH(aq) (10 mL). The mixture was extracted with CH_2Cl_2 (3 × 30 mL), the combined organic extracts were dried (Na_2SO_4), evaporated and purified by column chromatography on silica gel, eluting with CH_2Cl_2–MeOH–NH_3 (10 : 1 : 0.1), to give the diamine **22** (117 mg, 92%) as an oil; R_f 0.06 [CH_2Cl_2–MeOH–NH_3 (10 : 1 : 0.1)]; $[\alpha]_D^{26}$ +22.6 (*c* 0.46 in $CHCl_3$); ν_{max} (film)/cm^{-1} 3410 (N–H); δ_H(400 MHz, $CDCl_3$) 2.81–2.75 (2H, m, NC*H*Me_2 & NC*H*^{A}H^{B}CHSi), 2.48–2.42 (1H, m, NCH^{A}C*H*^{B}CHSi), 2.28–2.24 (1H, m, NCH_2C*H*$SiMe_3$), 1.54 (3H, br s, N–H), 1.06–1.04 [6H, m, $NCH(CH_3)_2$], 0.05 [9H, s, $Si(CH_3)_3$]; δ_C(100 MHz, $CDCl_3$) 50.8, 48.6, 41.9, 23.2, 22.9, 3.7; Found (ES): MH^+, 175.1631. $C_8H_{23}N_2Si$ requires *MH*, 175.1630; *m*/*z* (CI) 175 (82%, MH^+), 116 (100, $M^+ - NCHMe_2$).

(*S*)-N^2-Isopropyl-1-(methyldiphenylsilyl)ethane-1,2-diamine 23

In the same was as the diamine **22**, the carbamate **18** (460 mg, 1.16 mmol) and TFA (1.7 mL, 23.12 mmol) gave, after purification by column chromatography on silica gel, eluting with CH_2Cl_2–MeOH–NH_3 (10 : 1 : 0.1), the diamine **23** (343 mg, 99%) as an oil; R_f 0.11 [CH_2Cl_2–MeOH–NH_3 (10 : 1 : 0.1)]; $[\alpha]_D^{26}$ +22.5 (*c* 0.53 in $CHCl_3$); ν_{max} (film)/cm^{-1} 2965 (C–H); δ_H(400 MHz, $CDCl_3$) 7.62–7.58 (4H, m, Ar–H), 7.39–7.36 (6H, m, Ar–H), 2.95 (1H, dd, *J* 11.0, 3.0, NCH_2C*H*N), 2.86 (1H, dd, *J* 12.0, 3.0, NC*H*^{A}H^{B}CHN), 2.77–2.70 (1H, m, NC*H*Me_2), 2.57 (1H, dd, *J* 12.0, 11.0, NCH^A*H*^{B}CHN), 1.45 (3H, br s, N–H), 1.02–0.96 [6H, m, $NCH(CH_3)_2$], 0.64 (3H, s, $SiCH_3$); δ_C(100 MHz, $CDCl_3$) 135.3, 135.2, 135.0, 134.9, 129.5, 129.4 & 128.0, 50.8, 48.5, 40.5, 23.1, 22.8, −6.4; Found (CI): MH^+, 299.1946. $C_{18}H_{27}N_2Si$ requires *MH*, 299.1943; *m*/*z* (CI) 299 (100%, MH^+).

(*S*)-N^1-Isopropylpropane-1,2-diamine 24

In the same was as the diamine **22**, the carbamate **19** (175 mg, 0.81 mmol) and TFA (1.2 mL, 16.18 mmol) gave, after purification by column chromatography on silica gel, eluting with CH_2Cl_2–MeOH–NH_3 (10 : 1 : 0.1), the diamine **24** (65 mg, 69%) as an oil; R_f 0.01 [CH_2Cl_2–MeOH–NH_3 (10 : 1 : 0.1)]; $[\alpha]_D^{24}$ +40.0 (*c* 0.11 in $CHCl_3$); ν_{max} (film)/cm^{-1} 3420 (N–H); δ_H(400 MHz, $CDCl_3$) 2.96–2.91 (1H, m, NC*H*Me_2), 2.80–2.74 (1H, m, NCH_2C*H*Me), 2.60 (1H, dd, *J* 11.5, 4.5, NC*H*^{A}H^{B}CHMe), 2.32 (1H, dd, *J* 11.5, 4.5, NCH^A*H*^{B}CHMe), 1.59 (3H, br s, N–H), 1.07–1.04 [9H, m, $NCH(CH_3)_2$ & NCH_2CHCH_3]; δ_C(100 MHz, $CDCl_3$) 55.8, 48.8, 47.0, 23.1, 23.0, 22.2; Found (ES): MH^+, 117.1392. $C_6H_{17}N_2$ requires *MH*, 117.1391; *m*/*z* (CI) 117 (100%, MH^+).

(*R*)-2-Amino-3-isopropylamino-*N*-phenylpropionamide 25

In the same was as the diamine **22**, the carbamate **20** (300 mg, 0.93 mmol) and TFA (1.4 mL, 18.36 mmol) gave, after purification by column chromatography on silica gel, eluting with CH_2Cl_2–MeOH–NH_3 (10 : 1 : 0.1), the diamine **25** (184 mg, 89%) as an oil; R_f 0.1 [CH_2Cl_2–MeOH–NH_3 (10 : 1 : 0.1)]; $[\alpha]_D^{26}$ +16.9 (*c* 1.36 in $CHCl_3$); ν_{max} (film)/cm^{-1} 3290 (N–H), 1675 (C=O); δ_H(400 MHz, $CDCl_3$) 10.20 (1H, br s, NHC=O), 7.58–7.57 (2H, m, Ar–H), 7.54–7.27 (2H, m, Ar–H), 7.08–7.04 (1H, m, Ar–H), 3.43–3.40 (1H, m, NCH_2C*H*N), 2.96–2.91 (1H, m, NC*H*^{A}H^{B}CHN), 2.81–2.76 (2H, m, NCH^A*H*^{B}CHN & NC*H*Me_2), 1.78 (3H, br s, N–H), 1.06 [6H, d, *J* 6.0, NCH-$(CH_3)_2$]; δ_C(100 MHz, $CDCl_3$) 172.6, 138.1, 128.8, 123.9, 119.4, 54.8, 50.5, 48.8, 23.1; Found (ES): MH^+, 1222.1606. $C_{12}H_{20}N_3O$ requires *MH*, 222.1606; *m*/*z* (CI) 222 (100%, MH^+).

(*RS*)-N^1-Isopropylpent-4-ene-1,2-diamine 26

In the same was as the diamine **22**, the carbamate **21** (528 mg, 2.18 mmol) and TFA (3.3 mL, 43.58 mmol) gave, after purification by column chromatography on silica gel, eluting with CH_2Cl_2–MeOH–NH_3 (10 : 1 : 0.1), the diamine **26** (269 mg, 87%) as an oil; R_f 0.08 [CH_2Cl_2–MeOH–NH_3 (10 : 1 : 0.1)]; ν_{max} (film)/cm^{-1} 3330 (N–H); δ_H(400 MHz, $CDCl_3$) 5.78–5.72 (1H, m, H_2C=C*H*), 5.08–5.02 (2H, m, H_2C=CH), 2.82–2.79 (1H, m, NCH_2C*H*), 2.75–2.69 (1H, m, NC*H*Me_2), 2.63 (1H, dd, *J* 11.5, 4.0, NC*H*^{A}H^{B}CH), 2.33 (1H, dd, *J* 11.5, 8.5, NCH^A*H*^{B}CH), 2.18–2.15 (1H, m, H_2C=CHC*H*^{A}H^B), 1.99–1.95 (1H, m, H_2C=CHCH^A*H*^{B}), 1.30 (3H, br s, N–H), 1.01 [6H, d, *J* 4.5, $NCH(CH_3)_2$]; δ_C(100 MHz, $CDCl_3$) 135.5, 117.2, 53.8, 50.8, 48.8, 41.0, 23.1, 23.0; Found (ES): MH^+, 143.1548. $C_8H_{19}N_2$ requires *MH*, 143.1548; *m*/*z* (CI) 143 (100%, MH^+).

(1*S*,2*R*)-3,3,3-Trifluoro-*N*-(2-isopropylamino-1-trimethylsilylethyl)-2-methoxy-2-phenylpropionamide 27, E = $SiMe_3$

To Mosher's acid chloride [(*S*)-(−)-MTPA-Cl] (108 mg, 0.43 mmol) and Et_3N (0.079 mL, 0.57 mmol) in dry CH_2Cl_2 (2 mL) under nitrogen at −50 °C was added the diamine (*S*)-**22** (51 mg, 0.29 mmol). After 2 h, the mixture was warmed to room temperature and after 18 h, saturated $NaHCO_{3(aq)}$ (25 mL) was added. The mixture was extracted with CH_2Cl_2 (3 × 25 mL), the combined organic extracts were dried (Na_2SO_4), evaporated and purified by column chromatography on silica gel, eluting with petrol–EtOAc (1 : 1), to give the amide (1*S*,2*R*)-**27**, E = $SiMe_3$ (105 mg, 93%) as an oil, as an inseparable mixture of diastereomers (for diastereomer ratio measurements, the NMR spectra and GCMS were taken on the crude reaction mixture); R_f 0.41 [CH_2Cl_2–MeOH–NH_3 (10 : 1 : 0.1)]; ν_{max} (film)/cm^{-1} 3405 (N–H), 1685 (C=O); δ_H(400 MHz, $CDCl_3$) 7.61–7.55 (2H, m, Ar–H), 7.41–7.38 (3H, m, Ar–H), 6.81 (1H, br s, N–H), 3.65–3.57 (1H, m, NCH_2C*H*$SiMe_3$), 3.47 (2.8H, s, OCH_3), 3.39 (0.2H, s, OCH_3), 2.84–2.69 (3H, m, NCH_2-$CHSiMe_3$ & NC*H*Me_2), 1.45 (1H, br s, N–H), 1.03–0.95 [6H, m, $NCH(CH_3)_2$], 0.10 [8.5H, s, $Si(CH_3)_3$], 0.03 [0.5H, s, $Si(CH_3)_3$]; δ_C(100 MHz, $CDCl_3$) 166.0, 133.0, 132.9, 129.3, 128.5, 128.4, 127.9, 127.5, 84.9, 84.7, 55.0, 54.9, 48.1, 48.0, 47.8, 40.9, 40.8, 23.2, 22.6, −2.8, −3.0; δ_F(376 MHz, $CDCl_3$) 95.6 (minor CF_3) & 95.4 (major CF_3); Found (ES): MH^+, 391.2028. $C_{18}H_{30}F_3N_2O_2Si$ requires *MH*, 391.2028; *m*/*z* (CI) 391 (100%, MH^+). The diastereomer ratio of **27**, E = $SiMe_3$ was determined to be 93 : 7 by ^{1}H and ^{19}F NMR and GCMS analysis.

(1*S*,2*R*)-3,3,3-Trifluoro-*N*-[2-isopropylamino-1-(methyldiphenylsilyl)ethyl]-2-methoxy-2-phenylpropionamide 27, E = $SiMePh_2$

In the same way as amide **27**, E = $SiMe_3$, the diamine (*S*)-**23** (85 mg, 0.29 mmol), (*S*)-(−)-MTPA-Cl (108 mg, 0.43 mmol) and Et_3N (0.079 mL, 0.57 mmol), gave the Mosher amide (1*S*,2*R*)-**27**, E = $SiMePh_2$ (138 mg, 93%) as an oil; R_f 0.47

[CH_2Cl_2–MeOH–NH_3 (10 : 1 : 0.1)]; ν_{max} (film)/cm^{-1} 3400 (N–H), 1685 (C=O); δ_H(400 MHz, $CDCl_3$) 7.57–7.15 (15H, m, Ar–H), 4.37–4.30 (1H, m, NCH_2CHN), 3.15 (0.2H, s, OCH_3), 3.14 (2.8H, s, OCH_3), 2.93–2.82 (3H, m, NCH_2CHN & $NCHMe_2$), 1.13–0.97 [6H, m, $NCH(CH_3)_2$], 0.72 (2.8H, s, $SiCH_3$), 0.70 (0.2H, s, $SiCH_3$); δ_C(100 MHz, $CDCl_3$) 170.7, 167.1, 135.0, 134.9, 134.8, 134.0, 132.5, 130.2, 130.1, 129.4, 128.6, 128.5, 128.4, 128.3, 128.2, 127.8, 127.7, 126.5, 84.1, 83.9, 54.8, 48.3, 48.0, 47.4, 37.9, 21.7, 20.7, −5.4; δ_F(376 MHz, $CDCl_3$) 93.5 (major CF_3) & 92.7 (minor CF_3); Found (ES): MH^+, 515.2345. $C_{28}H_{34}F_3N_2O_2Si$ requires *MH*, 515.2341; *m*/*z* (CI) 515 (100%, MH^+). The diastereomer ratio of **27**, E = $SiMePh_2$ was determined to be 94 : 6 by ^1H and ^{19}F NMR and GCMS analysis.

(1*S*,2*R*)-3,3,3-Trifluoro-*N*-(2-isopropylamino-1-methylethyl)-2-methoxy-2-phenylpropionamide 27, E = Me

In the same way as amide **27**, E = $SiMe_3$, the diamine (*S*)-**24** (33 mg, 0.29 mmol), (*S*)-(−)-MTPA-Cl (108 mg, 0.43 mmol) and Et_3N (0.079 mL, 0.57 mmol), gave the Mosher amide (1*S*,2*R*)-**27**, E = Me (138 mg, 93%) as an oil; R_f 0.22 [CH_2Cl_2–MeOH–NH_3 (10 : 1 : 0.1)]; ν_{max} (film)/cm^{-1} 3325 (N–H), 1685 (C=O); δ_H(400 MHz, $CDCl_3$) 7.57–7.54 (2H, m, Ar–H), 7.40–7.36 (3H, m, Ar–H), 7.10 (1H, br s, N–H), 4.14–4.10 (1H, m, NCH_2CH), 3.43 (0.2H, s, OCH_3), 3.42 (2.8H, s, OCH_3), 2.82–2.80 (1H, m, $NCHMe_2$), 2.73–2.67 (2H, m, NCH_2CH), 2.37 (1H, br s, N–H), 1.26–1.15 (3H, m, NCH_2CHCH_3), 1.06–0.95 [6H, m, $NCH(CH_3)_2$]; δ_C(100 MHz, $CDCl_3$) 166.0, 165.9, 132.9, 132.8, 129.4, 128.5, 127.6, 125.3, 122.4, 84.4, 84.3, 55.0, 54.9, 51.3, 48.6, 48.5, 45.1, 45.0, 22.8, 22.7, 22.6, 22.5, 18.5, 18.4; δ_F(376 MHz, $CDCl_3$) 95.2 (minor CF_3) & 95.0 (major CF_3); Found (ES): MH^+, 333.1789. $C_{16}H_{24}F_3N_2O_2$ requires *MH*, 333.1790; *m*/*z* (CI) 333 (100%, MH^+). The diastereomer ratio of **27**, E = Me was determined to be 92 : 8 by ^1H and ^{19}F NMR and GCMS analysis.

(1*R*,2*R*)-3,3,3-Trifluoro-*N*-(2-isopropylamino-1-phenylcarbamoylethyl)-2-methoxy-2-phenylpropionamide 27, E = CONHPh

In the same way as amide **27**, E = $SiMe_3$, the diamine (*R*)-**25** (63 mg, 0.29 mmol), (*S*)-(−)-MTPA-Cl (108 mg, 0.43 mmol) and Et_3N (0.079 mL, 0.57 mmol), gave the Mosher amide (1*R*,2*R*)-**27**, E = CONHPh (63 mg, 50%) as an oil; R_f 0.56 [CH_2Cl_2–MeOH–NH_3 (10 : 1 : 0.1)]; ν_{max} (film)/cm^{-1} 3315 (N–H), 1675 (C=O); δ_H(400 MHz, $CDCl_3$) 10.65 (1H, br s, N–H), 7.94 (1H, s, N–H), 7.55–7.10 (10H, m, Ar–H), 4.44–4.41 (1H, m, NCH_2CHN), 3.53 (2.6H, s, OCH_3), 3.41 (0.4H, s, OCH_3), 3.33–3.27 (1H, m, NCH^AH^BCHN), 2.93–2.87 (1H, m, $NCHMe_2$), 2.78–2.59 (1H, m, NCH^AH^BCHN), 1.76 (1H, br s, N–H), 1.15–0.89 [6H, m $NCH(CH_3)_2$]; δ_C(100 MHz, $CDCl_3$) 169.5, 168.5, 137.9, 137.5, 132.8, 131.9, 129.6, 129.2, 128.7, 127.9, 127.4, 125.1, 122.2, 120.4, 119.6, 119.4, 84.4, 84.3, 84.1, 83.9, 55.3, 54.9, 52.2, 52.1, 48.9, 48.8, 47.8, 47.5, 23.2, 22.6; δ_F(376 MHz, $CDCl_3$) 93.0 (major CF_3) & 92.7 (minor CF_3); Found (ES): MH^+, 438.2005. $C_{22}H_{27}F_3N_3O_3$ requires *MH*, 438.2004; *m*/*z* (CI) 438 (100%, MH^+). The diastereomer ratio of **27**, E = CONHPh was determined to be 86 : 14 by ^1H and ^{19}F NMR analysis.

(1*R*,2*S*)-3,3,3-Trifluoro-*N*-[1-(isopropylaminomethyl)but-3-enyl]-2-methoxy-2-phenylpropionamide 27, E = allyl

In the same way as amide **27**, E = $SiMe_3$, the diamine (*S*)-**26** (41 mg, 0.29 mmol), (*S*)-(−)-MTPA-Cl (108 mg, 0.43 mmol) and Et_3N (0.079 mL, 0.57 mmol), gave the Mosher amide (1*R*,2*S*)-**27**, E = allyl (56 mg, 54%) as an oil; R_f 0.41 [CH_2Cl_2–MeOH–NH_3 (10 : 1 : 0.1)]; ν_{max} (film)/cm^{-1} 3410 & 3335 (N–H), 1690 (C=O); δ_H(400 MHz, $CDCl_3$) 7.58–7.56 (2H, m, Ar–H), 7.40–7.38 (3H, m, Ar–H), 7.10–6.85 (1H, br s, N–H), 5.80–5.69 (1H, m, $H_2C=CHCH_2$), 5.14–5.00 (2H, m, $H_2C=CHCH_2$), 4.10–4.08 (1H, m, NCH_2CHN), 3.42 (1.6H, s, OCH_3), 3.39 (1.4H, s, OCH_3), 2.78–2.65 (3H, m, $NCHMe_2$ & NCH_2CHN), 2.33–2.27 (2H, m, $H_2C=CHCH_2$), 1.03–0.95 [6H, m, $NCH(CH_3)_2$]; δ_C(100 MHz, $CDCl_3$) 166.0, 165.9, 134.2, 134.1, 133.1, 132.8, 129.3, 128.4, 127.8, 127.7, 125.3, 122.4, 117.9, 117.8, 84.3, 84.2, 83.9, 55.1, 55.0, 49.5, 48.8, 48.5, 37.1, 37.0, 23.1, 22.9; δ_F(376 MHz, $CDCl_3$) 95.2 & 95.0 (CF_3); Found (ES): MH^+, 359.1947. $C_{18}H_{26}F_3N_2O_2$ requires *MH*, 359.1946; *m*/*z* (CI) 359 (100%, MH^+). The diastereomer ratio of **27**, E = allyl was determined to be 50 : 50 by ^1H and ^{19}F NMR and GCMS analysis.

1-*tert*-Butoxycarbonyl-3-isopropylhexahydropyrimidine 28

To *N*-isopropyl-1,3-diaminopropane (135 mg, 1.17 mmol) in $CHCl_3$ (16 mL) was added $MgSO_4$ (1 g), K_2CO_3 (1 g), and paraformaldehyde (35 mg, 1.17 mmol) at room temperature. After 24 h, di-*tert*-butyl dicarbonate (260 mg, 1.18 mmol) was added. After 18 h, the mixture was filtered, evaporated and purified by column chromatography on silica gel, eluting with petrol–EtOAc (4 : 1 to 1 : 1), to give the carbamate **28** (230 mg, 86%) as an oil; R_f 0.22 [petrol–EtOAc (1 : 1)]; ν_{max} ($CHCl_3$)/cm^{-1} 1695 (C=O); δ_H(400 MHz, $CDCl_3$) 4.09 (2H, s, NCH_2N), 3.46 (2H, br s, $CONCH_2CH_2$), 2.85–2.68 (3H, m, $^iPrNCH_2CH_2$ and $CHCH_3$), 1.64–1.55 (2H, m, $CH_2CH_2CH_2$), 1.48 [9H, s, $C(CH_3)_3$], 1.09 [6H, d, *J* 7, $CH(CH_3)_2$]; δ_C(100 MHz, $CDCl_3$) 154.3, 79.4, 62.9, 62.3, 51.2, 50.1, 48.5, 48.3, 43.9, 43.1, 28.4, 24.2, 23.4, 19.6; Found (CI): MH^+ 229.1922. $C_{12}H_{25}N_2O_2$ requires *MH*, 229.1916); *m*/*z* (CI) 229 (5%, MH^+), 171 (100, M − ^{t}Bu) (Found: C, 63.1; H, 11.0; N, 12.2. $C_{12}H_{24}N_2O_2$ requires C, 63.1; H, 10.6; N, 12.25%).

(*RS*)-1-*tert*-Butoxycarbonyl-3-isopropyl-6-trimethylsilylhexahydropyrimidine 29, E = $SiMe_3$

To the pyrimidine **28** (75 mg, 0.33 mmol) and TMEDA (125 μL, 95 mg, 0.83 mmol) in THF (1.5 mL) was added *sec*-BuLi (0.59 mL, 0.83 mmol, 1.4 M in cyclohexane) at −78 °C. After 5 h, TMSCl (105 μL, 90 mg, 0.83 mmol) was added and the mixture was allowed to warm to room temperature. The mixture was purified by column chromatography on silica gel, eluting with petrol–EtOAc (20 : 1 to 4 : 1) to give the pyrimidine **29**, E = $SiMe_3$ (59 mg, 60%) as an oil; R_f 0.25 [petrol–EtOAc (4 : 1)]; ν_{max} ($CHCl_3$)/cm^{-1} 1675 (C=O); δ_H(400 MHz, $CDCl_3$) 5.02 (0.3H, br s, NCH), 4.45 (0.7H, br s, NCH^AH^BN), 3.90 (0.7H, br s, NCH^AH^BN), 3.62 (0.3H, br s, NCH), 3.45 (0.7H, br s, NCHSi), 3.34 (0.3H, br s, NCH), 3.00–2.65 (3H, m, CH_2CH_2N and $CHCH_3$), 2.15–1.82 (1H, m, $CH^CH^DCH_2N$), 1.58 (1H, dq, *J* 13 and 4, $CH^CH^DCH_2N$), 1.44 [9H, s, $C(CH_3)_3$], 1.08 (3H, d, *J* 6.5, $CHCH_3$), 1.06 (3H, d, *J* 6.5, $CHCH_3$), 0.08 [9H, s, $Si(CH_3)_3$]; δ_C(100 MHz, $CDCl_3$) 154.5, 79.3, 62.2, 60.3, 50.8, 49.8, 48.0, 46.7, 44.6, 43.8, 28.4, 23.8, 19.7, −1.0; Found (EI): M^+, 300.2232. $C_{15}H_{32}N_2O_2Si$ requires *M*, 300.2233; *m*/*z* (EI) 300 (0.8%, M^+), 57 (100, Bu).

(*RS*)-1-*tert*-Butoxycarbonyl-3-isopropyl-6-tributylstannylhexahydropyrimidine 29, E = $SnBu_3$

In the same way as the pyrimidine **29**, E = $SiMe_3$, the pyrimidine **28** (75 mg, 0.33 mmol), TMEDA (125 μL, 95 mg, 0.83 mmol), THF (1.5 mL), *sec*-BuLi (0.59 mL, 0.83 mmol, 1.4 M in cyclohexane) and Bu_3SnCl (225 μL, 270 mg, 0.83 mmol) gave, after purification by column chromatography on silica gel, eluting with petrol–EtOAc (50 : 1 to 9 : 1), the pyrimidine **29**, E = $SnBu_3$ (110 mg, 64%) as an oil; R_f 0.50 [petrol–EtOAc (9 : 1)]; ν_{max} ($CHCl_3$)/cm^{-1} 1675 (C=O); δ_H(300 MHz, $CDCl_3$) 5.11 (0.3H, d, *J* 11, NCH), 4.32 (0.7H, d, *J* 11.5, NCH_2N), 4.08 (1H, d, *J* 11.5, NCH_2N), 3.42 (0.7H, dd, *J* 8 and 5, NCHSn), 3.12 (0.3H, d, *J* 11), 3.06–3.00 (0.3H, m), 2.90–2.70 (3H, m, NCH_2CH_2 and $CHCH_3$), 1.90–1.20 [23H, m, CH_2CH_2N, $C(CH_3)_3$ and $Sn(CH_2CH_2CH_2)_3$], 1.14–1.09 [6H, m, $CH(CH_3)_2$], 0.98–0.81 [15H, m, $Sn(CH_2CH_2CH_2CH_3)_3$]; δ_C(75 MHz,

$CDCl_3$) 154.5, 79.4, 64.0, 50.3, 50.1, 45.0, 29.2, 28.3, 28.2, 27.6, 20.0, 19.3, 13.6, 11.0; Found (CI): MH^+, 519.2986. $C_{24}H_{51}N_2O_2{}^{120}Sn$ requires *MH*, 519.2972); *m/z* (CI) 519 (100%, MH^+).

(*RS*)-1-*tert*-Butoxycarbonyl-6-diphenylmethylsilyl-3-isopropylhexahydropyrimidine 29, E = $SiMePh_2$

In the same way as the pyrimidine **29**, E = $SiMe_3$, the pyrimidine **28** (75 mg, 0.33 mmol), TMEDA (125 μL, 95 mg, 0.83 mmol), THF (1.5 mL), *sec*-BuLi (0.59 mL, 0.83 mmol, 1.4 M in cyclohexane) and $Ph_2MeSiCl$ (263 μL, 288 mg, 0.83 mmol) gave, after purification by column chromatography on silica gel, eluting with petrol–EtOAc (20 : 1 to 4 : 1), the pyrimidine **29**, E = $SiMePh_2$ (89 mg, 64%) as an oil; R_f 0.18 [petrol–EtOAc (4 : 1)]; ν_{max} (film)/cm^{-1} 1685 (C=O); δ_H(400 MHz, $CDCl_3$) 7.67–7.53 (4H, m, ArH), 7.45–7.28 (6H, m, ArH), 4.98 (0.3H, br s, NCH_2N), 4.51–4.37 (1H, m, NCH_2N and NCHSi), 4.22 (0.7H, br s, NCHSi), 3.91 (0.7H, d, *J* 11, NCH_2N), 3.40 (0.3H, br s, NCH_2N), 2.80–2.50 (3H, m, NCH_2CH_2 and $CHCH_3$), 2.10–1.93 (1H, m, CH_2CH_2N), 1.79–1.67 (1H, m, CH_2CH_2N), 1.43 [9H, s, $C(CH_3)_3$], 1.02 (3H, d, *J* 7, $CHCH_3$), 0.97 (3H, d, *J* 7, $CHCH_3$), 0.70 (3H, s, $SiCH_3$); δ_C(100 MHz, $CDCl_3$) 154.5, 137.3, 136.4, 135.1, 134.8, 129.2, 129.1, 127.9, 127.7, 79.6, 61.9, 60.0, 50.8, 49.6, 47.5, 45.9, 42.7, 42.1, 28.3, 24.4, 23.8, 19.7, 19.6, −3.1, −3.6; Found (FI): M^+, 424.2542. $C_{25}H_{36}N_2O_2Si$ requires *M*, 424.2546); *m/z* (FI) 424 (100%, M^+).

(*RS*)-6-Allyl-1-*tert*-butoxycarbonyl-3-isopropylhexahydropyrimidine 29, E = allyl

In the same way as the pyrimidine **29**, E = $SiMe_3$, the pyrimidine **28** (75 mg, 0.33 mmol), TMEDA (125 μL, 95 mg, 0.83 mmol), THF (1.5 mL), *sec*-BuLi (0.59 mL, 0.83 mmol, 1.4 M in cyclohexane) and allyl bromide (71 μL, 100 mg, 0.83 mmol) gave, after purification by column chromatography on silica gel, eluting with petrol–EtOAc (4 : 1), the pyrimidine **29**, E = allyl (37 mg, 42%) as an oil; R_f 0.32 [petrol–EtOAc (1 : 1)]; ν_{max} ($CHCl_3$)/cm^{-1} 1690 (C=O); δ_H(400 MHz, $CDCl_3$) 5.72 (1H, ddt, *J* 16.5, 10 and 6.5, =CH), 5.05 (1H, d, *J* 16.5, =CH^AH^B), 5.02 (1H, d, *J* 10, =CH^AH^B), 4.85 (1H, d, *J* 11.5, NCH^CH^DN), 4.26 (1H, br s, $NCHCH_2$), 3.54 (1H, d, *J* 11.5, NCH^CH^DN), 2.88–2.82 (1H, m, $NCH^EH^FCH_2$), 2.78 (1H, septet, *J* 6.5, $CHCH_3$), 2.64 (1H, br t, *J* 12, $NCH^EH^FCH_2$) 2.45–2.37 (1H, m, =$CHCH^GH^H$), 2.30–2.23 (1H, m, =$CHCH^GH^H$), 1.99–1.89 (1H, m, $NCH_2CH^IH^J$), 1.44 [10H, m, $C(CH_3)_3$ and $NCH_2CH^IH^J$], 1.08 (3H, d, *J* 6.5, $CHCH_3$), 1.06 (3H, d, *J* 6.5, $CHCH_3$); δ_C(100 MHz, $CDCl_3$) 154.4, 135.1, 116.9, 79.5, 57.4, 50.4, 48.9, 43.4, 34.7, 28.4, 25.3, 19.7; Found (CI): MH^+, 269.2227. $C_{15}H_{29}N_2O_2$ requires *MH*, 269.2229); *m/z* (CI) 269 (56%, MH^+), 211 (100, $M^+ - C_4H_9$).

(*RS*)-1-*tert*-Butoxycarbonyl-3-isopropyl-6-phenylthiohexahydropyrimidine 29, E = SPh

In the same way as the pyrimidine **29**, E = $SiMe_3$, the pyrimidine **28** (75 mg, 0.33 mmol), TMEDA (125 μL, 95 mg, 0.83 mmol), THF (1.5 mL), *sec*-BuLi (0.59 mL, 0.83 mmol, 1.4 M in cyclohexane) and PhSSPh–MeI [PhSSPh (180 mg, 0.83 mmol) aged with MeI (51 μL, 42 mg, 0.83 mmol) in THF (1 mL) at room temperature for 1 h] gave, after purification by column chromatography on silica gel, eluting with petrol–EtOAc (9 : 1 to 4 : 1), the pyrimidine **29**, E = SPh (43 mg, 39%) as an oil; R_f 0.74 [petrol–EtOAc (1 : 1)]; ν_{max} ($CHCl_3$)/cm^{-1} 1685 (C=O); δ_H(400 MHz, $CDCl_3$) 7.49–7.46 (2H, m, ArH), 7.25–7.22 (3H, m, ArH), 6.01 and 5.74 (1H, 2 × br s, NCHS), 4.95 and 4.75 (1H, 2 × br d, *J* 8.5, NCH^AH^BN), 4.12 and 3.98 (1H, 2 × br d, *J* 8.5, NCH^AH^BN), 3.03–2.81 (3H, m, NCH_2CH_2 and $CHCH_3$), 2.26–2.16 (1H, m, $NCH_2CH^CH^D$), 1.82–1.64 (1H, m, $NCH_2CH^CH^D$), 1.31–1.12 (15H, m, 5 × CH_3); δ_C(100 MHz, $CDCl_3$) 153.2, 153.0, 135.0, 133.8, 133.4, 133.0, 128.9, 128.2, 127.6, 80.3, 62.5, 60.1, 57.5, 56.5, 51.1, 49.4, 43.9, 29.4, 27.5, 28.1, 27.9, 20.1, 19.7; Found (CI): MH^+, 337.1953. $C_{18}H_{29}N_2O_2S$ requires *MH*, 337.1950); *m/z* (CI) 337 (16%, MH^+), 227 (100, $M^+ - SPh$).

(*RS*)-6-Isopropyl-1,1-diphenylhexahydrooxazolo[3,4-*c*]-pyrimidin-3-one 30

In the same way as the pyrimidine **29**, E = $SiMe_3$, the pyrimidine **28** (75 mg, 0.33 mmol), TMEDA (125 μL, 95 mg, 0.83 mmol), THF (1.5 mL), *sec*-BuLi (0.59 mL, 0.83 mmol, 1.4 M in cyclohexane) and Ph_2CO (150 mg, 0.83 mmol, in THF, 0.5 mL) gave, after purification by column chromatography on silica gel, eluting with petrol–EtOAc (9 : 1 to 1 : 1), the amide **30** (63 mg, 57%) as an oil; R_f 0.35 [petrol–EtOAc (1 : 1)]; ν_{max} ($CHCl_3$)/cm^{-1} 1760 (C=O); δ_H(400 MHz, $CDCl_3$) 7.54–7.52 (2H, m, ArH), 7.38–7.24 (8H, m, ArH), 4.70 (1H, dd, *J* 11.5 and 2, NCH^AH^BN), 4.38 (1H, dd, *J* 11.5 and 4, PhCCH), 3.58 (1H, d, *J* 11.5, NCH^AH^BN), 3.04 (1H, dq, *J* 12.5 and 2, NCH^CH^D-CH_2), 2.77 (1H, septet, *J* 6.5, $CHCH_3$), 2.48 (1H, td, *J* 12.5 and 2, $NCH^CH^DCH_2$), 1.40–1.22 (2H, m, NCH_2CH_2), 1.09 (3H, d, *J* 6.5, CH_3), 1.02 (3H, d, *J* 6.5, CH_3); δ_C(100 MHz, $CDCl_3$) 156.2, 142.6, 139.2, 128.5, 128.4, 128.2, 127.7, 126.0, 125.9, 86.0, 62.0, 60.3, 51.2, 46.7, 27.3, 19.3, 19.2; Found (FI): M^+, 336.1832. $C_{21}H_{24}N_2O_2$ requires *M*, 336.1838); *m/z* (FI) 336 (100%, M^+).

(*RS*)-1-*tert*-Butoxycarbonyl-3-isopropyl-2-trimethylsilylhexahydropyrimidine 31

To the pyrimidine **28** (60 mg, 0.26 mmol) and TMEDA (105 μL, 80 mg, 0.70 mmol) in THF (0.4 mL) was added *sec*-BuLi (0.47 mL, 0.70 mmol, 1.4 M in cyclohexane) at −78 °C. After 5 h TMSCl (85 μL, 76 mg, 0.70 mmol) was added and the mixture was allowed to warm to room temperature. The mixture was purified by column chromatography on silica gel, eluting with petrol–EtOAc (20 : 1 to 4 : 1), to give the pyrimidine **31** (22 mg, 28%) as an oil; R_f 0.25 [petrol–EtOAc (4 : 1)]; ν_{max} ($CHCl_3$)/cm^{-1} 1675 (C=O); δ_H(400 MHz, $CDCl_3$) 5.84–5.63 (1H, m, SiCH), 4.83–4.61 (1H, m, CH^AH^BNCO), 3.95–3.65 (1H, m, CH^AH^BNCO), 2.96–2.73 (3H, m, CH_2NCHCH_3), 1.96–1.82 (2H, m, $CH_2CH_2CH_2$), 1.46 [9H, s, $C(CH_3)_3$], 1.11 (3H, d, *J* 6.5, $CHCH_3$), 1.08 (3H, d, *J* 6.5, $CHCH_3$), 0.12 [9H, s, $Si(CH_3)_3$]; δ_C(100 MHz, $CDCl_3$) 153.2, 80.0, 74.5, 73.6, 57.2, 56.5, 50.8, 49.2, 42.5, 31.5, 30.4, 28.4, 19.9, 0.0; Found (EI): MH^+, 301.2320. $C_{15}H_{33}N_2O_2Si$ requires *MH*, 301.2311); *m/z* (EI) 301 (12%, MH^+), 125 (100).

(*RS*)-N^1-*tert*-Butoxycarbonyl-N^2-isopropyl-1-trimethylsilyl-1,3-propanediamine 32, E = $SiMe_3$

In the same way as the carbamate **17**, the pyrimidine **29**, E = $SiMe_3$ (63 mg, 0.21 mmol), malonic acid (87 mg, 0.84 mmol) and pyridine (51 μL, 0.62 mmol), gave the carbamate **32**, E = $SiMe_3$ (52 mg, 86%) as an oil; ν_{max} ($CHCl_3$)/cm^{-1} 3420 (NH), 1695 (C=O); δ_H(300 MHz, $CDCl_3$) 4.30 (1H, br d, *J* 11, SiCH), 3.12 (1H, m, $CH^AH^BN^iPr$), 2.72–2.51 (3H, m, CH^CH^D-CH^AH^BNCH), 1.67 (1H, m, $CH^CH^DCH_2N^iPr$), 1.37 [9H, s, $C(CH_3)_3$], 1.03 (3H, d, *J* 6.5, $CHCH_3$), 1.01 (3H, d, *J* 6.5, $CHCH_3$), −0.02 [9H, s, $Si(CH_3)_3$]; δ_C(75 MHz, $CDCl_3$) 156.6, 79.0, 48.7, 44.5, 38.1, 31.5, 28.4, 22.8, −3.6; Found (CI): MH^+, 289.2312. $C_{14}H_{33}N_2O_2Si$ requires *MH*, 289.2311); *m/z* (CI) 289 (22%, MH^+), 233 (100, $MH^+ - C_4H_8$).

(*RS*)-N^1-*tert*-Butoxycarbonyl-N^2-isopropyl-1-allyl-1,3-propanediamine 32, E = allyl

In the same way as the carbamate **17**, the pyrimidine **29**, E = allyl (67 mg, 0.25 mmol), malonic acid (103 mg, 1.0 mmol) and pyridine (61 μL, 0.74 mmol), gave the carbamate **32**, E = allyl (64 mg, 100%) as an oil; ν_{max} ($CHCl_3$)/cm^{-1} 3420 (NH), 1705 (C=O); δ_H(400 MHz, $CDCl_3$) 5.74 (1H, ddt, *J* 16.5, 11 and

7.5, =CH), 5.07 (1H, d, *J* 16.5, =C*H*^{A}H^{B}), 5.06 (1H, d, *J* 11, =CH^{A}*H*^{B}), 4.80 (1H, br d, *J* 8, NH), 3.77–3.66 (1H, m, CH_2CH_2CH), 2.75 (1H, septet, *J* 6.5, C*H*CH_3), 2.68–2.56 (2H, m, NCH_2), 2.20 (2H, t, *J* 7.5, CH_2CH=), 1.73–1.60 (1H, m, $NCH_2CH^{C}H^{D}$), 1.50–1.30 [10H, m, $C(CH_3)_3$ and NCH_2-CH^{C}*H*^{D}] and 1.05 [6H, d, *J* 6.5, $CH(CH_3)_2$]; δ_C(100 MHz, $CDCl_3$) 155.8, 134.4, 117.7, 78.9, 48.7, 48.6, 43.9, 39.8, 34.9, 28.4, 22.9, 22.8; Found (CI): MH^+, 257.2227. $C_{14}H_{29}N_2O_2$ requires *MH*, 257.2229); *m*/*z* (CI) 257 (63%, MH^+), 201 (100, $MH^+ - C_4H_8$).

(*RS*)-*N*-(3-Amino-3-trimethylsilylpropyl)isopropylamine 33

In the same way as the diamine **22**, the carbamate **32**, E = $SiMe_3$ (52 mg, 0.18 mmol) and TFA (280 μL, 410 mg, 3.6 mmol) gave, after extraction with CH_2Cl_2 (4 × 5 mL) and evaporation, the diamine **33** (35 mg, 100%) as an oil; ν_{max} ($CHCl_3$)/cm^{-1} 3290 (NH), 1680 (NH); δ_H(300 MHz, $CDCl_3$) 4.17 (3H, br s, NH), 3.27 (1H, dt, *J* 11 and 5, NC*H*^{A}H$^{B}CH_2$), 3.07 (1H, septet, *J* 6.5, C*H*CH_3), 3.05–2.92 (1H, m, NCH^{A}*H*$^{B}CH_2$), 2.50 (1H, dd, *J* 9.5 and 5, NCHSi), 1.90–1.72 (2H, m, NCH_2CH_2), 1.26 [6H, d, *J* 6.5, $CH(CH_3)_2$], 0.09 [9H, s, $Si(CH_3)_3$]; δ_C(75 MHz, $CDCl_3$) 49.1, 46.8, 41.7, 30.4, 21.8, 21.7, −4.1; Found (CI): MH^+, 189.1794. $C_9H_{24}N_2Si$ requires *MH*, 189.1787); *m*/*z* (CI) 189 (77%, MH^+), 173 (100).

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