A New Synthesis of All Four Stereoisomers of 2-(2,3-Dihydroxypropyl)piperidine via Iterative Asymmetric Dihydroxylation To Cause Enantiomeric Enhancement. Application to Asymmetric Synthesis of Naturally Occurring Piperidine-Related Alkaloids

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Both enantiomers of 2-(2-propenyl)piperidine **1** (76−88% ee), prepared via the first asymmetric dihydroxylation (AD) of 5-hexenyl azide, underwent the second AD to provide all four of the stereoisomeric 2-(2,3-dihydroxypropyl)piperidines **2** with enantiomeric enhancement (>98% ee). An asymmetric synthesis, starting from **2**, of several 2-(2-hydroxyalkyl)piperidine alkaloids [(−)-halosaline, (+)-*N*-methylallosedridine, (+)-8-ethylnorlobelol, (+)-sedridine, (+)-allosedridine, (−)-allosedridine, and (+)-*N*-methylsedridine] and the ant defense alkaloids [(+)-tetraponerine-3 (**T-3**), **T-4**, **T-7**, and **T-8**] is demonstrated.

Introduction

Biologically active alkaloids of the substituted piperidine ring system have been the target of considerable synthetic efforts.[1] The development of methods for the asymmetric synthesis of 2-substituted piperidines remains an area of substantial interest.[2] During our continuing studies on asymmetric synthesis of piperidine alkaloids,[3] we recently achieved a new asymmetric synthesis of both enantiomers of 2-(2-propenyl)piperidine **1** via the Sharpless asymmetric dihydroxylation (AD) of 5-hexenyl azide, the design leading to 2-substituted piperidine and related alkaloids (Scheme 1).[4] However, the precedented AD established by the Sharpless group suggested that enantiomeric excess (ee) in the case of terminal olefins might be modest except for arylvinyls such as styrene.[5] In practice, the ees of **1** and *ent*-**1** were 76−88%.[4] Our interest in this field has been focused on the synthetic application of the double AD to cause enantiomeric enhancement (or amplification).[6] We anticipate that repeated AD for the terminal olefins might improve the stereoselectivity (ee) on the basis of the following consideration: The first AD (AD-mix-α) reaction produces the major (*S*) and minor (*R*) enantiomers. After the introduction of the terminal olefin followed by the second AD (AD-mix-α), four products result: (*S*,*S*)-, (*S*,*R*)-, (*R*,*S*)-, and (*R*,*R*)-isomers. The relationship between the desired (*S*,*S*)-isomer and the undesired (*S*,*R*)- and (*R*,*S*)-isomers is diastereomeric. Very little of the mirror image (*R*,*R*)-isomer is formed, and therefore the enantiomeric purity of the desired (*S*,*S*)-isomer will be high. On the other hand, the diastereomer of a mixture of (*S*,*R*)- and (*R*,*S*)-isomers could show low ee.[7]

We now describe our findings that additional AD of **1** and *ent*-**1** afforded all four stereoisomers of 2-(2,3-dihydoxypropyl)piperidine (**2**) with enantiomeric enhancement, and demonstrate the synthetic utility of **2** by an expeditious asymmetric synthesis of the 2-(2-hydroxyalkyl)piperidine alkaloids such as (−)-halosaline, (+)-*N*-methylallosedridine, (+)-8-ethylnorlobelol-I, (+)-sedridine, (+)-allosedridine, (−)-allosedridine, and (+)-*N*-methylsedridine and the ant defense alkaloids (+)-tetraponerine-3 (**T-3**), **T-4**, **T-7**, and **T-8** (Chart 1) in short steps.[8]

Results and Discussion

Synthesis of All Four Stereoisomers of 2-(2-Hydroxyalkyl)piperidine via Iterative Asymmetric Dihydroxylation. An asymmetric synthesis of 2-(2-propenyl)piperidines **1** and *ent*-**1** via the first AD (PYR ligand) reaction of 5-hexenyl azide has been performed by us.[4] On the basis of the above principle, the second AD [$(DHQ)_2$PYR ligand][9] reaction of the terminal olefin

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(3) (a) Takahata, H.; Bandoh, H.; Hanayama, M.; Momose, T. *Tetrahedron: Asymmetry* **1992**, *3*, 607. (b) Takahata, H.; Inose, K.; Momose, T. *Heterocycles* **1994**, *38*, 269.

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(5) For an excellent review, see: Kolb, H. C.; VanNieuwenhze, M. S.; Sharpless, K. B. *Chem. Rev.* **1994**, *94*, 2483.

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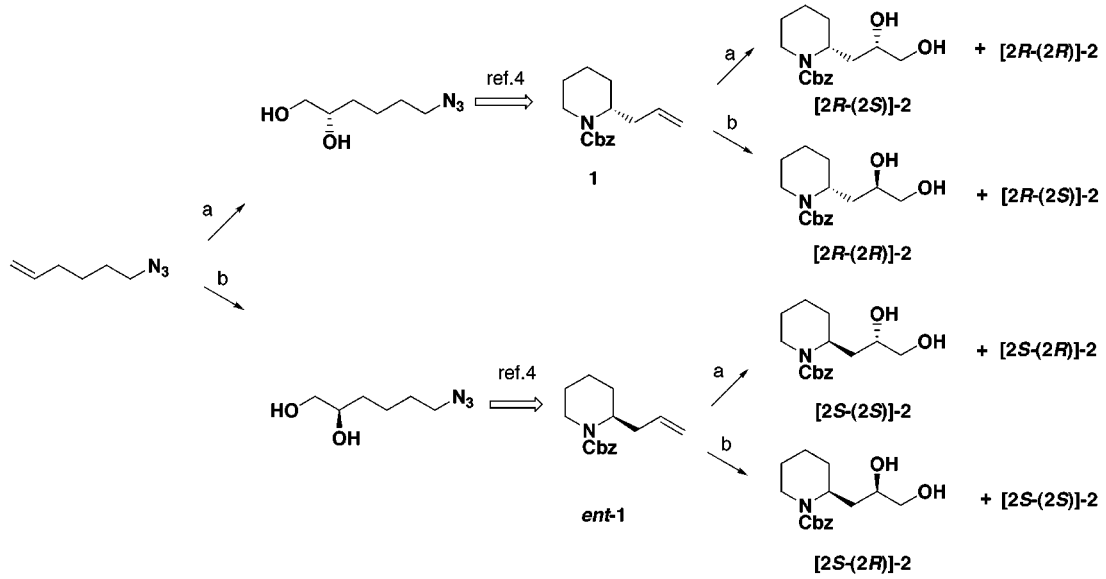
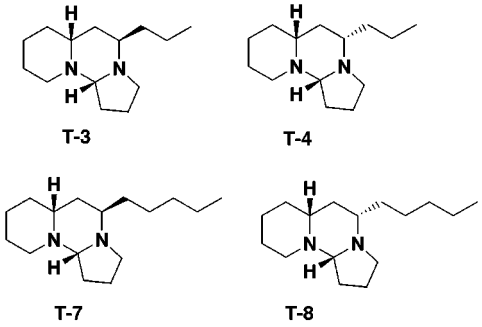
Scheme 1[a]



[a] Conditions: (a) cat. $K_2OsO_4 \cdot 2H_2O$/cat. $(DHQ)_2PYR$,/$K_3Fe(CN)_6$,/K_2CO_3; (b) cat. $K_2OsO_4 \cdot 2H_2O$/cat. $(DHQD)_2PYR$,/$K_3Fe(CN)_6$,/K_2CO_3, ref 4; (a) epoxidation (1, $CH_3C(OCH_3)_3$/PPTS; 2, CH_3COBr; 3, K_2CO_3); (b) vinylmagnesium bromide/CuBr−$(CH_3)_2S$; (c) MsCl/pyridine; (d) Ph_3P/THF/H_2O; (e) CbzCl/K_2CO_3.

Chart 1



in **1** was carried out to afford a readily separable mixture of the major diastereomer [2*R*-(2*S*)]-**2** (>98% ee) and the minor diastereomer [2*R*-(2*R*)]-**2** (54% ee). These results containing three other examples are shown in Table 1. Since the enantioselectivities of four all of the major diastereomers of **2** were found to be more than 98% ee, the enantiomeric enhancement by repeated AD was exemplified.

Asymmetric Synthesis of 2-(2-Hydroxyalkyl)piperidine Alkaloids. With all four homochiral 2-(2,3-dihydroxypropyl)piperidines **2** in hand, we focused our attention on their transformation into biologically active 2-(2-hydroxyalkyl)piperidine alkaloids. Our synthesis began with the epoxidation of **2**. The four diols **2** were converted into the four epoxides **3** by the Sharpless one-pot procedure (1, $CH_3C(OCH_3)_3$/PPTS; 2, CH_3COBr; 3, K_2CO_3)[10] in good yields (Scheme 2). Having obtained these results, the first asymmetric synthesis of (−)-halosarine (**4**),[11] isolated from *Haloxylon salicornicum*, was undertaken. The regioselective cleavage of the epoxide ring in [2*R*-(2*S*)]-**3** with vinylmagnesium bromide in combination with a cuprous bromide−dimethyl sulfide complex was performed to yield the alcohol **5** in 95% yield. Exposure of **5** to an atmosphere of hydrogen in the presence of $Pd(OH)_2$ as a catalyst in MeOH caused simultaneous reduction of its double bond and debenzyloxycarbonylation to give the desired (−)-**4** {$[\alpha]_D$ −19.0° (EtOH), lit.[11b] $[\alpha]_D$ −19.5° (EtOH)} in quantitative yield.

Two [2*R*-(2*S*)]-2-(2-hydroxyalkyl)piperidines, (+)-*N*-methylallosedridine (**6**),[12] isolated from *Sedum sarmentosum*, and (+)-8-ethylnorlobelol-I (**7**),[13] produced by *Loberia inflata*, are found. So far, an asymmetric synthesis of these alkaloids, to our knowledge, has not been reported. We began with the synthesis of **6**. Reduction of the epoxide [2*R*-(2*R*)]-**3** with $LiAlH_4$ gave **6** {$[\alpha]_D$ +78° (EtOH), lit.[12b] $[\alpha]_D$ +67° (96% EtOH)}as a single product in 89% yield. Its spectral data were identical with those reported.[14] Treatment of [2*R*-(2*R*)]-**3** with lithium dimethylcuprate resulted in the cleavage of the epoxide ring to provide the alcohol **8**, which was converted into [2*R*-(2*S*)]-**7** {mp 53−4 °C; $[\alpha]_D$ +10.2° (EtOH)} by hydrogenolysis in 82% overall yield. Surprisingly, both its melting point and specific rotation were obviously different from the reported values {mp 87 °C; $[\alpha]^{22}_D$ +22.3° (EtOH)}.[13] We considered the absolute configuration of natural (+)-8-ethylnorlobelol-I could be 2*S*-(2*S*) on the basis of the following speculation. Since halosarine (**4**) of [2*R*-(2*R*)] configuration appears levorotatory, both [2*R*-(2*R*)]-**7** and [2*S*-(2*R*)]-**7** will be levorotatory. Accordingly, only [2*S*-(2*S*)] remains among three possible configurations. In fact, it is known that sedridine (**9**) of [2*S*-2(*S*)] configuration is dextrorotatory.[15] In practice, [2*S*-2(*S*)]-**7** was synthesized from the epoxide [2S-2(R)]-**3** via **10**

(10) Kolb, H. C.; Sharpless, K. B. *Tetrahedron* **1992**, *48*, 10515.

(11) (a) Micel, K.-H.; Sandberg, F.; Haglid, F.; Norin, T. *Acta Pharm. Suec.* **1967**, *4*, 97. (b) Micel, K.-H.; Sandberg, F.; Haglid, F.; Norin, T.; Chan, R. P. K.; Craig, *J. C. Acta Chem. Scand.* **1969**, *23*, 3479.

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(14) Schneider, M. J.; Brendze, S.; Montali, J. A. *Phytochemistry* **1995**, *39*, 1387.

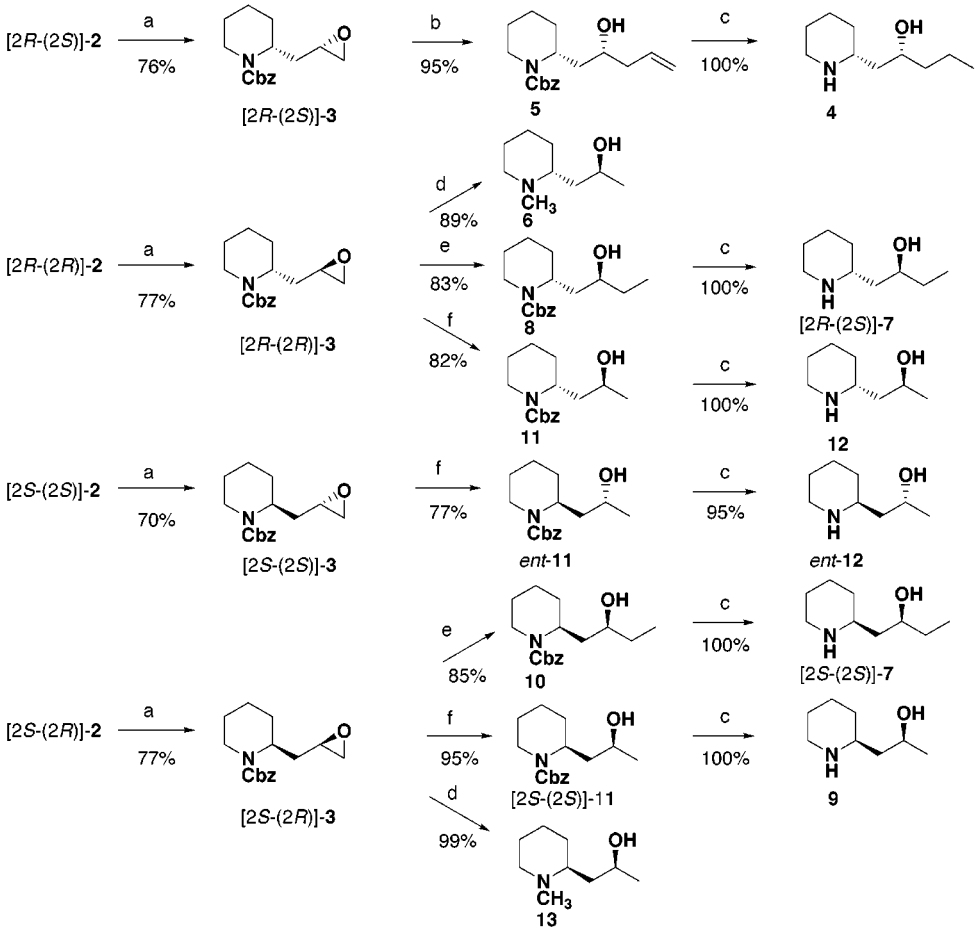
(15) (a) Beyerman, H. C.; Maat, L.; Van Veen, A.; Zweistra, A.; von Philipsborn, W. *Recl. Trav. Chim. Pays-Bas* **1965**, *84*, 1367. (b) Murahashi, S. Imada, Y.; Kohno, M.; Kawakami, T. *Synlett* **1993**, 395. (c) Louis, C.; Hootelé, C. *Tetrahedron: Asymmetry* **1997**, *8*, 109. (d) Littler, B. J.; Gallagher, T.; Boddy, I. K.; Riordan, P. *Synlett* **1997**, 22.

Table 1. AD Reaction of Both Enantiomers of 1

substrate **1**	ligand	major compd **2**	yield (%)	(ee (%))	minor compd **2**	yield (%)	(ee (%))
1	$(DHQ)_2PYR$[a]	[2*R*-(2*S*)]-**2**	70	(>98)	[2*R*-(2*R*)]-**2**	21	(54)
1	$(DHQD)_2PYR$[b]	[2*R*-(2*R*)]-**2**	69	(>98)	[2*R*-(2*S*)]-**2**	22	(54)
ent-**1**	$(DHQ)_2PYR$	[2*S*-(2*S*)]-**2**	70	(>98)	[2*S*-(2*R*)]-**2**	22	(72)
ent-**1**	$(DHQD)_2PYR$	[2*S*-(2*R*)]-**2**	74	(>98)	[2*S*-(2*S*)]-**2**	14	(47)

[a] $(DHQ)_2PYR$ = hydroquinine 2,5-diphenyl-4,6-pyrimidinediyl diether. [b] $(DHQD)_2PYR$ = hydroquinidine 2,5-diphenyl-4,6-pyrimidinediyl diether.

Scheme 2[a]



[a] Conditions: (a) (1) $(MeO)_3CMe$/PPTS; (2) MeCOBr; (3) K_2CO_3/MeOH; (b) vinylmagnesium bromide/$Me_2S-CuBr$; (c) $H_2/Pd(OH)_2$; (d) $LiAlH_4$; (e) Me_2CuLi; (f) Super-Hydride.

by the analogous procedure described for [2*R*-(2*S*)]-**7**. Both the melting point (mp 88−89 °C) and the specific rotation {$[\alpha]_D$ +25.8° (EtOH)} are almost identical with those reported (vide supra).[13] It is thus concluded that the absolute configuration of natural (+)-8-ethylnorlobelol-I is 2*S*-(2*S*).[16]

Next, an asymmetric synthesis of [2*S*-(2*S*)]-2-(2-hydroxypropyl)piperidine, (+)-sedridine (**9**),[15a] isolated from *Sedum acre*, was performed. Super-Hydride-induced reduction of [2*S*-2(*R*)]-**3** resulted in only ring-cleavage to yield the alcohol [2*S*-(2*S*)]-**11**, which was hydrogenated to give **9** {$[\alpha]_D$ +28.4° (EtOH), lit.[15b] $[\alpha]_D$ +28.5° (EtOH)} in 95% yield. Its spectral data were in agreement with those reported.[15] In a similar fashion, the synthesis of both enantiomers (**12** and *ent*-**12**) of allosedridine,[17,18] isolated from *Sedum nudum*, was achieved from [2*R*-(2*R*]- and [2*S*-(2*S*)]-**3**, respectively, using a two-step sequence. Finally, *N*-methylsedridine (**13**),[14,18] isolated from *Sedum polytrichoides*, was synthesized by reduction of [2*S*-2(*R*)]-**3** with $LiAlH_4$ in 99% yield. Its spectral data were consistent with those reported.[14]

Asymmetric Synthesis of Ant Defense Alkaloids. Eight toxic alkaloids with an original tricyclic structure are found in New Guinean ant venom: tetraponerine-1 to tetraponerine-8 (**T-1** to **T-8**) isolated from *Tetraponera* sp. by Braekman et al.[19] So far, the synthesis of **T-8** has been reported several times in both racemic and chiral forms,[20] whereas asymmetric synthesis of others except

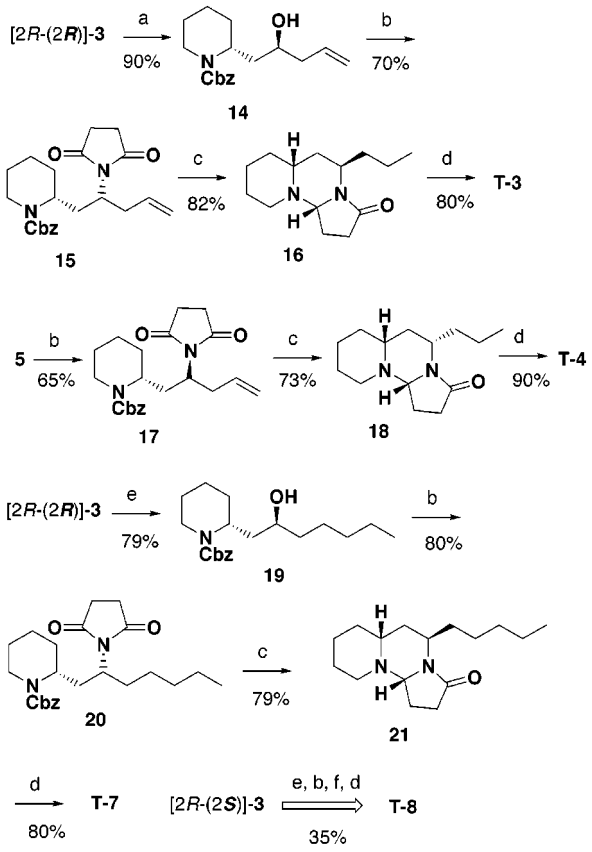
(16) Recently, the same correction of the absolute configuration of (+)-8-ethylnorlobelol-I was proposed. Mill, S.; Durant, A.; Hootelé, C. *Liebigs Ann.* **1996**, 2083.

(17) (a) Schöpf, C.; Gams, E.; Koppernock, F.; Rausch, R. Wallbe, R. *Liebigs Ann. Chem.* **1970**, *732*, 181. (b) Stevens, J. F.; T'Hart, H.; Hendriks, H.; Malingré, T. M. *Phytochemistry* **1992**, *31*, 3917.

(18) The absolute configurations of both allosedridine (**12**) and *N*-methylsedridine (**13**) remain unknown.

(19) (a) Merlin, P.; Breakman, J.-C.; Daloze, D.; Pasteels, J.-M. *J. Chem. Ecol.* **1988**, *14*, 517. (b) Breakman, J.-C.; Daloze, D.; Pasteels, J.-M.; Vanhecke, P.; Declercq, J.-P.; Sinnwell, V.; Franke, W. Z. *Naturforsch.* **1987**, *42C*, 627.

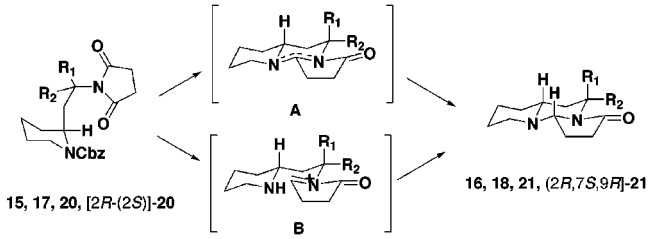
Scheme 3[a]



[a] Conditions: (a) vinylmagnesium bromide/CuBr−Me_2S; (b) succinimide/Ph_3P/DEAD; (c) H_2/10% Pd−C/4 atm; (d) $LiAlH_4$; (e) Bu_2CuLi; (f) H_2/$Pd(OH)_2$/4 atm.

for **T-7** (twice) has been reported only once. Among them, the synthesis of (+)-**T-3**,**4**,**7**,-**8** was performed from the epoxides [2*R*-(2*S*)]- and [2*R*-(2*R*)]-**3**. Our synthesis of (+)-**T-3** began with the cleavage of [2*R*-(2*R*)]-**3** with the Grignard reagent. According to the method described for **5**, the treatment of [2*R*-(2*R*)]-**3** with vinylmagnesium bromide in the combination with a cuprous bromide−dimethyl sulfide complex afforded the alcohol **14** in 90% yield (Scheme 3). The Mitsunobu reaction of **14** with succinimide provided the imide **15** in 70% yield. Catalytic reduction of **15** using 10% palladium carbon under hydrogen atmosphere at 4 atm resulted in conversion in a single step into the tricyclic lactam **16** as a single isomer in 82% yield.[21] Finally, reduction of the lactam **16** with $LiAlH_4$ gave (+)-**T-3** {$[\alpha]^{25}_D$ +34.6° ($CHCl_3$)} (80%), identical in all respects with those reported.[20f] Similarly, the synthesis of (+)-**T-4** {$[\alpha]^{25}_D$ +107.3° ($CHCl_3$)} was achieved in a three-step sequence from **5** in 43% overall yield. Next, we initiated the synthesis of (+)-**T-7**. The regioselective cleavage of [2*R*-(2*R*)]-**3** with lithium dibutylcuprate afforded the alcohol **19** in 79% yield, which was transformed in a three-step sequence into (+)-**T-7** {$[\alpha]^{25}_D$ +30.9° ($CHCl_3$)} in 51% overall yield from **19**. In an analogous way, (+)-**T-8** {$[\alpha]^{25}_D$ +98.2° ($CHCl_3$)} was obtained from [2*R*-(2*S*)]-**3** in 35% four-step yields.

Scheme 4



Since all four tricyclic diaza compounds are isolated as single diastereomers, these reductive cyclizations proceed highly stereoselectively. The formation of the compounds can be explained as follows: a hydrogenolysis of *N*-Cbz followed by condensation of the resulting secondary amine with the imide occurred to provide tricyclic iminium compound **A**, which was reduced by hydrogen to give the lactam; alternatively, both the hydrogenolysis of *N*-Cbz and a reduction of imide proceeded to give a secondary amino acyliminium intermediate, **B**, which was cyclized to afford the lactam (Scheme 4).

Conclusion

We developed a general access to synthetically useful homochiral 2-(2,3-dihydroxypropyl)piperidines **2** via iterative asymmetric dihydroxylation starting from an achiral 5-hexenyl azide. The two stereogenic centers of **2** were constructed with high enantiomeric enhancement in a sequence of two AD reactions. In practice, we demonstrated the synthetic utility of **2** as chiral synthons by the first asymmetric synthesis of several 2-(2-hydroxyalkyl)piperidine alkaloids except for **9**. In addition, the asymmetric synthesis of the ant defense alkaloids [(+)-**T-3**, (+)-**T-4**, (+)-**T-7**, and (+)-**T-8**] has been performed. Extension of this methodology (the enantiomeric enhancement via the 2-fold or more AD reactions) toward asymmetric synthesis of other biologically active compounds is under investigation.

Experimental Section

General Procedures. Column chromatography was performed on silica gel (Fuji-Division BW-200 or Merck 60 (no. 9385)) with a medium-pressure apparatus, and a mixture of ethyl acetate/hexane was used as eluent unless otherwise specified. The extracts were dried over Na_2SO_4 unless otherwise specified.

[2*R*-(2*S*)]- and [2*R*-(2*R*)]-1-Benzyloxycarbonyl-2-(2,3-dihydroxypropyl)piperidine [[2*R*-(2*S*)]- and [2*R*-(2*R*)]-2]. (*R*)-1-Benzyloxycarbonyl-2-(2-propenyl)piperidine **1** (270 mg, 1.04 mmol) was added to a mixture of AD-mix (1.35 g), prepared from $K_2OsO_4 \cdot 2H_2O$ (0.7 mg), $(DHQ)_2PYR$ (8.7 mg), $K_3Fe(CN)_6$ (945 mg), and K_2CO_3 (220 mg) by a known procedure,[9] *tert*-BuOH (5 mL), and H_2O (5 mL) at 0 °C. After the reaction mixture was stirred for 24 h at the same temperature, sodium sulfite (1.5 g) was added to the mixture. After being stirred for 30 min, the mixture was filtered through a Celite pad. The organic layer was separated, and the aqueous layer was extracted with ethyl acetate three times. The combined organic layers were washed with brine, dried, and evaporated. The residue was chromatographed using 50% ethyl acetate−hexane as eluent to yield major diastereomer [2*R*-(2*S*)]-**2** (213 mg, 70%) and minor diastereomer [2*R*-(2*R*)]-**2** (64 mg, 21%) as oils. The enantiomeric purities were

(20) Racemic form: (a) Merlin, P.; Breakman, J.-C.; Daloze, D. *Tetrahedron Lett.* **1988**, *29*, 1691. (b) Jones, T. H. *Tetrahedron Lett.* **1990**, *31*, 1535. (c) Jones, T. H. *Tetrahedron Lett.* **1990**, *31*, 4543. (d) Barluenga, J. Tomás, M.; Kouznetsov, V.; Rubio, E. *J. Org. Chem.* **1994**, *59*, 3699. Chiral form: (e) Yue, C.; Gauthier, I.; Royer, J.; Husson, H.-P. *J. Org. Chem.* **1996**, *61*, 4949. (f) Marcours, P.; Breakman, J.-C.; Daloze, D. *Tetrahedron* **1995**, *51*, 1415.

(21) Under an atmosphere of hydrogen, only the hydrogenolysis of *N*-Cbz proceeded to give no cyclized product. Cf. Scovill, J. P.; Burckhalter, J. H. *J. Heterocycl. Chem.* **1980**, *17*, 23.

determined by HPLC analysis (column, DAICEL CHIRALPAC AS), 40 °C, eluent hexane−2-propanol (9:1); flow rate 0.4 mL/min. The results are shown in Table 1.

Data for [2*R*-(2*S*)]-2: $[\alpha]^{25}_D$ +23.15° (*c* 1.310, $CHCl_3$); IR (neat) 3418, 3032, 2937, 2866, 1667, 1586, 1498, 1427, 1264, 1175, 1092 cm^{-1}; ^1H NMR (500 MHz, $CDCl_3$) δ 1.29 (1 H, ddd, J = 14,11, 10.90, 3.21 Hz), 1.42−1.65 (5 H, m), 1.76−1.81 (1 H, m), 1.91−1.97 (1 H, m), 2.425 (1 H, d, J = 4.91 Hz), 2.77 (1 H, td, J = 13.46, 2.78 Hz), 3.47−3.60 (3 H, m), 4.065 (1 H, d, J = 12.61 Hz), 4.44 (1 H, br s), 4.54 (1 H, d, J = 12.18 Hz), 5.15 (2 H, s), 7.32−7.40 (5 H, m); ^{13}C NMR (125 MHz, $CDCl_3$) δ 19.03, 25.37, 29.30, 33.21, 39.31, 47.19, 66.34, 67.53, 68.49, 127.84, 128.09, 128.51, 136.36, 156.87; HRMS calcd for $C_{16}H_{23}NO_4$ (M^+) 293.1627, found 293.1605.

Data for [2*R*-(2*R*)]-2: IR (neat) 3421, 2936, 1684, 1430 cm^{-1}; ^1H NMR (500 MHz, $CDCl_3$) δ 1.41−1.46 (1 H, m), 1.50−1.64 (6 H, m), 1.83−1.85 (1 H, m), 2.18 (1 H, br d, J = 9.40 Hz), 2.92 (2 H, td, J = 13.03, 1.50 Hz), 3.45 (1 H, br s), 3.68 (2 H, br d, J = 20.08 Hz), 4.06 (1 H, m), 5.13 (2 H, ABq, J = 25.32, 12.28 Hz), 7.31−7.39 (5 H, m); ^{13}C NMR (75 MHz, $CDCl_3$) δ 18.9, 25.5, 28.7, 33.6, 39.7, 48.5, 66.8, 67.3, 70.3, 128.0, 128.2, 128.7, 136.8, 156.0. HRMS calcd for $C_{16}H_{23}NO_4$ (M^+) 293.1627, found 293.1670.

[2*R*-(2*R*)]- and [2*R*-(2*S*)]-1-Benzyloxycarbonyl-2-(2,3-dihydroxypropyl)piperidine [[2*R*-(2*R*)]- and [2*R*-(2*S*)]-2]. The AD reaction was performed on a 15.4 mmol scale with AD-mix-β [used $(DHQD)_2PYR$ as ligand] as described in the typical procedure (vide supra). [2*R*-(2*R*)]- and [2R-(2S)]-**2** were obtained in 69% and 22% yields, respectively. $[\alpha]^{25}_D$ [[2*R*-(2*R*)]-**2**] +39.53° (*c* 1.575, $CHCl_3$).

[2*S*-(2*S*)]- and [2*S*-(2*R*)]-1-Benzyloxycarbonyl-2-(2,3-dihydroxypropyl)piperidine [[2*S*-(2*S*)]- and [2*S*-(2*R*)]-2]. The AD reaction was performed on a 0.79 mmol scale using (*S*)-1-Benzyloxycarbonyl-2-(2-propenyl)piperidine **1** with AD-mix-α [used $(DHQ)_2PYR$ as ligand] as described in the typical procedure (vide supra). [2*S*-(2*S*)]- and [2*S*-(2*R*)]-**2** were obtained in 70% and 22% yields, respectively. $[\alpha]^{25}_D$ [[2*S*-(2*S*)]-**2**] −40.41° (*c* 1.440, $CHCl_3$).

[2*S*-(2*R*)]- and [2*S*-(2*S*)]-1-Benzyloxycarbonyl-2-(2,3-dihydroxypropyl)piperidine [[2*S*-(2*R*)]- and [2*S*-(2*S*)]-2]. The AD reaction was performed on a 2.08 mmol scale with AD-mix-β [used $(DHQD)_2PYR$ as ligand] as described in the typical procedure (vide supra). [2*S*-(2*R*)]- and [2*S*-(2*S*)]-**2** were obtained in 74% and 14% yields, respectively. $[\alpha]^{25}_D$ [[2*S*-(2*R*)]-**2**] −23.82° (*c* 1.135, $CHCl_3$).

[2*R*-(2*S*)]-1-Benzyloxycarbonyl-2-(2,3-epoxypropyl)piperidine [[2*R*-(2*S*)]-3]. Trimethyl orthoacetate (0.83 mL, 6.7 mmol) was added to a solution of [2*R*-(2*S*)]-**2** (1.64 g, 5.6 mmol) and PPTS (11.3 mg, 0.045 mmol)) in CH_2Cl_2 (8.25 mL). After being stirred for 4 h, the reaction mixture was evaporated, and then CH_2Cl_2 (8.25 mL) and acetyl bromide (0.54 mL, 6.7 mmol) were successively added to the resulting residue. After being stirred for 45 min, the mixture was evaporated. To a solution of the resulting residue in methanol (18.7 mL) was added K_2CO_3 (1.0 g, 7.3 mmol), and the reaction mixture was stirred for 2 h. The reaction was quenched with saturated NH_4Cl and extracted with CH_2Cl_2. The extract was washed with brine, dried, and evaporated. The residue was chromatographed using 25% EtOAc−*n*-hexane as eluent to yield [2*R*-(2*S*)]-**3** (1.17 g, 76%) as an oil: $[\alpha]^{25}_D$ +35.46° (*c* 2.335, $CHCl_3$); IR (neat) 2938, 2862, 1694, 1423, 1265 cm^{-1}; ^1H NMR (500 MHz, $CDCl_3$) δ 1.35−1.65 (7 H, m), 1.85 (1 H, br s), 2.355 (1 H, dd, J = 5.02, 2.67 Hz), 2.58 (1 H, br s), 2.775 (1 H, t, J = 12.93 Hz), 2.85 (1 H, br s), 4.06 (1 H, br s), 4.55 (1 H, br s), 5.11 (2 H, br s), 7.26−7.35 (5 H, m); ^{13}C NMR (125 MHz, $CDCl_3$) δ 19.0, 25.6, 29.2, 33.4, 39.5, 46.8, 49.1, 50.4, 67.2, 128.1, 128.1, 128.6, 137.0, 155.6. Anal. Calcd for $C_{16}H_{21}NO_3$: N, 5.09; C, 69.79; H, 7.69. Found: N, 5.25; C, 69.30; H, 7.46.

[2*R*-(2*R*)]-1-Benzyloxycarbonyl-2-(2,3-epoxypropyl)piperidine [[2*R*-(2*R*)]-3]. By a procedure similar to that for the preparation of [2*R*-(2*S*)]-**3**, [2*R*-(2*R*)]-**2** (1.6 g, 5.45 mmol) was converted in a three-step sequence [(1) PPTS (11 mg, 0.044 mmol), trimethyl orthoacetate (0.81 mL, 6.54 mmol), CH_2Cl_2 (16 mL); (2) acetyl bromide (0.49 mL, 6.54 mmol); (3) K_2CO_3 (981 mg, 7.10 mmol), MeOH (18 mL)] to [2*R*-(2*R*)]-**3** (1.16 g, 77%) as an oil: $[\alpha]^{25}_D$ +38.21° (*c* 1.150, $CHCl_3$); IR (neat) 2936, 1694, 1423, 1259 cm^{-1}; ^1H NMR (500 MHz, $CDCl_3$) δ 1.38−1.72 (7 H, m), 2.00 (1 H, qui, J = 7.32 Hz), 2.43 (1 H, br s), 2.67 (1 H, br s), 2.88 (2 H, br d, J = 10.90 Hz), 4.09 (1 H, d, J = 10.04 Hz), 4.57 (1 H, s), 5.14 (2 H, ABq, J = 31.73, 12.50 Hz), 7.28−7.37 (5 H, m); ^{13}C NMR (125 MHz, $CDCl_3$) δ 19.0, 25.5, 28.6, 33.0, 39.4, 46.7, 48.9, 5.2, 67.0, 127.8, 127.9, 128.5, 137.0, 155.5. Anal. Calcd for $C_{16}H_{21}NO_3$: N, 5.09; C, 69.79; H, 7.69. Found: N, 4.80; C, 69.82; H, 7.69.

[2*S*-(2*S*)]-1-Benzyloxycarbonyl-2-(2,3-epoxypropyl)piperidine [[2*S*-(2*S*)]-3]. By a procedure similar to that for the preparation of [2*R*-(2*S*)]-**3**, [2S-(2S)]-**2** (144 mg, 0.49 mmol)) was converted in a three-step sequence [(1) PPTS (1.0 mg, 3.9 mmol, trimethyl orthoacetate (73 mL, 0.59 mmol), CH_2Cl_2 (1.4 mL); (2) acetyl bromide (44 mL, 0.59 mmol); (3) K_2CO_3 (88 mg, 0.63 mmol), MeOH (1.6 mL)] to [2*S*-(2*S*)]-**3** (95 mg, 70%) as an oil: $[\alpha]^{25}_D$ −38.43° (*c* 1.390, $CHCl_3$).

[2*S*-(2*R*)]-1-Benzyloxycarbonyl-2-(2,3-epoxypropyl)piperidine [[2S-(2*R*)]-3]. By a procedure similar to that for the preparation of [2*R*-(2*S*)]-**3**, [2S-(2R]-**2** (1.65 g, 5.6 mmol)) was converted in a three-step sequence [(1) PPTS (11.3 mg, 0.045 mmol, trimethyl orthoacetate (0.83 mL, 6.7 mmol), CH_2Cl_2 (16.5 mL); (2) acetyl bromide (0.54 mL, 6.7 mmol); (3) K_2CO_3 (1.0 g, 7.3 mmol), MeOH (18.7 mL)] to [2*S*-(2*R*)]-**3** (1.2 g, 77%) as an oil: $[\alpha]^{25}_D$ −36.14° (*c* 5.520, $CHCl_3$).

[2*R*-(2*R*)]-1-Benzyloxycarbonyl-2-(2-hydroxy-4-pentenyl)piperidine (5). To a slurry of CuBr−Me_2S (14.4 mg, 0.07 mmol) in THF (1.4 mL) was added a 1 M vinylmagnesium bromide−THF solution (1.10 mL, 1.10 mmol) at −78 °C with stirring. After the reaction mixture was stirred for 30 min, a solution of [2*R*-(2*S*)]-**3** (200 mg, 0.73 mmol) in THF (0.78 mL) was slowly added to it. The mixture was gradually warmed to −30 °C, stirred for 1.5 h, and quenched with saturated NH_4Cl. The mixture was diluted with ether, washed with brine, dried, and evaporated. The residue was chromatographed using 13% EtOAc−hexane as eluent to give **5** (210 mg, 95%) as an oil: $[\alpha]^{25}_D$ +39.19° (*c* 2.650, $CHCl_3$); IR (neat) 3447, 3069, 2938, 2864, 1668, 1424, 1353, 1262, 1174, 698 cm^{-1}; ^1H NMR (300 MHz, $CDCl_3$) δ 1.10−1.20 (1 H, m), 1.30−1.66 (6 H, m), 1.93 (1 H, t, J = 13.19 Hz), 2.05−2.21 (2 H, m), 2.60−2.70 (1 H, m), 3.30 (1 H, br s), 3.96 (1 H, br d, J = 13.19 Hz), 4.03 (1 H, m), 4.42−4.46 (1 H, m), 4.95−5.10 (4 H, m), 5.72−5.80 (1 H, m), 7.18−7.27 (5 H, m); ^{13}C NMR (75 MHz, $CDCl_3$) δ 19.2, 25.5, 29.4, 37.0, 39.3, 41.2, 47.2, 47.3, 47.5, 47.5, 66.9, 67.1, 67.5, 116.8, 127.9, 128.2, 128.4, 128.5, 128.6, 135.5, 136.6, 156.9; HRMS calcd for $C_{18}H_{25}NO_3$ (M^+) 303.1834, found 303.1814.

(−)-Halosarine (4). A suspension of **5** (237 mg, 0.78 mmol) and palladium hydroxide ($Pd(OH)_2$) (240 mg) in MeOH (4.4 mL) under a hydrogen atmosphere was stirred for 4 h. The mixture was filtered through a Celite pad, and the filtrate was evaporated. The residue was chromatographed on Al_2O_3 using 25% hexane−CH_2Cl_2 as eluent to give **4** (134 mg, 100%) as a solid: mp 83 °C (diisopropyl ether); $[\alpha]^{25}_D$ −18.98° (*c* 0.975, EtOH), lit.[11b] $[\alpha]^{25}_D$ −19.5° (*c* 0.6, EtOH); IR (KBr) 3313, 2930, 2857, 1456 cm^{-1}; ^1H NMR (300 MHz, $CDCl_3$) δ 0.91 (3 H, t, J = 6.89 Hz), 1.26−1.59 (12 H, m), 1.78−1.80 (1 H, m), 2.55 (1 H, td, J = 11.54, 2.75 Hz) 2.81−2.88 (1 H, m), 3.00−3.05 (1 H, m), 3.84−3.90 (1 H, m); ^{13}C NMR (75 MHz, $CDCl_3$) δ 14.3, 19.2, 24.9, 26.2, 31.7, 40.2, 42.2, 47.0, 54.8, 68.9; HRMS calcd for $C_{10}H_{21}NO$ (M^+) 171.1623, found 171.1635.

(+)-*N*-Methylallosedridine (6). To a suspension of $LiAlH_4$ (19 mg, 3.12 mmol) in THF (9.3 mL) was added a solution of [2*R*-(2*R*]-**3** (430 mg, 1.56 mmol) in THF (9.3 mL) at 0 °C. After being stirred for 1 h at room temperature, the reaction mixture was refluxed for 15 h. To the mixture were successively added H_2O (0.12 mL), 2 N NaOH (0.12 mL), H_2O (0.36 mL), and anhydrous K_2CO_3 with ice cooling, and the resulting mixture was stirred for 30 min at room temperature. The mixture was filtered through a Celite pad, and the filtrate was evaporated at room temperature. The residue was chromatographed using 5% MeOH−CH_2Cl_2 as eluent to yield **6** (217 mg, 89%) as an oil: $[\alpha]^{25}_D$ +78.53° (*c* 2.840, EtOH), lit.[12b] $[\alpha]^{25}_D$ +67° (*c* 0.9, EtOH 96%); IR (neat) 3384, 2934, 2856, 2794 cm^{-1}; ^1H NMR (500 MHz, $CDCl_3$) δ 1.13 (3 H, d, J = 6.20 Hz), 1.19 (1 H, ddd,

J = 14.32, 5.13, 2.56 Hz), 1.22−1.27 (1 H, m), 1.36−1.45 (2 H, m), 1.48−1.54 (1 H, m), 1.59−1.70 (2 H, m), 1.81 (1 H, ddd, J = 14.31, 10.26, 8.76 Hz), 2.36 (3 H, s), 2.38−2.43 (1 H, m), 2.57 (1 H, tdd, J = 7.69, 7.69, 3.85 Hz), 2.94 (1 H, ddd, J = 9.84, 6.84, 3.20 Hz), 3.91 (1 H, dqd, J = 10.25, 6.20, 2.56 Hz); ^{13}C NMR (125 MHz, $CDCl_3$) δ 21.2, 22.8, 24.3, 26.5, 39.5, 40.3, 52.2, 60.9, 68.0; HRMS calcd for $C_9H_{19}NO$ (M^+) 157.1467, found 157.1467.

[2*R*-(2*S*)]-1-Benzyloxycarbonyl-2-(2-hydroxybutyl)piperidine (8). A 1 M MeLi−Et_2O solution (2.82 mL, 2.82 mmol) was injected into a suspension of CuI (269 mg, 1.41 mmol) in Et_2O (7.2 mL) at −20 °C, and the reaction mixture resulted in a clear solution. A solution of [2*R*-(2*R*)]-**3** (260 mg, 0.94 mmol) in Et_2O (4.3 mL)was added to the lithium dimethylcuprate solution at −20 °C, and the mixture was stirred for 0.5 h. The reaction was warmed to 0 °C, stirred for 0.5 h, diluted with Et_2O, and quenched with saturated NH_4Cl. The organic solvent was washed with H_2O and brine, dried, and evaporated. The residue was chromatographed using 20% EtOAc−hexane as eluent to yield **8** (228 mg, 83%) as an oil: $[\alpha]^{25}_D$ +48.65° (*c* 1.825, $CHCl_3$); IR (neat) 3446, 2935, 2865, 1674, 1425, 1350, 1262, 1172, 1148, 698 cm^{-1}; ^{1}H NMR (300 MHz, $CDCl_3$) δ 0.83 (3 H, t, J = 7.42 Hz), 1.28−1.72 (9 H, m), 2.02 (1 H, br s), 2.77−2.86 (2 H, m), 3.44 (1 H, br s), 3.96 (1 H, br d, J = 13.19 Hz), 4.33−4.38 (1 H, m), 5.04 (2 H, ABq, J = 15.93, 12.64 Hz), 7.18−7.28 (5 H, m); ^{13}C NMR (75 MHz, $CDCl_3$) δ 10.1, 19.1, 25.5, 25.6, 29.2, 29.2, 30.5, 37.7, 39.7, 49.0, 67.3, 67.4, 71.5, 128.0, 128.1, 128.2, 128.3, 128.4, 128.4, 128.6, 137.0, 156.0. Anal. Calcd for $C_{17}H_{25}NO_3$: N, 4.81; C, 70.07; H, 8.65. Found: N, 4.52; C, 69.85; H, 8.58.

[2*R*-(2*S*)]-2-(2-Hydroxybutyl)piperidine [[2*R*-(2*S*)]-7]. A suspension of **8** (224 mg, 0.77 mmol) and $Pd(OH)_2$ (22 mg) in MeOH (4.4 mL) under a hydrogen atmosphere was stirred for 4 h. The mixture was filtered through a Celite pad, and the filtrate was evaporated. The residue was chromatographed on Al_2O_3 using 25% hexane−CH_2Cl_2 as eluent to give **4** (121 mg, 100%) as a solid: mp 53−4 °C (Et_2O); $[\alpha]^{25}_D$ +10.21° (*c* 1.080, EtOH); IR (KBr) 3302, 2925, 1453, 1324, 1121, 906, 793 cm^{-1}; ^{1}H NMR (300 MHz, $CDCl_3$) δ 0.90 (3 H, t, J = 7.69 Hz), 1.92−1.65 (9 H, m), 1.77−1.84 (1 H, m), 2.52−2.62 (1 H, m), 2.69 (1 H, tt, J = 10.99, 2.75 Hz), 2.98−3.05 (1 H, m), 3.68−3.77 (1 H, m); ^{13}C NMR (75 MHz, $CDCl_3$) δ 10.0, 24,7, 27.6, 31.0, 34.6, 42.1, 46.2, 58.4, 74.6. Anal. Calcd for $C_9H_{19}NO$: N, 8.91; C, 68.74; H, 12.18. Found: N, 8.91; C, 68.66; H, 12.18.

[2*S*-(2*S*)]-1-Benzyloxycarbonyl-2-(2-hydroxybutyl)piperidine (10). By a procedure similar to that for the preparation of **8**, [2*S*-(2*R*)]-**3** (402 mg, 2.11 mmol) was converted with lithium dimethylcuprate prepared by MeLi (4.21 mmol) and CuI (402 mg, 2.11 mmol) to **10** (260 mg, 85%) as an oil: $[\alpha]^{25}_D$ −30.83° (*c* 1.435, $CHCl_3$); IR (neat) 3447, 2935, 1670, 1424, 1259, 697 cm^{-1}; ^{1}H NMR (300 MHz, $CDCl_3$) δ 0.83 (3 H, t, J = 7.14 Hz), 1.05−1.16 (1 H, m), 1.26−1.66 (8 H, m), 1.86−1.96 (1 H, m), 2.60−2.70 (1 H, td, J = 12.64, 2.75 Hz), 3.11−3.13 (1 H, m), 3.93−3.97 (2 H, m), 4.41−4.46 (1 H, m), 5.06 (2 H, ABq, J = 22.80, 11.81 Hz), 7.20−7.28 (5 H, m); ^{13}C NMR (75 MHz, $CDCl_3$) δ 10.5, 19.1, 25.4, 29.4, 29.6, 37.1, 39.2, 47.2, 67.3, 68.4, 127.6, 127.9, 128.3, 136.4, 156.5; HRMS calcd for $C_{17}H_{25}NO_3$ (M^+) 291.1834, found 291.1829.

(+)-8-Ethylnorlobenol-I [[2*S*-(2*S*)]-7]. By a procedure similar to that for the preparation of [2*R*-(2*S*)]-**7**, **10** (120 mg, 0.77 mmol) was converted with $Pd(OH)_2$ (12 mg) in MeOH (2.4 mL) to [2*S*-(2*S*)]-**7** (121 mg, 100%): mp 89−90 °C (Et_2O), lit.[13] mp 87 °C; $[\alpha]^{25}_D$ +25.79° (*c* 1.380, EtOH), lit.[13] $[\alpha]^{25}_D$ +22.3° (*c* 1.56, EtOH); IR (KBr) 3272, 3148, 2992, 2926, 2832, 1452, 1342, 1156, 1102, 972 cm^{-1}; ^{1}H NMR (300 MHz, $CDCl_3$) δ 0.91 (3 H, t, J = 7.42 Hz), 1.30−1.61 (9 H, m), 1.79−1.81 (1 H, m), 2.55 (1 H, td, J = 11.81, 2.75 Hz), 2.83−3.05 (4 H, m), 3.75−3.82 (1 H, m); ^{13}C NMR (75 MHz, $CDCl_3$) δ 10.4, 25.0, 26.3, 30.8, 31.6, 41.7, 47.1, 55.0, 70.7; HRMS calcd for $C_9H_{19}NO$ (M^+) 157.1593, found 157.1568.

[2*S*-2(*S*)]-1-Benzyloxycarbonyl-2-(2-hydroxypropyl)piperidine [[2*S*-(2*S*)]-11]. Into a solution of [2*S*-(2*R*)]-**3** (300 mg, 1.09 mmol) in THF (5.7 mL) was injected a 1 M Super-Hydride−THF solution (4.36 mL, 4.36 mmol) at 0 °C. After the reaction mixture was stirred for 15 min, a few pieces of ice were added to it. After the reaction mixture was stirred for an additional 15 min at room temperature, excess CH_2Cl_2 was added to it. The organic solvent was washed with brine, dried, and evaporated. The residue was chromatographed using 20% EtOAc−hexane as eluent to yield [2*S*-(2*S*)]-**11** (286 mg, 95%) as an oil: $[\alpha]^{25}_D$ −28.52° (*c* 2.920, $CHCl_3$); IR (neat) 3447, 2935, 1670, 1425, 1260, 1176 cm^{-1}; ^{1}H NMR (500 MHz, $CDCl_3$) δ 1.19 (3 H, d, J = 6.20 Hz), 1.21−1.27 (1 H, m), 1.40−1.63 (5 H, m), 1.72−1.75 (1 H, m), 1.995 (1 H, t, J = 13.14 Hz), 2.76 (1 H, td, J = 10.58, 6.73 Hz), 3.53 (1 H, br s), 4.045 (1 H, br d, J = 12.82 Hz), 4.17 (1 H, s), 4.52 (1 H, br d, J = 10.25 Hz), 5.145 (2 H, ABq, J = 22.11, 9.83 Hz), 7.30−7.39 (5 H, m); ^{13}C NMR (125 MHz, $CDCl_3$) δ 19.2, 22.6, 25.5, 29.4, 39.4, 47.5, 63.4, 67.6, 128.0, 128.2, 128.6, 136.6, 157.0. Anal. Calcd for $C_{16}H_{23}NO_3$: N, 5.05; C, 69.28; H, 8.36. Found: N, 5.03; C, 68.86; H, 8.19.

(+)-Sedridine (9). A suspension of [2*S*-(2*S*)]-**11** (220 mg, 0.79 mmol) and $Pd(OH)_2$ (22 mg) in MeOH (5 mL) under a hydrogen atmosphere was stirred for 12 h. The mixture was filtered through a Celite pad, and the filtrate was evaporated to give **9** (113 mg, 100%) as a solid: mp 84−85 °C (isopropyl ether−petroleum ether), lit.[15b] mp 83−84 °C; $[\alpha]^{25}_D$ +28.36° (*c* 1.130, EtOH), lit.[15b] $[\alpha]^{24}_D$ +28.5° (*c* 2.32, EtOH); IR (KBr) 3277, 3166, 2968, 2856, 2811, 1474, 1453, 1370, 1340, 1158, 1110, 1093, 1054 cm^{-1}; ^{1}H NMR (500 MHz, $CDCl_3$) δ 1.175 (3 H, d, J = 6.41 Hz), 1.34−1.48 (4 H, m), 1.55−1.61 (3 H, m), 1.80−1.82 (1 H, m), 2.58 (1 H, td, J = 11.86 Hz, 2.78 Hz), 2.86−2.90 (1 H, m), 2.97 (2 H, br s), 3.04−3.07 (1 H, m), 4.125 (1 H, dqd, J = 9.40, 6.20, 3.20 Hz); ^{13}C NMR (125 MHz, $CDCl_3$) δ 23.8, 24.9, 26.2, 31.4, 43.8, 47.1, 55.0, 65.3. Anal. Calcd for C8H17NO: N, 9.78; C, 67.09; H, 11.96. Found: N, 9.72; C, 66.63; H, 11.95.

[2*R*-(2*S*)]-1-Benzyloxycarbonyl-2-(2-hydroxypropyl)piperidine (11). Into a solution of [2*R*-(2*R*)]-**3** (100 mg, 0.39 mmol) in THF (1.9 mL) was injected a 1 M Super-Hydride−THF solution (1.56 mL, 1.56 mmol) at 0 °C. After the reaction mixture was stirred for 15 min, a few pieces of ice were added to it. After the reaction mixture was stirred for an additional 15 min at room temperature, excess CH_2Cl_2 was added to it. The organic solvent was washed with brine, dried, and evaporated. The residue was chromatographed using 20% EtOAc−hexane as eluent to yield **11** (83 mg, 82%) as an oil: $[\alpha]^{25}_D$ +52.23° (*c* 1.740, $CHCl_3$); IR (neat) 3446, 2934, 1684, 1560, 1424 cm^{-1}; ^{1}H NMR (500 MHz, $CDCl_3$) δ 1.19 (3 H, br s), 1.41−1.63 (7 H, m), 1.83−1.87 (1 H, m), 2.91 (1 H, t, J = 12.93 Hz), 3.81 (1 H, br s), 4.05 (1 H, br s), 4.43 (1H, d, J = 5.34 Hz), 5.13 (2 H, ABq, J = 20.51, 12.39 Hz), 7.29−7.37 (5 H, m); ^{13}C NMR (125 MHz, $CDCl_3$) δ 19.1, 23.8, 25.6, 29.5, 39.7, 40.1, 49.0, 66.4, 67.3, 128.0, 128.1, 128.6, 136.9, 156.1. Anal. Calcd for $C_{16}H_{23}NO_3$: N, 5.05; C, 69.28; H, 8.36. Found: N, 4.77; C, 68.83; H, 8.41.

(+)-Allosedridine (12). A suspension of **11** (229 mg, 0.83 mmol) and $Pd(OH)_2$ (23 mg) in MeOH (4.7 mL) under a hydrogen atmosphere was stirred for 12 h. The mixture was filtered through a Celite pad, and the filtrate was evaporated to give **12** (119 mg, 100%) as a solid: mp 61 °C, lit.[17a] mp 62−63 °C; $[\alpha]^{25}_D$ +17.10° (*c* 1.550, MeOH), lit.[17a] $[\alpha]^{29}_D$ +16.2° (*c* 4.01, MeOH); IR (KBr) 3691, 3676, 2924, 1655, 1438, 1367, 1331, 1054, 790 cm^{-1}; ^{1}H NMR (500 MHz, $CDCl_3$) δ 1.03−1.09 (1 H, m), 1.11 (3 H, d, J = 5.98 Hz), 1.21−1.31 (2 H, m), 1.41−1.52 (2 H, m), 1.56−1.62 (2 H, m), 1.77−1.80 (1 H, m), 2.56 (1 H, td, J = 13.89, 2.99 Hz), 2.69 (1 H, t, J = 10.68 Hz), 3.02 (1 H, d, J = 13.67 Hz), 3.50 (2 H, br s), 3.98 (1 H, dqd, J = 10.26, 6.20, 2.14 Hz); ^{13}C NMR (125 MHz, $CDCl_3$) δ 24.0, 24.6, 27.3, 34.3, 44.4, 46.1, 58.1, 69.2. Anal. Calcd for $C_8H_{17}NO$: N, 9.78; C, 67.09; H, 11.96. Found: N, 9.54; C, 67.18; H, 11.90.

[2*S*-(2*R*)]-1-Benzyloxycarbonyl-2-(2-hydroxypropyl)piperidine (*ent*-11). By a procedure similar to that for the preparation of [2*R*-(2*S*)]-**11**, [2*S*-(2*S*)]-**3** (105 mg, 0.39 mmol) was converted with Super-Hydride ($LiEt_3BH$, 1.0 M in THF) (1.6 mL, 1.6 mmol) in THF (1.9 mL) to *ent*-**11** (85 mg, 84%): $[\alpha]^{25}_D$ −52.37° (*c* 1.275, $CHCl_3$).

(−)-Allosedridine (*ent*-12). By a procedure similar to that for the preparation of **12**, [2*S*-(2*R*)]-**11** was converted with $Pd(OH)_2$ (8 mg) in MeOH (6 mL) to *ent*-**12** (119 mg, 95%) as a

solid: mp 60−61 °C, lit.[17a] mp 62−63 °C; $[\alpha]^{25}_D$ −16.18° (*c* 1.550, MeOH), lit.[17a] $[\alpha]^{29}_D$ +16.2° (*c* 4.01, MeOH) for **12**.

(−)-*N*-Methylsedridine (13). By a procedure similar to that for the preparation of **6**, [2*S*-(2*R*)]-**3** (195 mg, 0.71 mmol) was converted with $LiAlH_4$ (53.8 mg, 1.42 mmol) in THF (4.2 mL) to **13** (116 mg, 100%) as an oil: $[\alpha]^{25}_D$ −32.99° (*c* 0.675, EtOH), lit.[12b] $[\alpha]^{23}_D$ −31° (*c* 1.05, 96% EtOH); IR (neat) 3383, 2932, 2856, 2792, 1456 cm^{-1}; ^1H NMR (500 MHz, $CDCl_3$) δ 1.155 (3 H, d, J = 6.20 Hz), 1.23−1.33 (2 H, m), 1.48−1.62 (3 H, m), 1.69−1.78 (2 H, m), 1.93−2.00 (2 H, m), 2.16−2.19 (1 H, m), 2.34 (3 H, s), 2.90 (1 H, br s, J = 11.54 Hz), 4.225 (1 H, dqd, J = 10.68, 5.98, 2.99 Hz); ^{13}C NMR (125 MHz, $CDCl_3$) δ 23.8, 24.7, 26.0, 29.9, 38.9, 44.3, 57.6, 63.1, 65.4; HRMS calcd for $C_9H_{19}NO$ (M^+) 157.1466, found 157.1479.

[2*R*-(2*S*)]-Phenylmethyl 2-(2-Hydroxypent-4-enyl)piperidinecarboxylate (14). By a procedure similar to that for the preparation of **5**, [2*R*-(2*R*)]-**3** (149 mg, 0.54 mmol)) was converted with a 1 M vinylmagnesium bromide−THF solution (0.81 mL, 0.81 mmol) in the presence of $CuBr{\cdot}SMe_2$ (11 mg, 0.54 mmol) to **14** (147 mg, 90%) as an oil: $[\alpha]^{25}_D$ +44.05° (*c* 2.250, $CHCl_3$); IR (neat) 3446, 2936, 1674, 1427, 1354, 1264, 1171, 1074, 698 cm^{-1}; ^1H NMR (300 MHz, $CDCl_3$) δ 1.35−1.71 (7 H, m), 1.77−1.87 (1 H, m), 2.04−2.34 (2 H, m), 2.80−2.95 (2 H, m), 3.66 (1 H, br s), 4.02−4.06 (1 H, m), 4.44−4.48 (1 H, m), 5.06−5.13 (4 H, m), 5.76−5.79 (1 H, m), 4.28−7.36 (5 H, m); ^{13}C NMR (75 MHz, $CDCl_3$) δ 19.2, 25.7, 29.2, 29.2, 29.3, 37.3, 37.4, 39.7, 42.1, 48.8, 67.2, 68.9, 68.9, 69.0, 69.0, 69.1, 69.1, 69.1, 69.2, 117.8, 117.9, 118.02, 127.9, 128.0, 128.5, 134.8, 136.8, 155.7; HRMS calcd for $C_{18}H_{25}O_3N$ (M^+) 303.1834, found 303.1841.

[2*R*-(2*R*)]-Phenylmethyl 2-(2-(2,5-Dioxopyrrolidinyl)-pent-4-enyl)piperidinecarboxylate (15). To a solution of **14** (145 mg, 0.48 mmol) and PPh_3 (375 mg, 1.43 mmol) in THF (4.8 mL) was added dropwise a solution of diethyl azodicarboxylate (DEAD) (225 mL, 1.43 mmol) in THF (4.8 mL) at −20 °C. Succinimide (142 mg, 1.43 mmol) was added to the mixture. Then the reaction mixture was slowly warmed to 0 °C and stirred for 4 h. The organic solvent was evaporated. The residue was chromatographed using 20% EtOAc−hexane as eluent to yield **15** (130 mg, 70%) as an oil: $[\alpha]^{25}_D$ +65.74° (*c* 1.510, $CHCl_3$); IR (neat) 2937, 1773, 1700, 1474, 1430, 1374, 1254, 1171, 699 cm^{-1}; ^1H NMR (300 MHz, $CDCl_3$) δ 1.25−1.69 (6 H, m), 2.14−2.41 (4 H, m), 2.52−2.71 (4 H, m), 2.73−2.82 (1 H, m), 4.02−4.27 (3 H, m), 4.95−5.08 (4 H, m), 5.61−5.72 (1 H, m), 7.26−7.39 (5 H, m); ^{13}C NMR (75 MHz, $CDCl_3$) δ 19.55, 25.98, 28.41, 28.74, 30.32, 37.39, 39.47, 47.40, 48.20, 67.31, 117.98, 127.90, 128.49, 134.55, 136.95, 155.30, 178.30; HRMS calcd for $C_{22}H_{28}O_4N_2$ (M^+) 384.2049, found 384.2036.

(2*R*,7*R*,9*R*)-1.6-Diaza-7-propyltricyclo[7.4.0.0^{2,6}]tridecan-5-one (16). A suspension of **15** (60 mg, 0.16 mmol) and 10% Pd/C (60 mg) in MeOH (228 mL) was stirred under hydrogen at 4 atm for 100 h. The mixture was filtered through a Celite pad, and the filtrate was evaporated. The residue was chromatographed using 1% MeOH−CH_2Cl_2 as eluent to give **16** (31 mg, 82%) as a solid: mp 39−40 °C; $[\alpha]^{25}_D$ +5.95° (*c* 1.695, $CHCl_3$); IR (neat) 2933, 2859, 2799, 1690, 1421, 1305, 1274, 1090 cm^{-1}; ^1H NMR (300 MHz, $CDCl_3$) δ 0.91 (3 H, t, J = 7.14 Hz), 1.18−1.88 (14 H, m), 2.12−2.50 (4 H, m), 2.91 (1 H, br d, J = 10.99 Hz), 3.78 (1 H, t, J = 6.04 Hz), 4.19 (1 H, q, J = 7.14 Hz); ^{13}C NMR (75 MHz, CDCl3) δ 14.28, 19.76, 24.62, 25.50, 29.96, 32.95, 33.02, 35.00, 46.88, 49.78, 56.49, 73.62, 77.40, 172.87; HRMS calcd for $C_{14}H_{24}ON_2$ (M^+) 236.1888, found 236.1867.

(+)-Tetraponerine-3 (T-3). To a suspension of $LiAlH_4$ (78 mg, 2.1 mmol) in THF (5.3 mL) was added a solution of **16** (49 mg, 0.21 mmol) in THF (2.7 mL) at 0 °C. After being stirred for 1 h at room temperature, the reaction mixture was refluxed for 6 h. To the mixture were successively added excess EtOAc and 10% NH_4OH with ice cooling. The organic layer was separated, and the aqueous layer was extracted with CH_2Cl_2. The combined solvents were washed with brine, dried with anhydrous K_2CO_3, and evaporated. The residue was chromatographed using 1% MeOH−CH_2Cl_2 as eluent to yield **T-3** (37 mg, 80%) as an oil: $[\alpha]^{25}_D$ +34.57° (*c* 0.505, $CHCl_3$), lit.[20e] $[\alpha]^{20}_D$ +31° (*c* 3.1, $CHCl_3$); IR (neat) 2928, 2858, 2800, 2748, 1457, 1389, 1353, 1130, 1117 cm^{-1}; ^1H NMR (500 MHz, C_6D_6) δ 0.93 (3 H, t, J = 7.26 Hz), 1.07 (1 H, br d, J = 12.6 Hz), 1.15−1.18 (1 H, m), 1.27−1.81 (14 H, m), 1.89−1.95 (1 H, m), 1.98−2.03 (1 H, m), 2.74−2.81 (3 H, m), 3.17−2.19 (1 H, m), 3.27 (1 H, dd, J = 5.13, 2.35 Hz); ^{13}C NMR (125 MHz, C_6D_6) δ 14.4, 14.5, 20.6, 22.1, 25.0, 26.3, 30.4, 32.0, 33.1, 33.1, 33.9, 50.6, 50.8, 52.8, 56.7, 75.5, 75.6; HRMS calcd for $C_{14}H_{26}N_2$ (M^+) 222.2096, found 222.2087.

[2*R*-(2*S*)]-Phenylmethyl 2-(2-(2,5-Dioxopyrrolidinyl)-pent-4-enyl)piperidinecarboxylate (17). By a procedure similar to that for the preparation of **15**, **5** (164 mg, 0.54 mmol) was converted by the Mitsunobu reaction using PPh_3 (425 mg, 1.62 mmol), DEAD (255 mL, 1.62 mmol), and succinimide (161 mg, 1.62 mmol) to **17** (134 mg, 65%) as an oil: $[\alpha]^{25}_D$ +42.70° (*c* 1.470, $CHCl_3$); IR (neat) 2937, 1772, 1700, 1425, 1370, 1256, 1187, 1135, 698 cm^{-1}; ^1H NMR (300 MHz, $CDCl_3$) δ 1.35−1.67 (6 H, m), 1.82−1.91 (1 H, m), 2.32−2.60 (6 H, m), 2.61−2.84 (2 H, m), 3.96−4.04 (1 H, m), 4.08−4.18 (2 H, m), 4.96−5.14 (4 H, m), 5.52−5.66 (1 H, m), 7.27−7.39 (5 H, m); ^{13}C NMR (75 MHz, $CDCl_3$) δ 19.2, 25.7, 28.1, 28.7, 36.3, 39.8, 48.9, 50.1, 67.3, 77.4, 117.9, 128.0, 128.6, 134.5, 137.0, 155.3, 177.7; HRMS calcd for $C_{22}H_{28}O_4N_2$ (M^+) 384.2049, found 384.2059.

(2*R*,7*S*,9*R*)-1.6-Diaza-7-propyltricyclo[7.4.0.0^{2,6}]tridecan-5-one (18). By a procedure similar to that for the preparation of **16**, **17** (42 mg, 0.11 mmol) was converted with reduction using 10% Pd/C (42 mg) to **18** (19 mg, 73%) as a solid: mp 58−60 °C; $[\alpha]^{25}_D$ +80.94° (*c* 1.015, $CHCl_3$); IR (neat) 2956, 2930, 2856, 2757, 1702, 1439, 1421, 1278 cm^{-1}; ^1H NMR (500 MHz, $CDCl_3$) δ 0.94 (3 H, t, J = 7.26 Hz), 1.26−1.45 (5 H, m), 1.54−1.64 (3 H, m), 1.69−2.00 (6 H, m), 2.07−2.14 (1 H, m), 2.24−2.31 (1H, m), 2.40−2.50 (2 H, m), 2.97−2.99 (1 H, m), 3.15−3.19 (1 H, m), 3.51 (1 H, t, J = 6.20 Hz); ^{13}C NMR (75 MHz, $CDCl_3$) δ 14.43, 19.78, 23.95, 24.37, 25.54, 31.34, 32.66, 34.00, 38.34, 49.55, 56.97, 61.83, 80.36, 174.74; HRMS calcd for $C_{14}H_{24}ON_2$ (M^+) 236.1888, found 236.1821.

(+)-Tetraponerine-4 (T-4). By a procedure similar to that for the preparation of **T-3**, **18** (46 mg, 0.19 mmol) was converted with $LiAlH_4$ (72 mg, 1.9 mmol) in THF (5 mL) to **T-4** (38 mg, 90%) as an oil: $[\alpha]^{25}_D$ +107.25° (*c* 1.155, $CHCl_3$), lit.[20e] $[\alpha]^{20}_D$ +105° (*c* 0.3, $CHCl_3$); IR (neat) 2932, 2857, 2790, 1378, 1338, 1191, 1157 cm^{-1}; ^1H NMR (500 MHz, C_6D_6) δ 0.88 (3 H, t, J = 7.16 Hz), 1.15−1.54 (11 H, m), 1.59−1.74 (7 H, m), 1.97−2.02 (1 H, m), 2.06−2.11 (1 H, m), 2.27−2.30 (1H, m), 2.80−2.82 (1 H, m), 3.11 (1 H, ddd, J = 8.12, 8.12, 2.56 Hz); ^{13}C NMR (125 MHz, C_6D_6) δ 14.78, 18.64, 20.14, 25.04, 25.16, 29.64, 32.91, 36.83, 37.88, 48.90, 48.99, 51.48, 61.15, 62.62, 85.48, 85.55; HRMS calcd for $C_{14}H_{26}N_2$ (M^+) 222.2096, found 222.2077.

[2*R*-(2*S*)]-Phenylmethyl 2-(2-Hydroxyheptyl)piperidinecarboxylate (19). To a suspension of CuI (415 mg, 2.18 mmol) in Et_2O (5.5 mL) was added a 1.6 M *n*-butyllithium−hexane solution (2.7 mL, 4.36 mmol) at −45 °C. A solution of [2*R*-(2*R*)]-**3** (300 mg, 1.09 mmol) in Et_2O (1.1 mL) was added to the reaction mixture at −70 °C. After being stirred for 2 h, the reaction was quenched with saturated NH_4Cl and extracted with Et_2O. The extract was washed with brine, dried, and evaporated. The residue was chromatographed using 13% EtOAc−hexane as eluent to give **19** (287 mg, 79%) as an oil: $[\alpha]^{25}_D$ +41.97° (*c* 1.215, $CHCl_3$); IR (neat) 3446, 2931, 2857, 1669, 1425, 1261, 1171, 697 cm^{-1}; ^1H NMR (300 MHz, $CDCl_3$) δ 0.88 (3 H, t, J = 6.87 Hz), 1.25−1.81 (16 H, m), 2.85−2.94 (2 H, m), 3.60−3.61 (1 H, m), 4.04 (1 H, br d, J = 12.09 Hz), 4.43−4.46 (1 H, m), 5.12 (2 H, ABq, J = 13.74, 12.64 Hz), 7.29−7.36 (5 H, m); ^{13}C NMR (75 MHz, $CDCl_3$) δ 14.24, 19.09, 22.81, 25.51, 25.62, 29.12, 31.99, 37.67, 37.99, 39.66, 48.90, 67.14, 69.96, 127.77, 127.86, 128.39, 136.74, 155.64; HRMS calcd for $C_{20}H_{31}O_3N$ (M^+) 333.2304, found 333.2290.

[2*R*-(2*R*)]-Phenylmethyl 2-(2-(2,5-Dioxopyrrolidinyl)-heptyl)piperidinecarboxylate (20). By a procedure similar to that for the preparation of **15**, **19** (130 mg, 0.39 mmol) was converted by the Mitsunobu reaction using Ph_3P (307 mg, 1.17 mmol), DEAD (184 mL, 1.17 mmol), and succinimide (116 mg, 1.17 mmol) in THF (3.9 mL) to **20** (129 mg, 80%) as an oil:

$[\alpha]^{25}_D$ +76.52° (*c* 2.58, $CHCl_3$); IR (neat) 2931, 2858, 1772, 1700, 1472, 1429, 1373, 1254, 1171, 698, 668 cm^{-1}; ^1H NMR (300 MHz, $CDCl_3$) δ 0.85 (3 H, t, J = 6.59 Hz), 1.24−1.79 (12 H, m), 2.16−2.29 (4 H, m), 2.64 (4 H, br s), 2.73−2.78 (1 H, m), 4.00−4.18 (3 H, m), 4.99−5.05 (2 H, m), 7.29−7.36 (5 H, m); ^{13}C NMR (75 MHz, $CDCl_3$) δ 14.24, 19.50, 22.70, 25.97, 26.36, 28.47, 28.73, 30.53, 31.76, 32.84, 39.41, 47.32, 48.88, 67.23, 127.83, 128.43, 136.93, 155.25, 178.42; HRMS calcd for $C_{24}H_{34}O_4N_2$ (M^+) 414.2519, found 414.2487.

(2*R*,7*R*,9*R*)-1.6-Diaza-7-pentyltricyclo[7.4.0.0^{2,6}]tridecan-5-one (21). By a procedure similar to that for the preparation of **16**, **20** (60 mg, 0.145 mmol) was converted with reduction using 10% Pd/C (60 mg) in CH_3OH (206 mL) to **21** (30 mg, 79%) as an oil: $[\alpha]^{25}_D$ +3.15° (c 1.525, $CHCl_3$); IR (neat) 2931, 2857, 2798, 1694, 1421, 1276 cm^{-1}; ^1H NMR (300 MHz, $CDCl_3$) δ 0.85 (3 H, t, J = 6.59 Hz), 1.18−1.86 (18 H, m),2.15−2.43 (4 H, m), 2.90 (1 H, br d, J = 10.99 Hz), 3.77 (1 H, br t, J = 6.04 Hz), 4.14−4.16 (1 H, m); ^{13}C NMR (75 MHz, $CDCl_3$) δ 14.3, 22.8, 24.6, 25.5, 26.1, 29.9, 30.8, 32.0, 32.9, 34.9, 47.1, 49.7, 50.4, 73.6, 77.4, 172.8; HRMS calcd for $C_{16}H_{28}ON_2$ (M^+) 264.2201, found 264.2222.

(+)-Tetraponerine-7 (T-7). By a procedure similar to that for the preparation of **T-3**, **21** (63 mg, 0.24 mmol) was converted with reduction using $LiAlH_4$ (90 mg, 2.4 mmol) in THF (3.5 mL) to **T-7** (48 mg, 80%) as an oil: $[\alpha]^{25}_D$ +30.91° (*c* 1.1350, $CHCl_3$), lit.[20e] $[\alpha]^{20}_D$ +30° (*c* 2.8, $CHCl_3$); IR (neat) 2931, 2857, 2798, 1694, 1421, 1276 cm^{-1}; ^1H NMR (500 MHz, C_6D_6) δ 0.92 (3 H, t, J = 7.05 Hz), 1.10 (1 H, br d, J = 2.35 Hz), 1.11−1.82 (19 H, m), 1.93 (1 H, ddd, J = 12.81, 12.81, 5.55 Hz), 2.02−2.05 (1 H, m), 2.76−2.82 (3H, m), 3.15−3.18 (1 H, m), 3.31 (1 H, dd, J = 4.70 Hz, 2.78 Hz); ^{13}C NMR (125 MHz, C_6D_6) δ 14.38, 22.16, 23.19, 25.18, 26.46, 27.35, 30.46, 31.02, 32.15, 32.46, 34.17, 50.58, 50.93, 53.25, 56.68, 75.42, 75.46; HRMS calcd for $C_{16}H_{30}N_2$ (M^+) 250.2409, found 250.2404.

[2*R*-(2*R*)]-Phenylmethyl 2-(2-Hydroxyheptyl)piperidinecarboxylate [[2*R*-(2*R*)]-19]. By a procedure similar to that for the preparation of **19**, [2*R*-(2*S*)]-**3** (300 mg, 1.09 mmol) was converted with *n*-Bu_2CuLi (2.18 mmol) to [2*R*-(2*R*)]-**19** (326 mg, 90%) as an oil: $[\alpha]^{25}_D$ +25.12° (*c* 1.0550, $CHCl_3$); IR (neat) 3462, 2933, 2858, 1670, 1430, 1353, 1258, 1174, 697 cm^{-1}; ^1H NMR (300 MHz, $CDCl_3$) δ 0.89 (3 H, t, J = 6.87 Hz), 1.15−1.80 (15 H, m), 1.95−2.05 (1 H, m), 2.70−2.79 (1 H, m), 3.27 (1 H, br s), 4.04−4.05 (2 H, m), 4.51−4.55 (1 H, m), 5.15 (2 H, ABq, J = 28.02 Hz, 12.09 Hz), 7.29−7.40 (5 H, m); ^{13}C NMR (75 MHz, $CDCl_3$) δ 14.3, 19.3, 22.9, 25.6, 26.0, 29.5, 32.1, 36.9, 37.7, 39.4, 47.4, 67.3, 67.5, 127.8, 128.1, 128.5, 136.6, 156.7; HRMS calcd for $C_{20}H_{31}O_3N$ (M^+) 333.2304, found 333.2279.

[2*R*-(2*S*)]-Phenylmethyl 2-(2-(2,5-Dioxopyrrolidinyl)-heptyl)piperidinecarboxylate [2*R*-(2*S*)]-20. By a procedure similar to that for the preparation of **15**, [2*R*-(2*R*)]-**19** (167 mg, 0.50 mmol) was converted by the Mitsunobu reaction with PPh_3 (393 mg, 1.50 mmol), DEAD (236 mL, 1.50 mmol), and succinimide (149 mg, 1.50 mmol) to [2*R*-(2*S*)]-**20** (171 mg, 83%) as an oil: $[\alpha]^{25}_D$ +24.98° (*c* 1.70, $CHCl_3$); IR (neat) 2930, 2859, 1772, 1698, 1425, 1371, 1262, 1185 cm^{-1}; ^1H NMR (300 MHz, $CDCl_3$) δ 0.83 (3 H, t, J = 6.59 Hz), 1.10−1.58 (13 H, m), 1.77−1.86 (1 H, m), 1.92−1.96 (1 H, m), 2.27−2.55 (5 H, m), 2.74−2.83 (1 H, m), 3.99−4.12 (3 H, m), 5.02−5.11 (2 H, m), 7.29−7.42 (5 H, m); ^{13}C NMR (75 MHz, $CDCl_3$) δ 14.3, 19.2, 22.8, 25.7, 26.4, 28.2, 28.7, 31.6, 31.7, 32.1, 39.8, 48.9, 48.9, 50.9, 67.2, 67.3, 77.4, 128.0, 128.0, 128.5, 136.9, 155.2, 177.9; HRMS calcd for $C_{24}H_{34}O_4N_2$ (M^+) 414.2518, found 414.2530.

(2*R*,7*S*,9*R*)-1,6-Diaza-7-pentyltricyclo[7.4.0.0^{2,6}]tridecan-5-one (2*R*,7*S*,9*R*)-21. A suspension of [2*R*-(2*S*)]-**20** (63 mg, 0.152 mmol) in MeOH (206 mL) was stirred under hydrogen at 5 atm in the presence of $Pd(OH)_2$ (12.6 mg) for 100 h. The mixture was filtered through a Celite pad, and the filtrate was evaporated. The residue was chromatographed using 1% MeOH−CH_2Cl_2 as eluent to give (2*R*,7*S*,9*R*)-**21** (22 mg, 55%) as an oil: $[\alpha]^{25}_D$ +63.50° (*c* 1.055, $CHCl_3$); IR (neat) 2931, 2856, 2799, 2758, 1700, 1420, 1377, 1341, 1276 cm^{-1}; ^1H NMR (300 MHz, $CDCl_3$) δ 0.86 (3 H, t, J = 6.59 Hz), 1.24−2.48 (22 H, m), 2.96 (1 H, br d, J = 10.99 Hz), 3.11−3.20 (1 H, m), 3.49 (1 H, t, J = 6.59 Hz); ^{13}C NMR (75 MHz, $CDCl_3$) δ 14.4, 23.0, 24.0, 24.4, 25.5, 26.3, 31.3, 31.8, 32.2, 32.6, 38.3, 49.5, 57.1, 61.8, 80.3, 174.7; HRMS calcd for $C_{16}H_{28}ON_2$ (M^+) 264.2202, found 264.2206.

(+)-Tetraponerine-8 (T-8). By a procedure similar to that for the preparation of **T-3**, (2*R*,7*S*,9*R*)-**21** (40 mg, 0.15 mmol) was converted with reduction using $LiAlH_4$ (57 mg, 1.51 mmol) in THF (4.3 mL) to **T-8** (32 mg, 85%) a solid: mp 38−40 °C, lit.[20e] mp 40 °C; $[\alpha]^{25}_D$ +98.18° (*c* 0.70, $CHCl_3$), lit.[20e] $[\alpha]^{20}_D$ +99° (*c* 0.6, $CHCl_3$); IR (neat) 2930, 2857, 2789, 2704, 2509, 1377, 1338 cm^{-1}; ^1H NMR (500 MHz, C_6D_6) δ 0.89 (3 H, t, J = 7.05 Hz), 1.16−1.77 (22 H, m), 2.01−2.14 (2 H, m), 2.29−2.32 (1H, m), 2.83 (1 H, br d, J = 9.61 Hz), 3.13−3.17 (1H, m); ^{13}C NMR (125 MHz, C_6D_6) δ 14.3, 20.2, 23.1, 25.1, 25.2, 26.2, 29.7, 32.8, 32.9, 34.6, 37.9, 49.0, 51.5, 61.3, 62.6, 85.6; HRMS calcd for $C_{16}H_30N_2$ (M^+) 250.2409, found 250.2398.

Supporting Information Available: ^1H and ^{13}C NMR spectra of new compounds. This material is available free of charge via the Internet at http://pubs.acs.org.

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