Chinese Journal of Chemistry, **2004**, *22*, 384—389 **Article**

A Valuable Synthetic Route to the Enantiopure Functionalized *N*-Substituted Aziridines

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Chiral butyrolacto[3,4-*b*]-2(*S*)-6(*R*)-1-*N*-akylaziridines **7** were synthesized in enantiopure form utilizing racemic 5-methoxy-3-bromo-2(5*H*)-furanone (**5**) and available amines (**6**) as key precursors. After highly effective reduction of **7**, the functionalized 2(*S*),3(*R*)-dihyroxymethyl-*N*-alkylaziridines (**8**) were obtained in good yields with ⩾98% *ee*. This is a simple and pratical method for the preparation of enantiopure aziridines which are important intermediates in the synthesis of biologic active molecules.

Keywords asymmetric synthesis, chiral 2(*S*),3(*R*)-dihyroxymethyl-*N*-alkylaziridine, biologic active molecule, X-ray crystllography

Introduction

Aziridines are highly versatile synthetic precursors and have been used as synthons for chiral amines, amino acids, amino alcohols, alkaloids and *β*-lactam antibiotics.[1-3] There are also a number of natural products which contain this functionality and display potent antitumor and antibiotic activity.[4] The synthesis of the chiral aziridine ring is generally achieved starting from enantiomerically pure natural compounds[1-3] or by direct aziridination[5] of a nitrene to olefins as well as of a carbene to imines. Although the synthetic routes to chiral aziridines have been developed, considerably less attention has been paid to the synthesis of functionalized aziridines from racemic and available materials through further chemical transformations.[6] Thus, the development of a simple and effective method for preparation of enantiopure aziridines would be desirable. Recently, we have found that chiral 3-bromo-2(5*H*)-furanone reacts easily with some nucleophiles such as ethyl acetoacetate to give chiral bicylo[3.3.0]octene derivatives via tandem asymmetric Michael addition/intramolecular nucleophilic substitution.[7] The preceding results led us to explore the possibility of using dinucleophilic reagents to convert 5-alkyloxy-3-bromo-2(5*H*)-furanones into other heterocyclic compounds. Now we report our results on the synthesis of enantiopure 5-(*R*)-methoxy-butyrolacto-[3,4-*b*]-2(*S*)-6(*R*)-1-*N*-alkylaziridines **7a**—**7c** from racemic 5-methoxy-3-bromo-2(5*H*)-furanones **5a** + **5b** with primary amines **6a**—**6c** and subsequent highly effective reduction of **7a**—**7c** to afford the functionalized 2(*S*),3(*R*)-dihyroxymethyl-*N*-alkylaziridines **8a**—**8c**.

Results and discussion

The synthesis of racemic 5-methoxy-2-(5*H*)-furanone **3a** + **3b** was conveniently achieved starting from 5-hydroxy-2(5*H*)-furunone (**2**). The photooxidation of furfural (**1**) is probably most suitable for the preparation of **2**.[8-10] We performed the improved photosynthetic procedure using 95% C_2H_5OH as a solvent at room temperature providing 5-hydroxy-2(5*H*)-furanone in good yield. A racemic mixture of 5-methoxy-2(5*H*)-furanone (**3**) was readily available in 82% yield through acetalization of the resulting 5-hydroxy-2(5*H*)-furanone in methanol under refluxing.[11,12] The racemic mixture of 5-methoxy-3-bromo-2(5*H*)-furanone (**5**) was easily prepared in four steps in 53% overall yield from **1** on large scale (Scheme 1).[13,14]

For the reaction of racemic mixture of 5-methoxy-3-bromo-2(5*H*)-furanone (**5**) with amines **6**, we utilized a procedure on the basis of previous work.[7-14] Treatment of the racemic precursor **5** with commercially available amines, in acetonitrile at room temperature in the presence of potassium carbonate and TBAB gave the corresponding crude racemic product **7**(*R*)+**7**(*S*) via the tandem asymmetric Michael addition/internal nucleophilic substitution. The enantiopure 5-(*R*)-methoxy-butyrolacto[3,4-*b*]-2(*S*)-6(*R*)-1-*N*-akyl-aziridines with two stereogenic centers **7a**—**7c** were obtained in 38%—42% yields with ⩾98% *ee* after purification by column chromatography and the resolution of the racemic product by recrystallization [a mixture of petroleum ether/ethyl acetate=4∶1 (*V*∶*V*)] (Scheme **2**).

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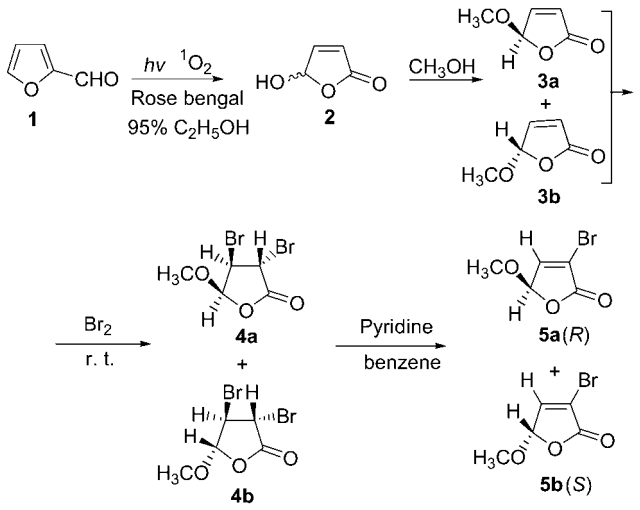
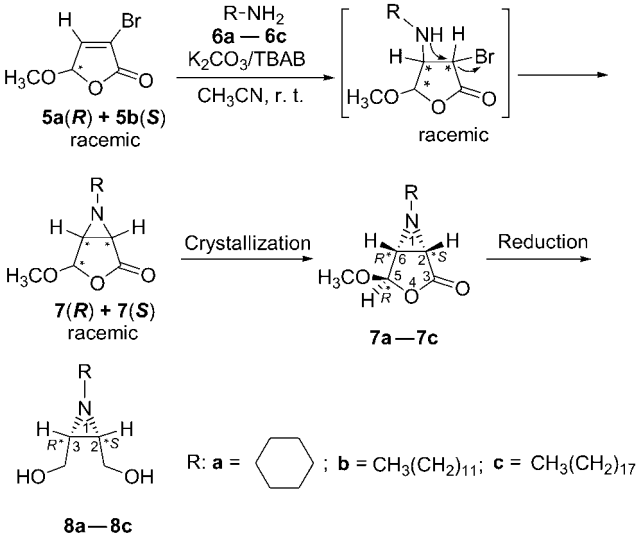
Scheme 1



Scheme 2



The stereochemistry of this novel chiral compounds **7** were readily confirmed by analytical and spectroscopic data, such as IR, ^{1}H NMR, ^{13}C NMR, MS, $[\alpha]_D^{20}$ and elemental analysis. **7a** is rectangle transparent crystal determined by spectroscopy method and X-ray crystallography, respectively. The presence of methoxy-2(5*H*)-furanune moieties was deduced from the ^{1}H NMR spectrum, which showed the signal at δ 5.20 (H, s, H-5) assignable to the acetal proton, where there was no coupling between the vicinal protons H-5/H-6, establishing a *trans* relationship. In addition, the ^{1}H NMR spectrum also showed two signals at δ 2.82 (d, J=4.4 Hz, 1H, H-2) and 2.61 (d, J=4.4 Hz, 1H, H-6) assignable to the two protons in the aziridine ring, indicating a *cis* relationship. The presence of IR band at 3074 cm^{-1} was assignable to a C—H stretch in an aziridine ring and the signals at δ 43.9 (C-2) and δ 37.2 (C-6) of the ^{13}C NMR spectrum were also in agreement with the presence of a fused butyrolacto[3, 4-*b*]/aziridine ring. On the basis of the data, the proposed structure of 5-(*R*)-methoxy-butyrolacto[3,4-*b*]-2(*S*)-6(*R*)-1-*N*-cyclohexanyl-aziridine (**7a**) was consistent with the stereochemistry and configuration of its molecule**,** and this was further confirmed by its X-ray crystallography as shown in Figure 1 and Figure 2. The whole chiral molecule **7a** has three chiral centers including the original chiral center C(5)(*R*) and two new stereogenic centers C(2)(*S*), C(6)(*R*). From the viewpoint of the structure of the aziridine derivative **7a,** the bond angles of the aziridine component of the whole molecule are: C(10)-N(1)-C(7) 60.13(6)°, C(10)-C(7)-N(1) 58.78(11)°, N(1)-C(10)-C(7) 61.13(11)°, which are approximate to 60° and in agreement with the theoretical value. The selective bond lengths and bond angles of compound **7a** are listed in Table 1 and Table 2. The lactone ring fused with aziridine ring to form the compound with [3.1.0] bicyclic skeleton.

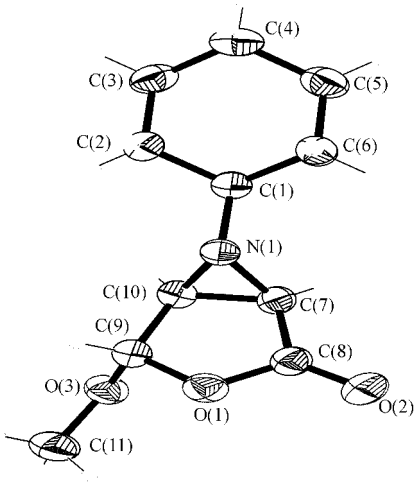


Figure 1 The ORTEP drawing of the molecule **7a.**

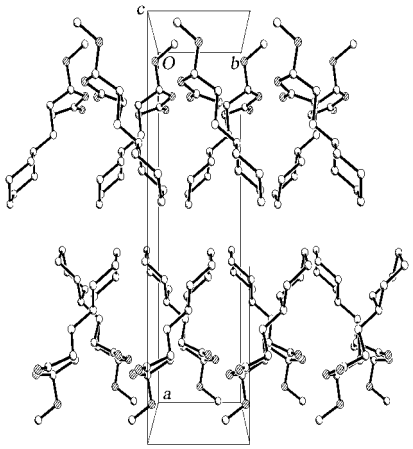


Figure 2 The crystal packing of the molecule **7a.**

Table 1 The main bond lengths (nm) of compound **7a**

N(1)—C(10)	0.1454(2)	O(3)—C(11)	0.1432(3)	C(5)—H(5A)	0.09700
N(1)—C(1)	0.1473(2)	C(1)—C(2)	0.1515(2)	C(5)—H(5B)	0.09700
N(1)—C(7)	0.1489(2)	C(1)—C(6)	0.1516(3)	C(6)—H(6A)	0.09700
O(1)—C(8)	0.1360(2)	C(2)—C(3)	0.1523(3)	C(7)—C(8)	0.1463(3)
O(1)—C(9)	0.1460(2)	C(3)—C(4)	0.1510(3)	C(7)—C(10)	0.1475(2)
O(2)—C(8)	0.1202(2)	C(4)—C(5)	0.1518(3)	C(7)—H(7A)	0.09800
O(3)—C(9)	0.1369(2)	C(5)—C(6)	0.1522(3)	C(9)—C(10)	0.1487(3)

Table 2 The main bond angles (°) of compound **7a**

C(10)-N(1)-C(1)	113.50(14)	N(1)-C(1)-C(6)	110.91(14)	C(8)-C(7)-N(1)	110.36(16)
C(10)-N(1)-C(7)	60.13(12)	C(2)-C(1)-C(6)	110.33(17)	C(1)-N(1)-C(7)	113.70(13)
C(10)-C(7)-N(1)	58.74(11)	C(1)-C(2)-C(3)	110.80(16)	O(2)-C(8)-O(1)	120.85(19)
N(1)-C(10)-C(7)	61.13(11)	C(4)-C(5)-C(6)	111.76(17)	O(2)-C(8)-C(7)	129.6(2)
C(9)-O(3)-C(11)	114.47(17)	C(1)-C(6)-C(5)	110.41(16)	C(8)-O(1)-C(9)	110.83(14)
N(1)-C(1)-C(2)	109.07(14)	C(8)-C(7)-C(10)	106.04(16)	N(1)-C(10)-C(9)	113.71(15)

Using the synthetic strategy outlined in Scheme 2, 5-(*R*)-methoxy-butyrolacto[3,4-*b*]-2(*S*)-6(*R*)-1-*N*-alkyl-aziridines **7a—7c** were reduced by $LiAlH_4$ in a suspension of THF to give the enantiopure functionalized compounds, 2(*S*),3(*R*)-dihydroxymethyl-*N*-alkylaziridines **8a**—**8c** in good yields with $\geqslant$98% *ee*. The chemical structure of **8a** is readily confirmed by analytical data and spectroscopic data. The stereochemistry and perspective view of **8a** are indicated in the fine crystal structure as shown in Figure 3 and Figure 4. On the basis of the data, the proposed structure of 2(*S*),3(*R*)-dihydroxymethyl-*N*-alkylaziridine (**8a**) was consistent with the stereochemistry and configuration of its molecule**,** and this was further confirmed by its X-ray crystallography as shown in Figure 3 and Figure 4. The whole chiral molecule has two new stereogenic centers C(2)(*S*), C(6)(*R*). From the viewpoint of the structure of the aziridine derivative **8a,** the bond angles of the aziridine component of the whole molecule are: C(8)-N(1)-C(7) 60.73(8)°, N(1)-C(7)-C(8) 59.52(7)° N(1)-C(8)-C(7) 59.75(7)°, which are approximate to 60° and in agreement with the theoretical value. The selective bond lengths and bond angles of compound **8a** are listed in Table 3 and Table 4. The crystal structure is stabilized by a three-dimensional network of hydrogen bonds between the hydroxyl group O1-H1A as a donor and the hydroxyl group O(2) as an acceptor with geometry O(1) — H(1A) ··· O(2) 0.2752 nm, O(1)—H(1A)···O(2) 175.09° (symmetry code i: x, $y+1$, z) as well as between the hydroxyl group O2-H2A as a donor and the aziridine N atom as an acceptor with geometry O(2) — H(2A) ··· N 0.2779 nm, O(1) — H(1A)···O(2) 172.57° (symmetry code i: $-x+1$, $-y+1$, $-z$).

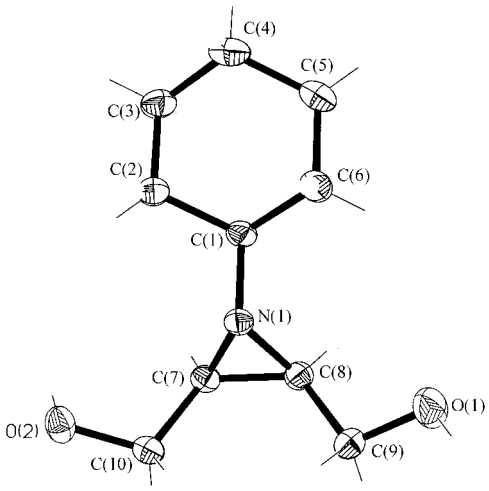


Figure 3 The ORTEP drawing of **8a.**

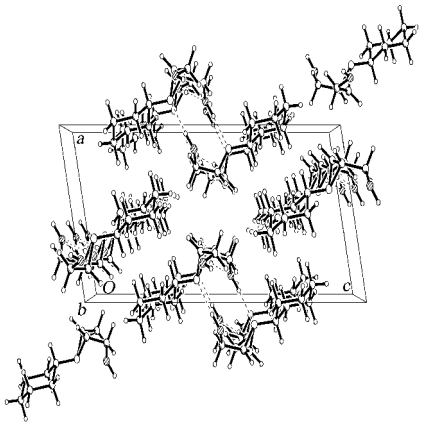


Figure 4 The crystal packing of **8a.**

Table 3 The main bond lengths (nm) of compound **8a**

N(1)—C(8)	0.14679(15)	C(2)—C(3)	0.15244(17)	O(1)—H(1A)	0.08200
N(1)—C(7)	0.14714(15)	C(3)—C(4)	0.1515(2)	O(2)—H(2A)	0.08900
N(1)—C(1)	0.14764(13)	C(4)—C(5)	0.1518(2)	C(1)—H(1B)	0.09800
O(1)—C(9)	0.14004(17)	C(5)—C(6)	0.15301(19)	C(2)—H(2B)	0.09700
O(2)—C(10)	0.14140(15)	C(7)—C(8)	0.14857(16)	C(3)—H(3A)	0.09700
C(1)—C(6)	0.15156(17)	C(7)—C(10)	0.15006(16)	C(3)—H(3B)	0.09700
C(1)—C(2)	0.15163(17)	C(8)—C(9)	0.14958(17)	C(4)—H(4A)	0.09700

Table 4 The main bond angles (°) of compound **8a**

C(8)-N(1)-C(7)	60.73(8)	N(1)-C(1)-C(2)	110.68(9)	C(1)-C(6)-C(5)	110.53(11)
N(1)-C(7)-C(8)	59.52(7)	C(6)-C(1)-C(2)	111.46(10)	N(1)-C(7)-C(10)	117.52(10)
N(1)-C(8)-C(7)	59.75(7)	C(1)-C(2)-C(3)	110.54(10)	C(8)-C(7)-C(10)	122.23(10)
C(8)-N(1)-C(1)	114.80(9)	C(4)-C(3)-C(2)	111.07(12)	N(1)-C(8)-C(9)	118.37(10)
C(7)-N(1)-C(1)	115.53(9)	C(3)-C(4)-C(5)	111.74(12)	C(7)-C(8)-C(9)	123.83(10)
N(1)-C(1)-C(6)	109.31(9)	C(4)-C(5)-C(6)	111.37(12)	O(1)-C(9)-C(8)	108.51(10)

In conclusion, we have developed a convenient and efficient procedure to enantiopure 5-(*R*)-methoxy-butyrolacto[3,4-*b*]-2(*S*)-6(*R*)-1-*N*-alkylaziridines and functionalized 2(*S*),3(*R*)-dihydroxymethyl-*N*-alkylaziridines in good yields with ⩾98% *ee* from racemic starting materials. In view of the simple and mild conditions used, the method appears to be of general application for the preparation of functionalized *N*-alkyl aziridines and shows their usefulness in asymmetric synthesis for some biologic active compounds.

Experimental

Instruments and materials

Infrared spectra were recorded on a Fourier 170-sx spectrophotometer. ^{1}H NMR and ^{13}C NMR spectra were recorded on a Bruker-400 MHz or on a Bruker-500 MHz spectrometer and the chemical shifts were expressed in δ-values using TMS as the internal standard. Mass spectra were determined with a Finnigan GC2000/TRACE TM/MS mass spectrometer. Microanalyses were performed on a Perkin-Elmer 240-C Elemental Analyser. Na-D line polarimetry was carried out at 20 ℃ in a Perkin-Elmer 241-C polarimeter. Melting points were determined on a Liuben microthermopan and are uncorrected.

All chemical reagents were commercially available and treated with standard methods before use. Solvents were dried in a routine way and redistilled.

General procedure for the preparation of 5-(*R*)-methoxy-butyrolacto[3,4-*b*]-2(*S*)-6(*R*)-1-*N*-alkylaziridines 7a—7c

Amine **6** (11 mmol) under an N_2 atmosphere was added to the mixture of K_2CO_3 (5.53 g, 40 mmol), TBAB (1.61 g, 5 mmol) and acetonitrile (25 mL). The mixture was stirred for 20 min. Then, racemic synthon (1.93 g, 10 mmol) **5** was added and the mixture was stirred at room temperature until the chiral synthon **5** consumed, as monitored by TLC. The mixture was filtered and the salts were washed with acetonitrile. The organic layer was dried and evaporated under reduced pressure, and the residue was purified by column chromatography and recrystallization [a mixture of petroleum ether/ethyl acetate = 4 ∶ 1 (*V* ∶ *V*)] to give *5*-(*R*)-methoxy-butyrolacto[3,4-*b*]-2(*S*)-6(*R*)-1-*N*-alkylaziridines **7a—7c.**

5-(*R*)-Methoxy-butyrolacto[3,4-*b*]-2(*S*)-6(*R*)-1-*N*-cyclohexylaziridine (**7a**) Yield 0.89 g (42 %), m. p. 83—84 ℃, $[\alpha]_D^{20}$ −7.5 (*c* 0.72, C_2H_5OH); IR (KBr) *v*: 3074, 2929, 2858, 1763, 1363, 1218, 1130, 1022, 935, 915 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 5.20 (s, 1H), 3.53 (s, 3H, OCH_3), 2.82 (d, J=4.4 Hz, 1H, H-2), 2.61 (d, J=4.4 Hz, 1H, H-6) , 1.88—1.92 (m, 4H, CH_2, 2× CH), 1.54—1.64 (m, 1H, CH), 1.35—1.48 (m, 3H, CH_2, CH), 1.26—1.3.6 (m, 3H, CH_2, CH); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 171.8 (C-3), 103.5 (C-5), 65.5 (C-7), 56.7 (C-1′), 43.9 (C-2), 37.2 (C-6), 32.2 (C-2′, C-6′), 25.7 (C-2′), 24.3 (C-5′), 24.2 (C-3′); EIMS *m/z* (%): 212 (M^++1, 6), 211 (M^+, 5), 182 (M^+−C_2H_5, 7), 168 (M^+−C_2H_5N, 5), 152 (M^+−C_3H_9N, 24), 124 ($C_8H_{14}N^+$, 23), 84 ($C_4H_4O_2^+$, 54), 74 ($C_4H_{12}N^+$, 37), 55 ($C_4H_7^+$, 100). Anal. calcd for $C_{11}H_{17}NO_3$: C 62.54, H 8.11, N 6.63; found C 62.41, H 8.09, N 6.67.

5-(*R*)-Methoxy-butyrolacto[3,4-*b*]-2(*S*)-6(*R*)-1-*N*-dodecylaziridine (7b) Yield 1.36 g (39%), m.p. 68—69 ℃, $[\alpha]_D^{20}$ +41.2 (*c* 0.233, $CHCl_3$); IR (KBr) *v*: 3062, 2929, 2852, 1766, 1466, 1348, 1138, 934 cm^{-1}; ^{1}H NMR (500 MHz, $CDCl_3$) δ: 5.22 (s, 1H, H-5), 3.53 (s, 3H, OCH_3), 2.79 (d, J=4.1 Hz, 1H, H-2), 2.58 (d, J = 4.1 Hz, 1H, H-6), 2.32—2.41 (m, 2H, NCH_2), 1.57—1.63 (m, 2H, CH_2), 1.25—1.43 (m, 18H, 9×

CH_2), 0.90 (t, J=6.8 Hz, 3H, CH_3); ^{13}C NMR (125 MHz, $CDCl_3$) δ: 172.14 (C-3), 103.83 (C-5), 58.35 (C-7), 57.21 (C-1′), 45.60 (C-2), 38.74 (C-6), 32.32, 30.04, 29.99, 29.89, 29.86, 29.85, 29.84, 29.80, 27.46, 27.46, 23.10, 14.53; EIMS *m/z* (%): 299 (M^++2, 89), 298 (M^++1, 100), 296 (M^+−1, 38), 268 (M^+−C_2H_5, 35), 266 (M^+−OCH_3, 32), 254 (M^+−C_3H_7, 45), 238 (M^+−C_3H_9N, 52), 209 (M^+−$C_5H_{14}N$, 44),194 (M^+−$C_6H_{17}N$, 45), 166 (M^+−$C_6H_{17}N$, 48), 154 ($C_{11}H_{23}^+$, 41), 138 ($C_9H_{16}N^+$, 45), 124 ($C_9H_{16}N^+$, 45), 112 ($C_8H_{16}^+$, 56), 110 ($C_8H_{14}^+$, 82), 96 ($C_6H_{10}N^+$, 59), 82 ($C_6H_{10}^+$, 50), 70 ($C_4H_8N^+$, 48), 55 ($C_4H_7^+$, 50), 41 ($C_3H_5^+$, 42). Anal. calcd for $C_{17}H_{31}NO_3$: C 68.65, H 10.51, N 4.71; found C 68.57, H 10.64, N 6.36.

5-(*R*)-Methoxy-butyrolacto[3,4-*b*]-2(*S*)-6(*R*)-1-*N*-octadecylaziridine (7c) Yield 1.44 g (38%), m.p. 77—78 ℃, $[\alpha]_D^{20}$ −26.8 (*c* 0.276, $CHCl_3$); IR (KBr) *v*: 3060, 2929, 2861, 1766, 1456, 1346, 1138, 1032, 934 cm^{-1}; ^1H NMR (500 MHz, $CDCl_3$) δ: 5.23 (s, 1H, H-5), 3.53 (s, 3H, OCH_3), 2.79 (d, J=4.2 Hz, 1H, H-2), 2.58 (d, J=4.1 Hz, 1H, H-6), 2.32—2.40 (m, 2H, NCH_2), 1.56—1.63 (m, 2H, CH_2), 1.18—1.43 (m, 30H, 15×CH_2), 0.90 (t, J=6.8 Hz, 3H, CH_3); ^{13}C NMR (125 MHz, $CDCl_3$) δ: 172.13 (C-3), 103.82 (C-5), 58.35 (C-7), 57.21 (C-1′), 45.60 (C-2), 38.74 (C-6), 32.34, 31.12, 31.10, 31.09, 30.05, 30.03, 30.00, 29.90, 29.89, 29.86, 29.85, 29.82, 29.80, 27.46, 27.47, 23.10, 14.54; EIMS *m/z* (%): 383 (M^++2, 16), 382 (M^++1, 36), 354 (M^+−CHN, 42), 338 (M^+−C_3H_7, 23), 324 (M^+−C_4H_9N, 16), 322 (M^+−C_3H_7N, 32), 310 (M^+−C_5H_{11}, 26), 296 (M^+−C_6H_{13}, 8), 294 (M^+−$C_5H_{13}N$, 31), 250 (M^+−$C_8H_{21}N$, 30), 236 (M^+−$C_9H_{23}N$, 25), 143 ($C_9H_{21}N^+$, 41), 111 ($C_7H_{13}N^+$, 60), 96 ($C_6H_{10}N^+$, 93), 83 ($C_4H_3O_2^+$, 100), 69 ($C_4H_7N^+$, 97), 56 ($C_4H_8^+$, 66), 55 ($C_4H_7^+$, 58). Anal. calcd for $C_{23}H_{43}NO_3$: C 72.39, H 11.36, N 3.67; found C 72.18, H 11.75, N 3.49.

General procedure for the preparation of 2(*S*),3(*R*)-dihydroxymethyl-*N*-alkylaziridines 8a—8c

To a suspension of $LiAlH_4$ (2 mmol) in 30 mL of THF at −5—0 ℃ was added slowly **7** (1 mmol) in 30 mL of THF. The mixture was stirred for 2 h at 0—4 ℃ and 11 h at room temperature until the chiral synthon **7a** consumed, as monitored by TLC. After the addition of 2 mL saturated solution of Na_2SO_4, the mixture was stirred for 1 h and then 20 mL of EtOH was added. The mixture was filtered and the salts were washed with EtOH. The organic layer was dried and evaporated under reduced pressure, and the residue was purified by column chromatography and recrystallization to give **8**.

2(*S*),3(*R*)-Dihydroxymethyl-*N*-cyclohexylaziridine (8a) Yield 0.85 g (92%) from 5 mmol of **7a,** m.p. 121—122 ℃, $[\alpha]_D^{20}$ +2.0 (*c* 1.29, C_2H_5OH); IR (KBr) *v*: 3364, 3103, 2857, 1458, 1371, 1257, 1136, 1058, 1043, 883, 579 cm^{-1}; ^1H NMR (500 MHz, $CDCl_3$) δ: 3.73 (d, J=6.0 Hz, 2H, C**H**$_2$OH), 3.63 (d, J=6.0 Hz, 2H, C**H**$_2$OH), 3.27—3.52 (br, 2H, 2OH, after exchange with D_2O, the characteristic peak was lost), 1.88 (q, J= 4.1 Hz, 1H, H-2), 1.87 (q, J = 4.1 Hz, 1H, H-3), 1.86—1.87 (m, 4H, 2×CH_2), 1.58—1.70 (m, 1H, CH), 1.27—1.36 (m, 3H, CH_2, CH), 1.11—1.24 (m, 3H, CH_2, CH); ^{13}C NMR (125 MHz, $CDCl_3$) δ: 68.6, 61.0, 61.0, 43.9, 43.9, 33.0, 33.0, 26.3, 25.2, 25.2; EIMS *m/z* (%): 186 (M^++1, 65), 185 (M^+, 8), 168 (M^+−OH, 23), 154 (M^+−CH_2OH, 100),136 (M^+−CH_2OH−H_2O, 10), 84 ($C_6H_{12}^+$, 28), 74 ($C_4H_{12}N^+$, 92), 72 ($C_4H_{10}N^+$, 55), 55 ($C_3H_5N^+$, 88). Anal. calcd for $C_{10}H_{19}NO_2$: C 64.83, H 10.34, N 7.56; found C 64.57, H 10.53, N 7.39.

2(*S*),3(*R*)-Dihydroxymethyl-*N*-dodecylaziridine (8b) Yield 0.53 g (98%) from 2 mmol of **7b**, m.p. 49—50 ℃, $[\alpha]_D^{20}$ +23.3 (*c* 0.279, C_2H_5OH); IR (KBr) *v*: 3339, 3102, 2853, 1467, 1377, 1103, 1034 cm^{-1}; ^1H NMR (500 MHz, $CDCl_3$) δ: 3.73 (d, J=6.1 Hz, 2H, C**H**$_2$OH), 3.63 (d, J=6.1 Hz, 2H, C**H**$_2$OH), 3.18—3.59 (br, 2H, 2OH, after exchange with D_2O, the characteristic peak was lost), 2.36 (q, J=7.6 Hz, 2H, H-2, H-3), 1.81—1.84 (m, 2H, NCH_2), 1.55—1.58 (m, 2H, CH_2), 1.15—1.36 (m, 18H, 9×CH_2), 0.89 (t, J=6.8 Hz, 3H, CH_3); ^{13}C NMR (125 MHz, $CDCl_3$) δ: 61.24, 60.95, 45.03, 32.32, 31.17, 30.08, 30.05, 30.04, 30.03, 30.02, 30.00, 29.86, 29.76, 27.66, 23.09, 14.53; EIMS *m/z* (%): 272 (M^++1, 95), 253 (M^+−H_2O, 15), 242 (M^+−C_2H_5, 17), 240 (M^+−CH_2OH, 99), 228 (M^+−C_3H_7, 35), 196 (M^+−$C_4H_{13}N$, 23), 172 (M^+−C_7H_{15}, 30), 158 (M^+−$C_{10}H_{24}N$, 24), 128 ($C_9H_{20}^+$, 24), 115 ($C_7H_{17}N^+$, 45), 85 ($C_6H_{13}^+$, 72), 71 ($C_5H_{11}^+$, 65), 55 ($C_4H_7^+$, 100), 42 ($C_3H_6^+$, 59). Anal. calcd for $C_{16}H_{33}NO_2$: C 70.80, H 12.25, N 5.16; found C 70.98, H 12.50, N 4.88.

2(*S*),3(*R*)-Dihydroxymethyl-*N*-octadecylaziridine (8c) Yield 0.24 g (89%) from 0.756 mmol of **7c**, m.p. 61—63 ℃, $[\alpha]_D^{20}$ +31.9 (*c* 0.276, C_2H_5OH); IR (KBr) *v*: 3406, 3089, 2850, 1463, 1398, 1136, 1039 cm^{-1}; ^1H NMR (500 MHz, $CDCl_3$) δ: 3.72 (d, J=6.2 Hz, 2H, CH_2OH), 3.62 (d, J=6.2 Hz, 2H, C**H**$_2$OH), 2.85—3.58 (br, 2H, 2OH, after exchange with D_2O, the characteristic peak was lost), 2.36 (q, J=7.8 Hz, 2H, H-2, H-3), 1.80—1.85 (m, 2H, NCH_2), 1.55—1.58 (m, 2H, CH_2), 1.14—1.35 (m, 30H, 15×CH_2), 0.89 (t, J=6.8 Hz, 3H, CH_3); ^{13}C NMR (125 MHz, $CDCl_3$) δ: 61.24, 60.96, 45.03, 32.34, 32.33, 30.32, 30.16, 30.14, 30.13, 30.12, 30.11, 30.08, 30.05, 30.04, 30.03, 30.02, 29.96, 29.88, 29.78, 27.67, 23.11, 14.63; EIMS *m/z* (%): 356 (M^++1, 12), 338 (M^++1−H_2O, 15), 328 (M^+−CHN, 30), 324 (M^+−CH_2OH, 53), 296 (M^+−CH_2OH−C_2H_4, 100), 172 (M^+−$C_{13}H_{27}$, 27), 140 ($C_{10}H_{20}$, 35), 128 (C_9H_{20}, 36), 85 ($C_6H_{13}^+$, 39), 71 ($C_5H_{11}^+$, 41), 57 ($C_4H_9^+$, 36), 55 ($C_4H_7^+$, 41), 43 ($C_3H_7^+$, 43), 41 ($C_3H_5^+$, 48). Anal. calcd for $C_{22}H_{45}NO_2$: C 74.31, H 12.76, N 3.94; found C 74.10, H 12.42, N 3.79.

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