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Article

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Synthesis of β-Amino Ketones by Addition of Aryl Methyl Ketones to Sulfinimines: Application to the Total Synthesis of HPA-12, Norsedamine and Sedamine

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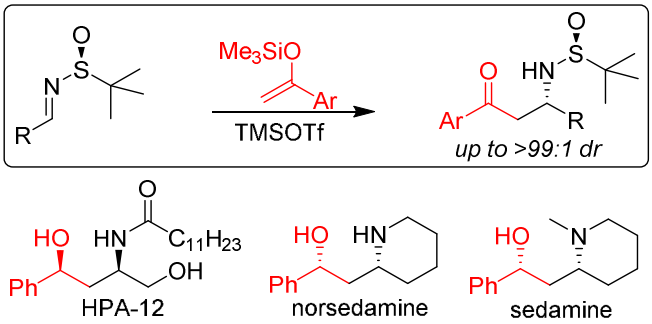


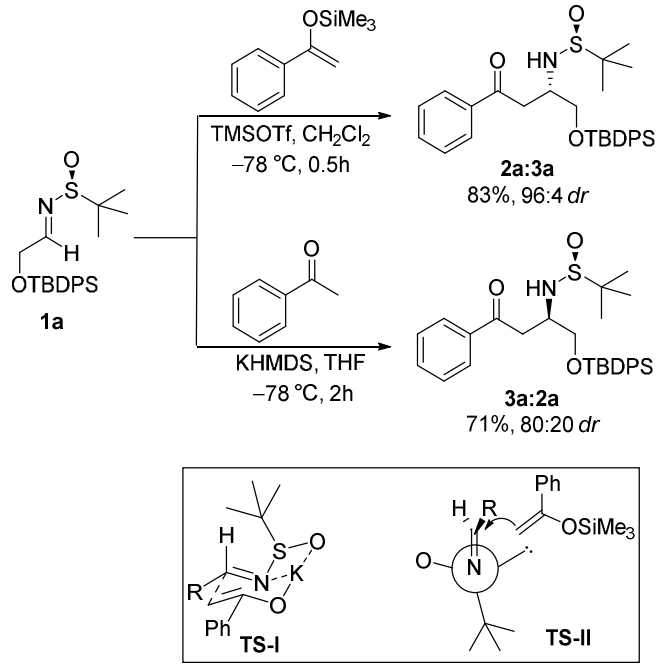
Abstract: Synthesis of β-sulfinamido ketones is accomplished by the addition of silyl enol ethers derived from arylmethyl ketones to chiral sulfinimines in excellent yield and selectivity. Application of the formed β-amino substituted ketones is exemplified in the total synthesis of sphingolipid HPA-12 and the sedamine alkaloids.

Introduction

The pioneering work of Davis and Ellman concerning the nucleophilic addition reactions of chiral sulfinimines has revolutionized the synthesis of amine containing compounds.[1] The ability of chiral sulfinimines to exert excellent stereoselectivity in nucleophilic reactions, coupled with the ease of deprotection of the sulfinyl group stabilized the sulfinimines as the most frequently used compounds for an alleviated synthesis of chiral amines. Although a number of nucleophilic addition reactions of sulfinimines were documented in literature, the direct addition of ketones to sulfinimines to access the *β*-sulfinamido ketones, a building block with potential application in the synthesis of a number of natural products, is scantily addressed. Prior to our efforts Davis and Yang reported the addition of potassium enolates of ketones to benzylidine *para*-toluenesulfinamide[2] while Han's group documented the addition of indanone derived lithium enolates to sulfinimines.[3a] Han's group also reported the addition of lithium enolate of acetophenone to trifluoro acetaldehyde derived sulfinimine.[3b] Herein, we report a systematic study in developing an optimized protocol for the addition of different aryl methyl ketones to functionalized and non-functionalized sulfinimines and their application to the total synthesis of simple sedamine alkaloids and ceramide trafficking inhibitor sphingolipid HPA-12.

Results and Discussion

We commenced our study with the addition of acetophenone to the *N*-*tert*-butylsulfinylimine **1a** (prepared from *tert*-butyldiphenylsilyloxy acetaldehyde) using KHDMS as base. The reaction afforded the diastereomeric sulfinamido ketones **3a:2a** in 80:20 diastereomeric ratio in 71% yield. Interestingly, when the addition of the silyl enol ether derived from acetophenone to the sulfinimine **1a** was carried out, the reaction furnished the product sulfinamido ketones **2a:3a** in 96:4 ratio and the major diastereomer **2a** was isolated in 83% yield (Scheme 1). Similar outcome was observed in our earlier work concerning the addition of metal enolates/ silyl enol ethers derived from enones to sulfinimines.[4] The reversal of diastereoselectivity in the addition of potassium enolate versus silyl enol ether can be explained using a chelation controlled chair transition state **TS-I** and Cram's open transition state **TS-II** as described earlier.[2,4]

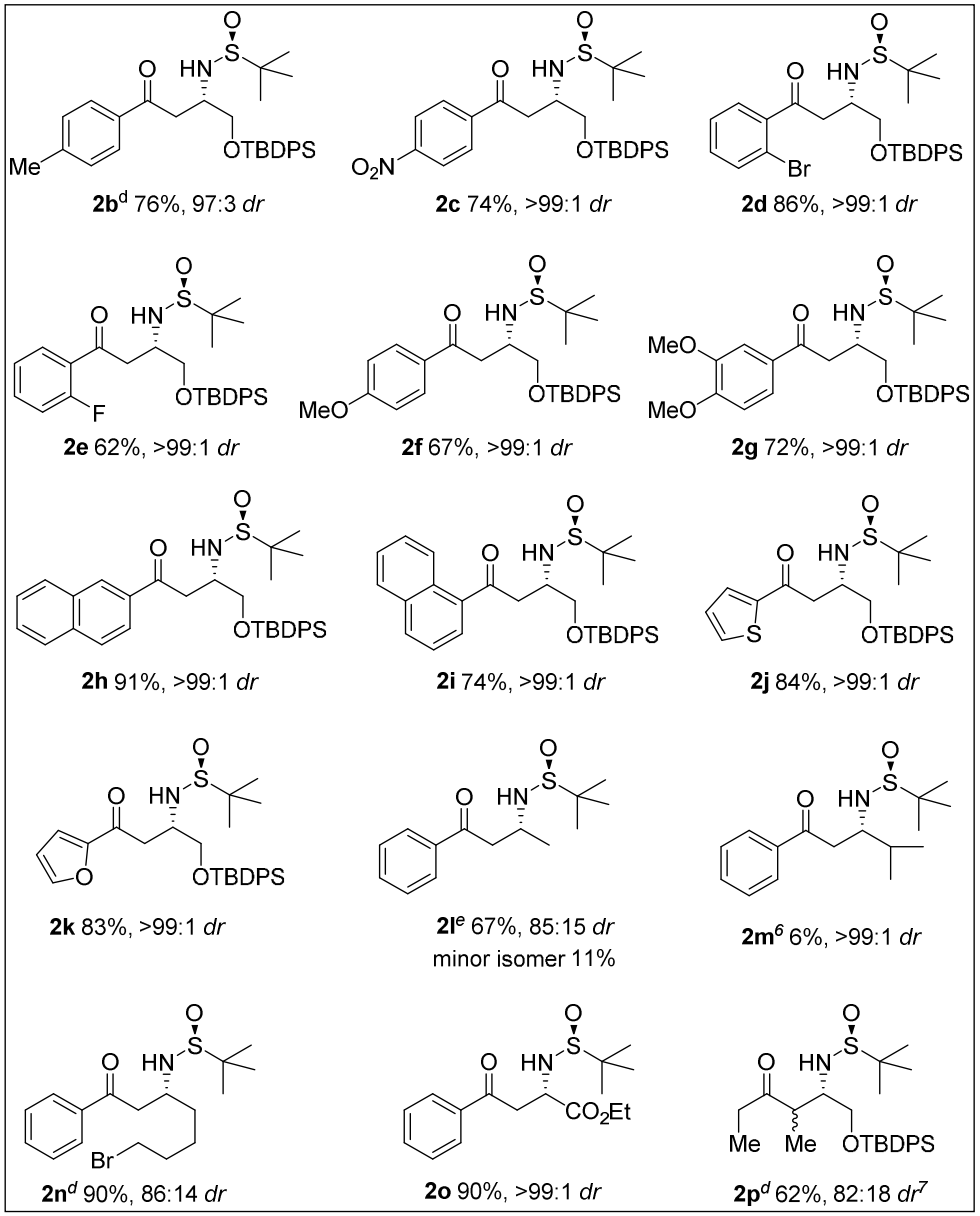


Scheme 1: Addition of potassium enolate/silyl enol ether derived from acetophenone to sulfinimine **1a**

After having established that the addition of silyl enol ether derived from acetophenone to the sulfinimine **1a** proceeds with good diastereoselectivity, we generalized the reaction with several silyl enol ethers derived from various arylmethyl ketones. In all cases, the reaction furnished the products with excellent diastereoselecitvity and in good yields. Addition of ortho aryl substituted acetophenones such as *ortho*-flouro, bromo acetophenone afforded the product *β*-sulfinamido ketones **2d-2e** in excellent selectivity and yields, while the reaction of silyl enol ethers derived from 2-acetyl thiophene and 2-acetyl furan furnished the corresponding products **2j-2k** in good yield and with excellent selectivity. Addition of silyl enol ether derived from acetophenone to the sulfinimine **1b** prepared from acetaldehyde afforded the product **2l** in a separable 85:15 ratio with **2l** being the major diastereomer isolated in 67% yield. Structure and absolute stereochemistry of **2l** was confirmed by single crystal X-ray analysis. Reaction of silyl enol ether derived from acetophenone to the sulfinimine **1c** prepared from isobutyraldehyde afforded the product **2m** in mere 6% yield[5] although the selectivity is >99:1. The addition of neither the silyl enol ether nor the potassium enolate derived from acetophenone to sulfinimine **1g** prepared from pivalaldehyde furnished the required product. Formation of the product **2o**

was observed in 90% yield with excellent diastereoselectivity in the reaction of silyl enol ether derived from acetophenone and sulfinimine **1e** derived from ethylglyoxalate. Addition of silyl enol ether derived from 3-pentanone to the sulfinimine **1a** afforded the product **2p**[6] as a non-separable 82:18 diastereomeric ratio in 62% yield. All the above results are summarized in Chart 1.

Chart 1: Addition of silyl enol ethers derived from arylmethyl ketones to sulfinimines[a-c]



2b[d] 76%, 97:3 *dr* **2c** 74%, >99:1 *dr* **2d** 86%, >99:1 *dr*

2e 62%, >99:1 *dr* **2f** 67%, >99:1 *dr* **2g** 72%, >99:1 *dr*

2h 91%, >99:1 *dr* **2i** 74%, >99:1 *dr* **2j** 84%, >99:1 *dr*

2k 83%, >99:1 *dr* **2l**[e] 67%, 85:15 *dr* minor isomer 11% **2m**[6] 6%, >99:1 *dr*

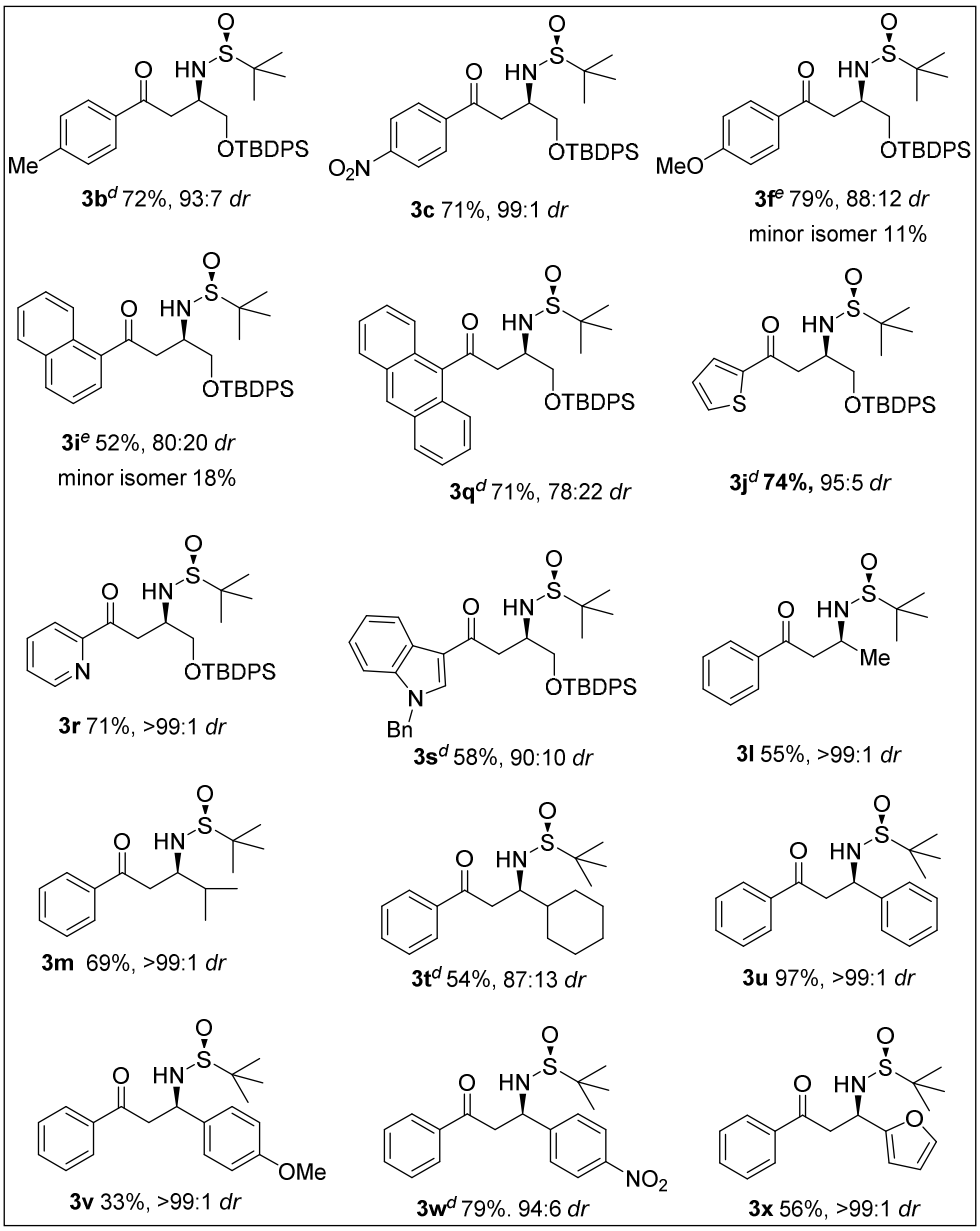
2n[d] 90%, 86:14 *dr* **2o** 90%, >99:1 *dr* **2p**[d] 62%, 82:18 *dr*[7]

[a]Unless indicated all reactions were carried out with the silyl enol ethers derived from arylmethyl ketones. [b]Diastereomeric ratios were determined based on ^{1}H NMR. [c]Yield refer to isolated yield after column purification. [d]Non-separable mixture of diastereomers. [e]Separable mixture of diastereomers.

After successful addition of the silyl enol ethers derived from arylmethyl ketones to sulfinimines, generalization of the procedure for the addition of potassium enolates derived from arylmethyl ketones to various sulfinimines was under taken. It was found that the addition of *para*-methyl, *para*- methoxy, *para*-nitro acetophenones to the sulfinimine **1a** afforded the products **3c-3f** with very good selectivity and yields. Reaction of potassium enolates of 2-acetylnapthalene and 9-acetylanthracene with the sulfinimine **1a** furnished the products **3i** and **3q** in 80:20 and 78:22 diastereomeric ratios respectively with moderate yields. The formation of products **3j** and **3r-3s** were observed in excellent selectivity and yields in the addition of potassium enolates of hetero arylmethyl ketones such as 2-acetylthiophene, 2-actylpyridine and 3-acetyl-*N*-benzyl indole to sulfinimine **1a**. Addition of acetophenone to sulfinimines **1b**-**1c**, **1f** (prepared from cyclohexylcarboxaldehyde) yielded the products **3l-3m, 3t** in excellent diastereoselectivity and in moderate yields. The addition of acetophenone to sulfinimine **3u** derived from benzaldehyde furnished the product in 97% yield as a single diastereomer, both the physical and spectral properties were good in agreement with that reported in literature.[3c] Further, this addition was extended to sulfinimines derived from 4-methoxy benzaldehyde, 4-nitro benzaldehyde and furfural to afford the products **3v-x** in excellent diastereoselectivity and yields. All the results are summarized in Chart-2.

As observed earlier (vide supra) addition of potassium enolate derived from acetophenone to sulfinimine **1a** afforded the diastereomer **3a** as the major product. To check the generality of the diastereomeric switch and to explore the reactivity towards other sulfinimines, addition of a number of potassium enolates derived from arylmethyl ketones to various sulfinimines was undertaken.

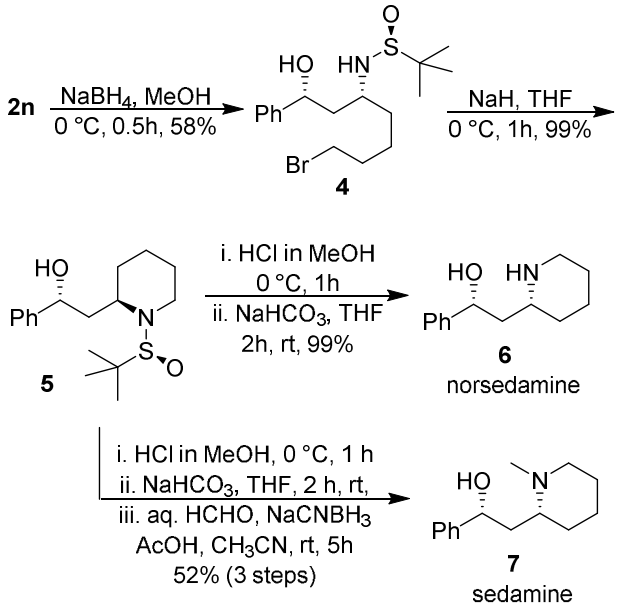
Chart 2: Addition of potassium enolates derived from arylmethyl ketones to sulfinimines[a-c]



[a]Unless indicated all reactions were carried out with the potassium enolates derived from arylmethyl ketones. [b]Diastereomeric ratios were determined based on ^{1}H NMR. [c]Yield refer to isolated yield after column purification. [d]Non-separable mixture of diastereomers. [e]Separable mixture of diastereomers.

The utility of formed *β*-sulfinamido ketones **2a-x**/**3a-x** are exemplified in short synthesis of the alkaloids norsedamine and sedamine as shown below. Reduction of the ketone in **2n** (86:14 diastereomeric mixture) afforded the alcohol **4** in 58% yield as a major diastereomer after column purification. Treatment of **4** with NaH furnished the cyclized product **5** in almost quantitative yield.

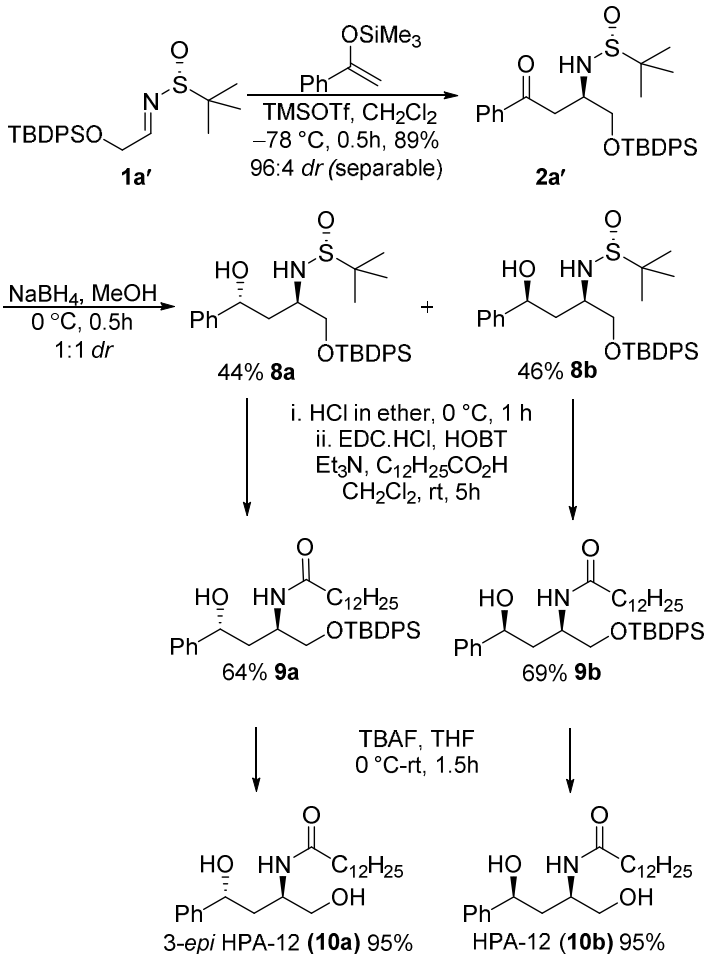
Deprotection of the sulfinamide in **5** yielded norsedamine **6** in 99% yield, the physical and spectral properties of which is identical in all aspects with that reported in literature.[7] Reductive alkylation of the **6** with aq. formaldehyde in the presence of sodium cyanoborohydride yielded sedamine **7**, the physical characteristics of which were in good agreement with that reported in literature.[7] (Scheme-2)



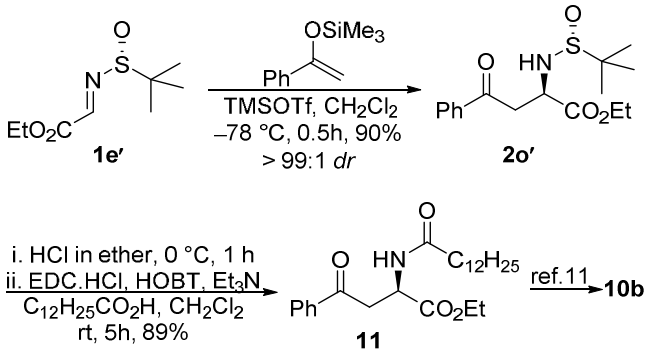
Scheme 2: Total synthesis of norsedamine **6** and sedamine **7**

Similarly, reduction of the ketone in **2a'** (enantiomer of **2a)** with $NaBH_4$ furnished a mixture of separable diastereomeric alcohols **8a** and **8b** in 44% and 46% yields respectively. After separation of the diastereomers, individually they were subjected to deprotection of the sulfinyl group followed by amide formation with dodecanoic acid to afford the corresponding amide **9a** in 64% yield. Deprotection of the TBDPS group completed the synthesis of the reported structure of HPA-12 **10a** (Scheme 3). Following a similar sequence, the other isomer **8b** was transformed to the revised structure of HPA-12 **10b**. Both physical and spectral data of compounds **10a** and **10b** were in good agreement with that reported in literature.[8] In an alternate route for the synthesis of HPA-12 the sulfinamido group in the keto ester **2o'** (enantiomer of **2o**) was deprotected which on reaction with dodecanoic acid afforded the keto amide **11** in 90% yield. Diastereoselectivity reduction of the keto group as well as reduction of the ester in **11** is a

procedure reported by Kobayashi *et al*.[9] This route constitutes a formal synthesis of HPA-12 (Scheme 4).



Scheme 3: Total synthesis of 3-*epi*-HPA-12 **10a** and HPA-12 **10b**



Scheme 4: Formal synthesis of HPA-12 **10b**

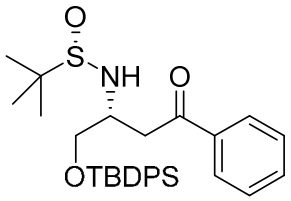
In conclusion, an efficient synthesis of *β*-amino ketones was accomplished by the addition of silyl enol ethers derived from arylmethyl ketones to chiral sulfinimines. High diastereoselctivity and

enantioselectivities were observed in the reaction. Application of the strategy is demonstrated in a short synthesis of HPA-12, norsedamine and sedamine.

Experimental:

General Procedures: Column chromatography was performed on silica gel, Acme grade 100-200 mesh. TLC plates were visualized either with UV, in an iodine chamber, or with phosphomolybdic acid spray, unless noted otherwise. All reagents were purchased from commercial sources and used without additional purification. THF was freshly distilled over Na-benzophenone ketyl. Melting points were uncorrected. Unless stated otherwise, ^{1}H NMR and ^{13}C NMR spectra were recorded either on a 400 machine in $CDCl_3$ as solvent with TMS as reference unless otherwise indicated. High-resolution mass spectra (HRMS) were recorded on a Q-TOF micromass spectrometer using electron spray ionization mode. Sulfinimine **1a** and **1d** were prepared according to the procedure described by us earlier.[4] All other sulfinimines were prepared according to the procedure described by Ellman *et al.*[10a] and Morgas *et al.*[10b]

General procedure A for the addition of pottasium enolate derived from the arylmethyl ketones to the sulfinimine 1a: The following preparation of **3a** is representative.

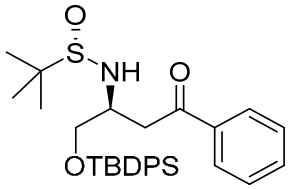


3a

(*R*)-3-((*tert*-butyl(λ^1-oxidanyl)- λ^3-sulfanyl)amino)-4-((*tert*-butyldiphenylsilyl)oxy)-1-phenylbutan-1-one (3a): To a pre-cooled (−78 °C) stirred solution of acetophenone (0.08 g, 0.67 mmol) in dry THF (10 mL) under argon atmosphere at −78 °C was added KHMDS (0.5 M solution in toluene 1.34 mL, 0.67 mmol). The reaction mixture was stirred for 1 h at the same temperature and the sulfinimine **1a** (0.1 g, 0.25 mmol) dissolved in 5 mL dry THF was added at −78 °C. The reaction mixture was stirred at

the same temperature for additional 2 hours which was quenched by addition of saturated NH_4Cl solution (20 mL) and was extracted with EtOAc (2 × 20 mL). The organic layer was washed with brine (20 mL) and dried over Na_2SO_4. Evaporation of solvent followed by silica gel column chromatography of the resulting crude residue with petroleum ether/EtOAc as eluent afforded the sulfinamide **3a** in 93% yield (0.121 g) as a 80:20 diastereomeric mixture. Major isomer was separated using silica gel column chromatography in 71% yield (0.092 g) as a gummy mass. $[\alpha]_D^{24}$ +19.6 (*c* 0.5, $CHCl_3$). IR (Neat): ν_{max} 3582, 2930, 2857, 1682, 1110, 1069 cm^{-1}. ^1H NMR (400 MHz, $CDCl_3$): δ 7.85 (d, *J* = 7.6 Hz, 2H), 7.57 (dd, *J* = 16.4, 7.2 Hz, 5H), 7.46 (t, *J* = 7.6 Hz, 2H), 7.42-7.24 (m, 6H), 4.22 (d, *J* = 9.2 Hz, 1H), 4.03-3.89 (m, 1H), 3.85 (dd, *J* = 10, 3.6 Hz, 1H), 3.80 (dd, *J* = 10, 4.8 Hz, 1H), 3.55 (m, 2H), 1.19 (s, 9H), 1.03 (s, 9H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 198.9, 136.8, 135.45 (2C), 135.41 (2C), 133.3, 133.0, 132.9, 129.8 (2C), 128.6 (2C), 128.1 (2C), 127.7 (4C), 65.8, 55.9, 54.9, 40.6, 26.8 (3C), 22.5 (3C), 19.2. HRMS (ESI-TOF) *m/z:* $[M+Na]^+$ calcd for $C_{30}H_{39}NO_3SSi$+Na 544.2318.; found 544.2314.

General procedure B for the addition of silyl enol ether derived from the arylmethyl ketones to the sulfinimines 1a-1e: The following preparation of **2a** is representative:

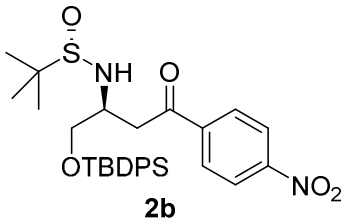


2a

(*S*)-3-((*tert*-butyl(λ^1-oxidanyl)- λ^3-sulfanyl)amino)-4-((*tert*-butyldiphenylsilyl)oxy)-1-phenylbutan-1-one (2a): To a pre-cooled solution of acetophenone (0.06 g, 0.5 mmol) in dry CH_2Cl_2 (5 mL) at 0 °C under argon atmosphere was added Et_3N (0.19 mL, 1.4 mmol) followed by TMSOTf (0.18 mL, 1 mmol). The reaction mixture was stirred for 1 h at the same temperature. After completion of the reaction (TLC) it was quenched by addition of saturated $NaHCO_3$ solution (20 mL). The reaction mixture was diluted with petroleum ether (30 mL) and was stirred for 5 minutes. The organic layer was

separated and was washed with water (20 mL), brine (20 mL) and was dried over Na_2SO_4. Evaporation of solvent gave the silyl enol ether which was used in the next step without further purification.

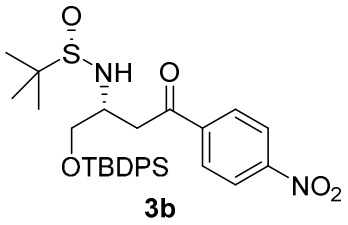
A solution of the crude silyl enol ether (obtained above) in dry CH_2Cl_2 (5 mL) under argon atmosphere was cooled to −78 °C and sulfinimine **1a** (0.1 g, 0.25 mmol) dissolved in dry CH_2Cl_2 (5 mL) was added. TMSOTf (0.09 mL, 0.5 mmol) was introduced into the reaction mixture and was stirred for 0.5h at −78 °C. After completion of the reaction (TLC), it was quenched by addition of saturated $NaHCO_3$ solution (20 mL) and was extracted with EtOAc (2 × 20 mL). The organic layer was washed with brine and dried over Na_2SO_4. Evaporation of solvent followed by silica gel column chromatography of the resulting crude residue with petroleum ether/EtOAc as eluent afforded the product **2a** as a 94:6 diastereomeric mixture). Major isomer was separated using silica gel column chromatography in 83% yield (0.108 g) as a gummy mass. $[\alpha]_D^{24}$ +8.0 (*c* 1.0, $CHCl_3$). IR (Neat) 3416, 2930, 2858, 1682, 1590, 1111, 1065 cm^{-1}. ^1H NMR (400 MHz, $CDCl_3$): δ 7.89 (d, *J* = 7.2 Hz, 2H), 7.70-7.51 (m, 5H), 7.50-7.26 (m, 8H), 4.15-4.00 (m, 2H), 3.98 (dd, *J* = 10, 3.6 Hz, 1H), 3.35 (dd, *J* = 17.2, 6.4 Hz, 1H), 3.14 (dd, *J* = 17.2, 5.2 Hz, 1H), 1.15 (s, 9H), 1.07 (s, 9H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 198.1, 136.8, 135.6 (2C), 135.5 (2C), 133.2, 133.1, 132.7, 129.8 (2 C), 128.6 (3C), 128.1 (3C), 127.8 (4C), 66.3, 55.8, 54.4, 41.2, 26.9 (3C), 22.5 (3C), 19.2. HRMS (ESI-TOF) *m/z:* $[M+Na]^+$ calcd for $C_{30}H_{39}NO_3SSi$+Na 544.2318; found: 544.2321.



2b

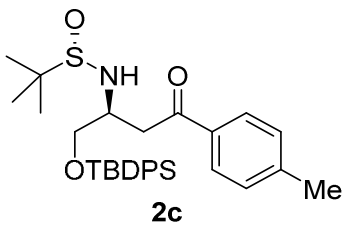
(*S*)-3-((*tert*-butyl(λ^1-oxidanyl)-λ^3-sulfanyl)amino)-4-((*tert*-butyldiphenylsilyl)oxy)-1-(4-nitrophenyl)butan-1-one (2b): Compound **2b** was prepared from 4-nitro acetophenone (0.1 g, 0.60 mmol) and sulfinimine **1a** (0.10 g, 0.25 mmol) using the general procedure **B** described above in 74% yield (0.104 g) as a gummy mass. $[\alpha]_D^{24}$ +7.3 (*c* 1.8, $CHCl_3$). IR (Neat) 3380, 2929, 2856, 1691, 1527,

1346, 1111, 1014 cm^{-1}. ^1H NMR (400 MHz, $CDCl_3$): δ 8.29 (d, J = 9.2 Hz, 2H), 8.01 (d, J = 9.2 Hz, 2H), 7.69-7.56 (m, 4H), 7.47-7.29 (m, 6H), 4.13-4.00 (m, 2H), 3.98 (dd, J = 10, 5.2 Hz, 1H), 3.88 (dd, J = 10, 4 Hz, 1H), 3.38 (dd, J = 16.8, 6.8 Hz, 1H), 3.15 (dd, J = 17.2, 5.2 Hz, 1H), 1.16 (s, 9H), 1.08 (s, 9H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 196.6, 150.4, 141.2, 135.6 (2C), 135.5 (2C), 133.0, 132.6, 129.9, 129.1 (3C), 127.8 (3C), 123.8 (4C), 66.2, 55.9, 53.9, 41.8, 26.9 (3C), 22.5 (3C), 19.3. HRMS (ESI-TOF) *m/z:* $[M+Na]^+$ calcd for $C_{30}H_{38}N_2O_5SSi$+Na 589.2168; found: 589.2170.



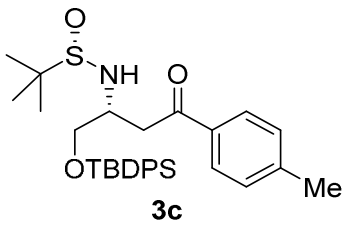
3b

(*R*)-3-((*tert*-butyl(λ^1-oxidanyl)-λ^3-sulfanyl)amino)-4-((*tert*-butyldiphenylsilyl)oxy)-1-(4-nitrophenyl)butan-1-one (3b): Compound **3b** was prepared from 4-nitro acetophenone (0.123 g, 0.74 mmol) and sulfinimine **1a** (0.15 g, 0.37 mmol) using the general procedure **A** described above in 71% yield (0.150 g) as a gummy mass. $[\alpha]_D^{24}$ +37.9 (*c* 1.0, $CHCl_3$). IR (Neat) 3380, 2929, 2856, 1691, 1527, 1346, 1111, 1014 cm^{-1}. ^1H NMR (400 MHz, $CDCl_3$): δ 8.29 (d, J = 8.8 Hz, 2H), 8.07 (d, J = 9.2 Hz, 2H), 7.64-7.49 (m, 4H), 7.48-7.23 (m, 6H), 4.09 (d, J = 9.6 Hz, 1H), 4.02-3.90 (m, 1H), 3.90-3.76 (m, 2H), 3.66-3.45 (m, 2H), 1.19 (s, 9H), 1.03 (s, 9H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 197.2, 160.9, 150.4, 141.1, 135.43 (2C), 135.40 (2C), 132.8, 129.9 (2C), 129.1 (2C), 127.8 (4C), 123.8 (2C), 65.8, 56.0, 54.6, 41.4, 26.8 (3C), 22.5 (3C), 19.2. HRMS (ESI-TOF) *m/z:* $[M+Na]^+$ calcd for $C_{30}H_{38}N_2O_5SSi$+Na 589.2168; found: 589.2170.



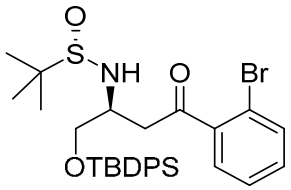
2c

(*S*)-3-((*tert*-butyl(λ^1-oxidanyl)- λ^3-sulfanyl)amino)-4-((*tert*-butyldiphenylsilyl)oxy)-1-(*p*-tolyl)butan-1-one (2c): Compound **2c** was prepared from 4-methyl acetophenone (0.04 g, 0.30 mmol) and sulfinimine **1a** (0.060 g, 0.15 mmol) using the general procedure **B** described above in 76% yield (0.061 g) as a gummy mass. $[\alpha]_D^{24}$ +5.1 (*c* 1.7, $CHCl_3$). IR (Neat) 3583, 2934, 2857, 1679, 1108, 1017 cm^{-1}. ^1H NMR (400 MHz, $CDCl_3$): δ 7.79 (d, *J* = 8 Hz, 2H), 7.70-7.56 (m, 4H), 7.46-7.28 (m, 6H), 7.25 (d, *J* = 8 Hz, 2H), 4.15-3.99 (m, 2H), 3.97 (dd, *J* = 10, 5.2 Hz, 1H), 3.86 (dd, *J* = 10, 4 Hz, 1H), 3.32 (dd, *J* = 16.8, 6.8 Hz, 1H), 3.12 (dd, *J* = 16.8, 5.6 Hz, 1H), 1.15 (s, 9H), 1.07 (s, 9H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 197.7, 144.0, 135.6 (2C), 135.5 (2C), 134.5, 133.1, 132.8, 129.79, 127.77, 129.2 (2C), 128.2 (2C), 127.74 (2C), 127.73 (2C), 66.4, 55.8, 54.5, 41.1, 26.9 (3C), 22.5 (3C), 19.2. HRMS (ESI-TOF) *m/z:* $[M+Na]^+$ calcd for $C_{31}H_{41}NO_3SSi$+Na 558.2474; found: 558.2479.



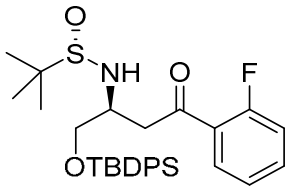
3c

(*R*)-3-((*tert*-butyl(λ^1-oxidanyl)- λ^3-sulfanyl)amino)-4-((*tert*-butyldiphenylsilyl)oxy)-1-(*p*-tolyl)butan-1-one (3c): Compound **3c** was prepared from 4-methyl acetophenone (0.1 g, 0.75 mmol) and sulfinimine **1a** (0.15 g, 0.37 mmol) using the general procedure **A** described above in 72% yield (0.130 g) as a gummy mass. $[\alpha]_D^{24}$ +16.7 (*c* 1.4, $CHCl_3$). IR (Neat) 3583, 2934, 2857, 1679, 1108, 1017 cm^{-1}. ^1H NMR (400 MHz, $CDCl_3$): δ 7.93 (d, *J* = 8.0 Hz, 1H), 7.60 (d, *J* = 7.6 Hz, 2H), 7.56 (d, *J* = 7.6 Hz, 2H), 7.48-7.20 (m, 8H), 4.25 (d, *J* = 8.8 Hz, 1H), 3.94 (m, 1H), 3.84 (dd, *J* = 10.4, 4.0 Hz, 1H), 3.79 (dd, *J* = 10.0, 5.2 Hz, 1H), 3.64-3.42 (m, 2H), 2.42 (s, 3H), 1.19 (s, 9H), 1.03 (s, 9H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 198.5, 144.1, 135.44 (2C), 135,41 (2C), 134.4, 133.0, 132.9, 129.8 (2C), 129.2 (2C), 128.3 (2C), 127.7 (4C), 65.8, 55.9, 54.9, 40.4, 26.8 (3C), 22.5 (3C), 21.6, 19.2. HRMS (ESI-TOF) *m/z:* $[M+Na]^+$ calcd for $C_{31}H_{41}NO_3SSi$+Na 558.2474; found: 558.2479.



2d

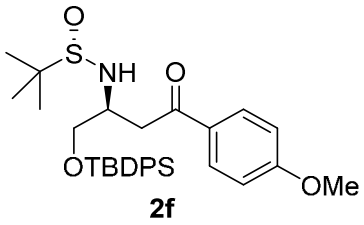
(*S*)-1-(2-bromophenyl)-3-((*tert*-butyl(λ^1-oxidanyl)-λ^3-sulfanyl)amino)-4-((*tert*-butyldiphenylsilyl)oxy)butan-1-one (2d): Compound **2d** was prepared from 2-bromo acetophenone (0.075 g, 0.38 mmol) and sulfinimine **1a** (0.1 g, 0.25 mmol) using the general procedure **B** described above in 86% yield (0.128 g) as a white solid. Mp: 104-106 °C. $[\alpha]_D^{24}$ +15.4 (*c* 0.5, $CHCl_3$). IR (Neat) 3253, 2930, 2856, 1703, 1110, 1037 cm^{-1}. ^1H NMR (400 MHz, $CDCl_3$): δ 7.66 (t, *J* = 6.4 Hz, 4H), 7.60 (d, *J* = 8 Hz, 1H), 7.47-7.22 (m, 9H), 4.07-3.90 (m, 3H), 3.83 (d, *J* = 6.8 Hz, 1H), 3.37 (dd, *J* = 17.2, 6.8 Hz, 1H), 3.17 (dd, *J* = 17.6, 4 Hz, 1H), 1.19 (s, 9H), 1.07 (s, 9H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 201.6, 141.1, 135.6 (2C), 135.5 (2C), 133.8, 133.1, 132.8, 131.8, 139.9, 129.0, 127.8 (5C), 127.5, 118.8, 66.4, 55.8, 54.0, 45.6, 26.9 (3C), 22.6 (3C), 19.3. HRMS (ESI-TOF) *m/z:* $[M+Na]^+$ calcd for $C_{30}H_{38}BrNO_3SSi$+Na 622.1423; found: 622.1424.



2e

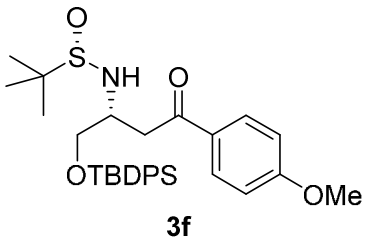
(*S*)-3-((*tert*-butyl(λ^1-oxidanyl)-λ^3-sulfanyl)amino)-4-((*tert*-butyldiphenylsilyl)oxy)-1-(2-fluorophenyl)butan-1-one (2e): Compound **2e** was prepared from 2-fluoro acetophenone (0.042 g, 0.30 mmol) and sulfinimine **1a** (0.015 g, 0.15 mmol) using the general procedure **B** described above in 74% yield (62% g) as a gummy mass. $[\alpha]_D^{24}$ +12.3 (*c* 0.6, $CHCl_3$). IR (Neat) 3402, 2927, 2857, 1686, 1455, 1111 cm^{-1}. ^1H NMR (400 MHz, $CDCl_3$): δ 7.79 (dt, *J* = 7.6, 1.6 Hz, 1H), 7.65 (dt, *J* = 8.0, 1.2 Hz, 4H), 7.60-7.46 (m, 1H), 7.47-7.27 (m. 6H), 4.10-4.0 (m, 2H), 3.97 (dd, *J* = 10, 4.8 Hz, 1H), 3.82 (dd, *J* = 10.4, 3.6 Hz, 1H), 3.39 (ddd, *J* = 29.6, 7.2, 3.2 Hz, 1H), 3.19 (ddd, *J* = 17.2, 4.0, 2.8 Hz, 1H), 1.16 (s,

9H), 1.07 (s, 9H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 196.2, 135.6 (2C), 135.5 (2C), 134.8, 134.7, 133.1, 132.8, 130.6 (d, J = 2.5 Hz), 129.8, 127.8 (3C), 127.7 (3C), 124.5 (d, J = 3.3 Hz), 116.8, 116.6, 66.5, 55.8, 54.3 (d, J = 2 Hz), 46.4 (d, J = 7.3 Hz), 26.8 (3C), 22.5 (3C), 19.3. HRMS (ESI-TOF) *m/z:* $[M+Na]^+$ calcd for $C_{30}H_{38}FNO_3SSi$+Na 562.2223; found: 562.2226.



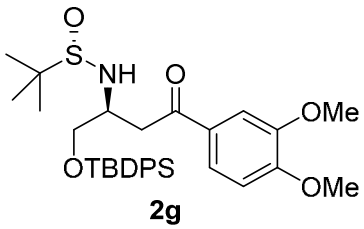
2f

(*S*)-3-((*tert*-butyl(λ^1-oxidanyl)-λ^3-sulfanyl)amino)-4-((*tert*-butyldiphenylsilyl)oxy)-1-(4-methoxyphenyl)butan-1-one (2f): Compound **2f** was prepared from 4-methoxy acetophenone (0.045 g, 0.30 mmol) and sulfinimine **1a** (0.045 g, 0.15 mmol) using the general procedure **B** described above in 80% yield (0.067 g) as a gummy mass. $[\alpha]_D^{24}$ +4.5 (*c* 2.2, $CHCl_3$). IR (Neat) 3434, 2957, 2857, 1674, 1600, 1172, 1111 cm^{-1}. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.88 (d, J = 8.8 Hz, 1H), 7.70-7.56 (m, 4H), 7.46-7.26 (m, 6H), 6.92 (d, J = 8.8 Hz, 2H), 4.12 (d, J = 7.2 Hz, 1H), 4.09-4.00 (m, 2H), 3.96 (dd, J = 10, 5.6 Hz, 1H), 3.90-3.80 (m, 4H), 3.31 (dd, J = 16.8, 6.8 Hz, 1H), 3.10 (dd, J = 16.4, 5.6 Hz, 1H), 1.15 (s, 9H), 1.07 (s, 9H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 196.6, 163.5, 135.5 (2C), 133.1, 132.8, 130.3 (2C), 130.0, 129.76, 129.74, 127.72 (2C), 127.71 (2C), 113.7 (2C), 66.4, 55.7, 55.4, 54.5, 40.8, 26.8 (3C), 22.5 (3C), 19.2. HRMS (ESI-TOF) *m/z:* $[M+Na]^+$ calcd for $C_{31}H_{41}NO_4SSi$+Na 574.2423; found: 574.2423.



3f

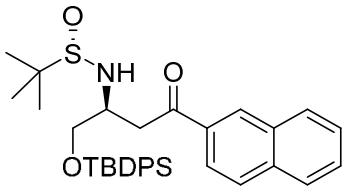
(*R*)-3-((*tert*-butyl(λ^1-oxidanyl)-λ^3-sulfanyl)amino)-4-((*tert*-butyldiphenylsilyl)oxy)-1-(4-methoxyphenyl)butan-1-one (3f): Compound **3f** was prepared from 4-methoxy acetophenone (0.112 g, 0.74 mmol) and sulfinimine **1a** (0.150 g, 0.37 mmol) using the general procedure **A** described above in 79% yield (0.163 g) as a major diastereomer along with the minor diastereomer in 11% yield as a gummy mass. $[\alpha]_D^{24}$ +33.4 (*c* 0.85, $CHCl_3$). IR (Neat) 3434, 2957, 2857, 1674, 1600, 1172, 1111 cm^{-1}. ^1H NMR (400 MHz, $CDCl_3$): δ 7.94 (d, *J* = 8.8 Hz, 2H), 7.65-7.50 (m, 4H), 7.49-7.21 (m, 6H), 6.93 (d, *J* = 9.2 Hz, 2H), 4.27 (d, *J* = 8.8 Hz, 1H), 3.93 (m, 1H), 3.88 (s, 3H), 3.87-3.71 (m, 2H), 3.61-3.39 (m, 2H), 1.19 (s, 9H), 1.03 (s, 9H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 197.4, 163.7, 135.46 (2C), 135.43 (2C), 133.0, 132.9, 130.5 (2C), 130.0, 129.8 (2C), 127.7 (4C), 113.7 (2C), 65.9, 55.8, 55.5, 40.1, 26.8 (3C), 22.5 (3C), 19.2. HRMS (ESI-TOF) *m/z:* $[M+Na]^+$ calcd for $C_{31}H_{41}NO_4SSi$+Na 574.2423; found: 574.2423.



2g

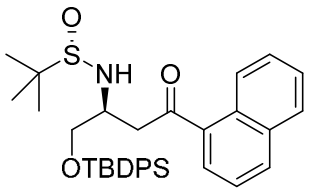
(*S*)-3-((*tert*-butyl(λ^1-oxidanyl)-λ^3-sulfanyl)amino)-4-((*tert*-butyldiphenylsilyl)oxy)-1-(3,4-dimethoxyphenyl)butan-1-one (2g): Compound **2g** was prepared from 3,4-dimethoxy acetophenone (0.067 g, 0.37 mmol) and sulfinimine **1a** (0.075 g, 0.19 mmol) using the general procedure **B** described above in 72% yield (0.79 g) as a gummy mass. $[\alpha]_D^{24}$ +4.6 (*c* 0.5, $CHCl_3$). IR (Neat) 3286, 2955, 2862, 1660, 1590, 1266, 1019 cm^{-1}. ^1H NMR (400 MHz, $CDCl_3$): δ 7.69-7.56 (m, 4H), 7.53 (dd, *J* = 8.4, 2 Hz, 1H), 7.46 (d, *J* = 2 Hz, 1H), 7.45-7.26 (m, 6H), 6.87 (d, *J* = 8.4 Hz, 1H), 4.11 (d, *J* = 7.6 Hz, 1H), 4.09-4.00 (m, 1H), 3.96 (m, 4H), 3.92 (s, 3H), 3.85 (dd, *J* = 10, 4.4 Hz, 1H), 3.33 (dd, *J* = 16.8, 6.8 Hz, 1H), 3.09 (dd, *J* = 16.4, 5.6 Hz, 1H), 1.16 (s, 9H), 1.07 (s, 9H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 196.7, 153.4, 149.0, 135.6 (2C), 135.5 (2C), 133.1, 132.8, 130.2, 129.8, 129.78, 127.74 (2C), 127.73 (2C),

122.9, 110.0, 109.9, 66.4, 56.1, 55.9, 55.8, 54.6, 40.6, 28.7 (3C), 22.5 (3C), 19.3. HRMS (ESI-TOF) *m/z:* $[M+Na]^+$ calcd for $C_{32}H_{43}NO_5SSi$+Na 604.2529; found: 604.2531.



2h

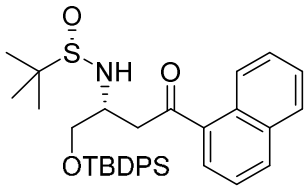
(*S*)-3-((*tert*-butyl(λ^1-oxidanyl)- λ^3-sulfanyl)amino)-4-((*tert*-butyldiphenylsilyl)oxy)-1-(napthalen-2-yl)butan-1-one (2h): Compound **2h** was prepared from 2-acetyl napthalene (0.08 g, 0.47 mmol) and sulfinimine **1a** (0.1 g, 0.25 mmol) using the general procedure **B** described above in 91% yield (0.13 g) as a gummy mass. $[\alpha]_D^{24}$ +3.5 (*c* 0.9, $CHCl_3$). IR (Neat) 3672, 2993, 2813, 1703, 1491, 1141cm^{-1}. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.40 (s, 1H), 7.95 (t, *J* = 8.8 Hz, 2H), 7.89 (d, *J* = 8.4 Hz, 2H), 7.70-7.50 (m, 6H), 4.17-4.04 (m, 2H), 4.01 (dd, *J* = 10.4, 4.8 Hz, 1H), 3.91 (dd, *J* = 10, 3.2 Hz, 1H), 3.48 (dd, *J* = 16.4, 6 Hz), 3.28 (17.2, 5.2 Hz, 1H), 1.16 (s, 9H), 1.09 (s, 9H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 198.1, 135.6, 135.59 (2C), 135.5 (2C), 134.2, 133.1, 132.8, 132.4, 129.9, 129.83, 129.82, 129.6, 128.5, 127.7 (5C), 126.8, 123.7, 66.4, 55.8, 54.6, 41.2, 26.9 (3C), 22.5 (3C), 19.3. HRMS (ESI-TOF) *m/z:* $[M+Na]^+$ calcd for $C_{34}H_{41}NO_3SSi$+Na 594.2474; found: 594.2476.



2i

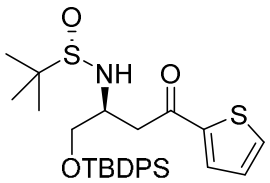
(*S*)-3-((*tert*-butyl(λ^1-oxidanyl)- λ^3-sulfanyl)amino)-4-((*tert*-butyldiphenylsilyl)oxy)-1-(napthalen-1-yl)butan-1-one (2i): Compound **2i** was prepared from 1-acetyl naphthalene (0.08 g, 0.47 mmol) and sulfinimine **1a** (0.1 g, 0.25 mmol) using the general procedure **B** described above in 74% yield (0.106 g) as a gummy mass. $[\alpha]_D^{24}$ −1.0 (*c* 1.2, $CHCl_3$). IR (Neat) 3298, 2934, 2859, 1676, 1109, 1069 cm^{-1}. ^{1}H

NMR (400 MHz, $CDCl_3$): δ 8.56 (d, J = 8.4 Hz, 1H), 7.99 (d, J = 8.4 Hz, 1H), 7.93-7.78 (m, 2H), 7.64 (dt, J = 8, 1.2 Hz, 4H), 7.60-7.43 (m, 3H), 7.43-7.26 (m, 6H), 4.12 (m, 2H), 4.02 (dd, J = 10.4, 4.8 Hz, 1H), 3.90 (dd, J = 10.4, 3.6 Hz, 1H), 3.45 (dd, J = 16.8, 6.8 Hz, 1H), 3.25 (dd, J = 16.8, 4.8 Hz, 1H), 1.16 (s, 9H), 1.07 (s, 9H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 201.9, 135.6 (2C), 135.53, 135.50 (2C), 133.9, 133.1, 132.9, 132.7, 130.1, 129.8 (2C), 128.4, 127.9 (2C), 127.8 (4C), 126.5, 125.8, 124.3, 66.5, 55.8, 54.6, 44.6, 26.9 (3C), 22.5 (3C), 19.3. HRMS (ESI-TOF) *m/z:* $[M+Na]^+$ calcd for $C_{34}H_{41}NO_3SSi$+Na 594.2474; found: 594.2478.



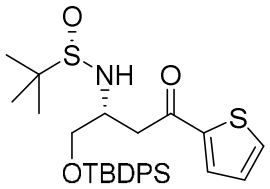
3i

(*R*)-3-((*tert*-butyl(λ^1-oxidanyl)- λ^3-sulfanyl)amino)-4-((*tert*-butyldiphenylsilyl)oxy)-1-(napthalen-1-yl)butan-1-one (3i): Compound **3i** was prepared from 1-acetyl naphthalene (0.127 g, 0.75 mmol) and sulfinimine **1a** (0.15 g, 0.37 mmol) using the general procedure **A** as a separable 80:20 diastereomeric mixture. The major isomer XX was isolated in 52% yield (0.110 g) as a gummy mass. $[\alpha]_D^{24}$ –8.9 (*c* 0.8, $CHCl_3$). IR (Neat) 3298, 2934, 2859, 1676, 1109, 1069 cm^{-1}. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.56 (d, J = 8.4 Hz, 1H), 7.99 (t, J = 8.0 Hz, 2H), 7.89 (d, J = 7.2 Hz, 1H), 7.68-7.42 (m, 7H), 7.42-7.25 (m, 6H), 4.26 (d, J = 9.2 Hz, 1H), 4.02 (m, 1H), 3.97-3.79 (m, 2H), 3.78-3.57 (m, 2H), 1.21 (s, 9H), 1.02 (s, 9H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 202.9, 135.5 (2C), 135.4 (2C), 133.9, 133.0, 132.9, 132.8, 130.1, 129.8 (2C), 128.4, 128.3, 128.0, 127.7 (5C), 126.4, 125.7, 124.4, 65.9, 55.9, 55.2, 44.0, 26.8 (3C), 22.5 (3C), 19.2. HRMS (ESI-TOF) *m/z:* $[M+Na]^+$ calcd for $C_{34}H_{41}NO_3SSi$+Na 594.2474; found: 594.2478.



2j

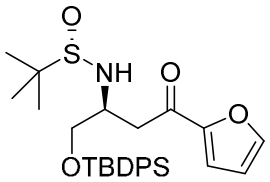
(*S*)-3-((*tert*-butyl(λ^1-oxidanyl)- λ^3-sulfanyl)amino)-4-((*tert*-butyldiphenylsilyl)oxy)-1-(thiophen-2-yl)butan-1-one (2j): Compound **2j** was prepared from 2-acetyl thiophene (0.037 g, 0.3 mmol) and sulfinimine **1a** (0.06 g, 0.15 mmol) using the general procedure **B** described above in 84% yield (0.065 g) as a gummy mass. $[\alpha]_D^{24}$ –1.7 (*c* 0.9, $CHCl_3$). IR (Neat) 3382, 2930, 2856, 1659, 1416, 1111 cm^{-1}. ^1H NMR (400 MHz, $CDCl_3$): δ 7.72-7.57 (m, 6H), 7.48-7.27 (m, 6H), 7.12 (dd, *J* = 4.8, 4 Hz, 1H), 4.06 (d, *J* = 7.6 Hz, 1H), 4.06-4.00 (m, 1H), 3.96 (dd, *J* = 10.4, 5.6 Hz, 1H), 3.86 (dd, *J* = 10.0, 4.0 Hz, 1H), 3.30 (dd, *J* = 16.0, 6.8 Hz, 1H), 3.06 (dd, *J* = 16.0, 5.2 Hz, 1H), 1.14 (s, 9H), 1.08 (s, 9H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 190.84, 144.3, 135.5 (2C), 135.4 (2C), 133.9, 133.0, 132.6, 132.1, 128.9, 128.1, 127.7 (5C), 66.3, 55.8, 54.7, 41.9, 26.8 (3C), 22.4 (3C), 19.2. HRMS (ESI-TOF) *m/z:* $[M+Na]^+$ calcd for $C_{28}H_{37}NO_3S_2Si$+Na 550.1882; found: 550.1882.



3j

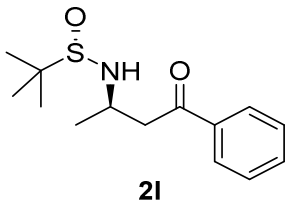
(*R*)-3-((*tert*-butyl(λ^1-oxidanyl)- λ^3-sulfanyl)amino)-4-((*tert*-butyldiphenylsilyl)oxy)-1-(thiophen-2-yl)butan-1-one (3j): Compound **3j** was prepared from 2-acetyl thiophene (0.094 g, 0.74 mmol) and sulfinimine **1a** (0.15 g, 0.37 mmol) using the general procedure **A** described above in 74% yield (0.146 g) as a gummy mass. $[\alpha]_D^{24}$ +16.9 (*c* 1.05, $CHCl_3$). IR (Neat) 3382, 2930, 2856, 1659, 1416, 1111 cm^{-1}. ^1H NMR (400 MHz, $CDCl_3$): δ 7.75 (d, *J* = 3.6 Hz, 1H), 7.66 (d, *J* = 4.8 Hz, 1H), 7.60-7.50 (m, 4H), 7.48-7.24 (m, 6H), 7.13 (t, *J* = 4.8 Hz, 1H), 4.27 (d, *J* = 9.2 Hz, 1H), 3.99-3.86 (m, 1H), 3.83 (dd, *J* = 10.0, 4.0 Hz, 1H), 3.77 (dd, *J* = 10.0, 5.6 Hz, 1H), 3.52 (dd, *J* = 16.8, 6.4 Hz, 1H), 3.48 (dd, *J* = 16.4, 5.6 Hz, 1H), 1.19 (s, 9H), 1.03 (s, 9H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 191.6, 144.2, 135.43 (2C), 135.40 (2C), 134.1, 132.9, 132.8, 132.5, 129.8 (2C), 128.2, 127.7 (4C), 65.7, 55.9, 55.0, 41.1, 26.8 (3C),

22.5 (3C), 19.2. HRMS (ESI-TOF) *m/z:* $[M+Na]^+$ calcd for $C_{28}H_{37}NO_3S_2Si+Na$ 550.1882; found: 550.1882.



2k

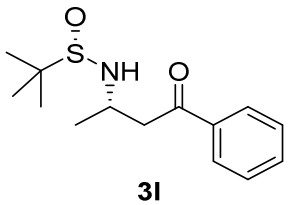
(*S*)-3-((*tert*-butyl(λ^1-oxidanyl)-λ^3-sulfanyl)amino)-4-((*tert*-butyldiphenylsilyl)oxy)-1-(furan-2-yl)butan-1-one (2k): Compound **2k** was prepared from 2-acetyl furan (0.1 g, 0.9 mmol) and sulfinimine **1a** (0.08 g, 0.20 mmol) using the general procedure **B** described above in 83% yield (0.081 g) as a gummy mass. $[\alpha]_D^{24}$ +4.1 (*c* 2.8, $CHCl_3$). IR (Neat) 3403, 2929, 2859, 1671, 1468, 1111, 1017 cm^{-1}. ^1H NMR (400 MHz, $CDCl_3$): δ 7.64 (t, J = 6.4 Hz, 4H), 7.57 (s, 1H), 7.48-7.29 (m, 6H), 7.16 (d, J = 3.6 Hz, 1H), 6.53 (d, J = 3.6 Hz, 1H), 4.01-3.93 (m, 2H), 3.94 (dd, J = 10.0, 4.8 Hz, 1H), 3.84 (dd, J = 10.0, 3.6 Hz, 1H), 3.25 (dd, J = 16.0, 6.8 Hz, 1H), 2.98 (dd, J = 16.4, 5.2 Hz, 1H), 1.13 (s, 9H), 1.08 (s, 1H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 187.1, 152.8, 146.4, 135.6 (2C), 135.5 (2C), 133.0, 132.7, 129.8, 129.78, 127.73 (2C), 127.72 (2C), 117.2, 112.3, 66.4, 55.8, 54.5, 41.2, 26.8 (3C), 22.4 (3C), 19.2. HRMS (ESI-TOF) *m/z:* $[M+Na]^+$ calcd for $C_{28}H_{37}NO_4SSi+Na$ 534.2110; found: 534.2112.



2l

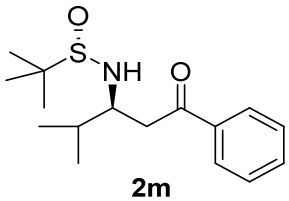
(*R*)-3-((*tert*-butyl(λ^1-oxidanyl)-λ^3-sulfanyl)amino)-1-phenylbutan-1-one (2l): Compound **2l** was prepared from acetophenone (0.110 g, 0.74 mmol) and sulfinimine **1b** (0.110 g, 0.74 mmol) using the general procedure **B** as a separable 85:15 diastereomeric mixture. The major isomer XX was isolated in 67% yield (0.134 g) as a white solid. Mp: 75-80 °C. $[\alpha]_D^{24}$ +62.5, (*c* 0.55, $CHCl_3$). IR (Neat) 3421, 2973, 2923, 1680, 1452, 1044 cm^{-1}. ^1H NMR (400 MHz, $CDCl_3$): δ 7.94 (d, J = 8 Hz, 2H), 7.57 (t, J =

7.2 Hz, 1H), 7.47 (t, *J* = 7.6 Hz, 2H), 4.11-3.94 (m, 1H), 3.80 (d, *J* = 6.4 Hz, 1H), 3.40 (dd, *J* = 17.2, 7.6 Hz, 1H), 3.06 (dd, *J* = 16.8, 4.8 Hz, 1H), 1.44 (d, *J* = 6.4 Hz, 3H), 1.16 (s, 9H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 198.7, 136.9, 133.3, 128.6 (2C), 128.0 (2C), 55.6, 49.2, 46.4, 22.5 (3C), 22.1. HRMS (ESI-TOF) *m/z:* $[M+Na]^+$ calcd for $C_{14}H_{21}NO_2S$+Na 290.1191; found: 290.1189.



3l

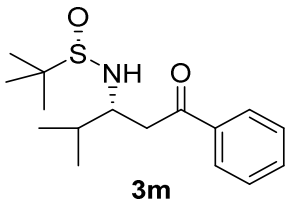
(*S*)-3-((*tert*-butyl(λ^1-oxidanyl)- λ^3-sulfanyl)amino)-1-phenylbutan-1-one (3l): Compound **3l** was prepared from acetophenone (0.245 g, 2.0 mmol) and sulfinimine **1b** (0.15 g, 1.0 mmol) using the general procedure **A** described above in 55% yield (0.150 g) as a gummy mass. $[\alpha]_D^{24}$ +87.3, (*c* 1.2, $CHCl_3$). IR (Neat) 3421, 2973, 2923, 1680, 1452, 1044 cm^{-1}. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.94 (d, *J* = 8.4 Hz, 2H), 7.56 (t, *J* = 6.8 Hz, 1H), 7.45 (t, *J* = 7.6 Hz, 2H), 4.18 (d, *J* = 6.0 Hz, 1H), 3.96 (sep, *J* = 6.4 Hz, 1H), 3.28 (d, *J* = 5.6 Hz, 2H), 1.34 (d, *J* = 6.8 Hz, 3H), 1.20 (s, 9H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 198.9, 136.8, 133.4, 128.6 (2C), 128.0 (2C), 55.4, 48.4, 46.0, 22.6 (3C), 21.5. HRMS (ESI-TOF) *m/z:* $[M+Na]^+$ calcd for $C_{14}H_{21}NO_2S$+Na 290.1191; found: 290.1190, *m/z:* $[M+H]^+$ calcd for $C_{14}H_{21}NO_2S$+H 268.1374; found: 268.1371.



2m

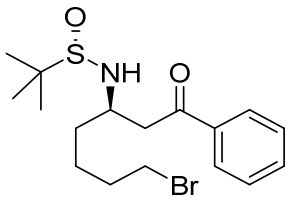
(*S*)-3-((*tert*-butyl(λ^1-oxidanyl)- λ^3-sulfanyl)amino)-4-methyl-1-phenylpentan-1-one (2m): Compound **2m** was prepared from acetophenone (0.136 g, 1.14 mmol) and sulfinimine **1c** (0.1 g, 0.57 mmol) using the general procedure **B** described above in 6% yield (0.01 g) as a colorless liquid. $[\alpha]_D^{24}$ +25.6, (*c* 0.45, $CHCl_3$). IR (Neat) 3299, 2922, 2853, 1680, 1020 cm^{-1}. ^{1}H NMR (400 MHz, $CDCl_3$): δ

7.94 (d, *J* = 7.6 Hz, 2H), 7.57 (t, *J* = 7.2 Hz, 1H), 7.47 (d, *J* = 7.6 Hz, 2H), 3.82-3.70 (m, 1H), 3.68 (d, *J* = 7.2 Hz, 1H), 3.32 (dd, *J* = 16.4, 8.8 Hz, 1H), 3.06 (dd, *J* = 16.4, 3.6 Hz, 1H), 2.15 (m, 1H), 1.13 (s, 9H), 1.04 (t, *J* = 7.2 Hz, 6H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 199.0, 137.1, 133.2, 128.6 (2C), 128.1 (2C), 58.9, 56.0, 41.4, 32.1, 22.5 (3C), 19.3, 18.6. HRMS (ESI-TOF) *m/z:* $[M+Na]^+$ calcd for $C_{16}H_{25}NO_2S$+Na 318.1504; found: 318.1503.



3m

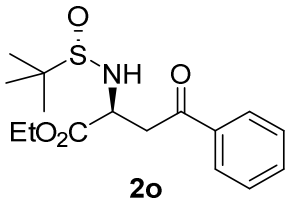
(*R*)-3-((*tert*-butyl(λ^1-oxidanyl)- λ^3-sulfanyl)amino)-4-methyl-1-phenylpentan-1-one (3m): Compound **3m** was prepared from acetophenone (0.16 g, 1.4 mmol) and sulfinimine **1c** (0.12 g, 0.69 mmol) using the general procedure **A** described above in 69% yield (0.14 g) as a white solid. Mp: 61-66 °C. $[\alpha]_D^{24}$ +74.1, (*c* 1.5, $CHCl_3$). IR (Neat) 3299, 2922, 2853, 1680, 1020 cm^{-1}. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.944 (d, *J* = 7.2 Hz, 2H), 7.56 (t, *J* = 7.6 Hz, 1H), 7.45 (t, *J* = 7.6 Hz, 2H), 4.09 (d, *J* = 8.8 Hz, 1H), 3.61-3.45 (m, 1H), 3.42 (dd, *J* = 17.2, 4.8 Hz, 1H), 3.34 (dd, *J* = 17.2, 6.0 Hz, 1H), 2.13-1.95 (m, 1H), 1.23 (s, 9H), 0.96 (d, *J* = 6.4 Hz, 3H), 0.91 (d, *J* = 6.8 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 199.5, 136.9, 133.3, 128.6 (2C), 128.1 (2C), 59.5, 56.1, 41.3, 31.6, 22.7 (3C), 19.4, 18.5. HRMS (ESI-TOF) *m/z:* $[M+Na]^+$ calcd for $C_{16}H_{25}NO_2S$+Na 318.1504; found: 318.1503.



2n

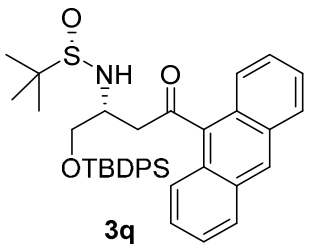
(*R*)-7-bromo-3-((*tert*-butyl(λ^1-oxidanyl)- λ^3-sulfanyl)amino) -1-phenylpentan-1-one (2n): Compound **2n** was prepared from acetophenone (0.537 g, 0.47 mmol) and sulfinimine **1d** (0.6 g, 2.24

mmol) using the general procedure **B** described above in 81% yield (0.7 g) as a nonseparable 86:14 diastereomeric mixture. $[\alpha]_D^{24}$ +56.0, (*c* 0.4, $CHCl_3$). IR (Neat) 3220, 2949, 2864, 1680, 1450, 1053 cm^{-1}. ^1H NMR (400 MHz, $CDCl_3$): δ 7.94 (d, *J* = 7.2 Hz, 2H), 7.57 (t, *J* = 7.2 Hz, 1H), 7.46 (t, *J* = 7.6 Hz, 2H), 4.17-4.09 (m, 0.23H, minor), 3.94-3.80 (m, 2H, major), 3.55-3.35 (m, 3H), 3.09 (dd, *J* = 17.6, 4 Hz, 1H), 2.00-1.77 (m, 4H), 1.77-1.63 (m, 2H), 1.60-1.48 (m, 1H), 1.23 (s, 1.3H, minor), 1.16 (s, 9H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 198.9, 136.9, 133.3, 128.6 (2C), 128.0 (2C), 55.8, 53.1, 44.7, 34.1, 33.5, 32.2, 24.7 (3C), 22.5 (3C). HRMS (ESI-TOF) *m/z:* $[M+Na]^+$ calcd for $C_{17}H_{26}BrNO_2S$+Na 410.0765; found: 410.0764.



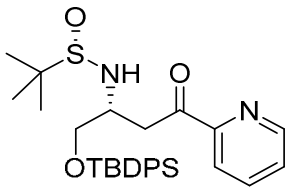
2o

Ethyl (*S*)-2-((*tert*-butyl(λ^1-oxidanyl)- λ^3-sulfanyl)amino)-4-oxo-4-phenylbutanoate (2o): Compound **2o** was prepared from acetophenone (0.116 g, 0.97 mmol) and sulfinimine **1e** (0.1 g, 0.48 mmol) using the general procedure **B** described above 79% yield (0.125 g) as a gummy mass. $[\alpha]_D^{24}$ +40.8, (*c* 1.3, $CHCl_3$). IR (Neat) 3228, 2976, 1738, 1684, 1175, 1066 cm^{-1}. ^1H NMR (400 MHz, $CDCl_3$): δ 7.94 (d, *J* = 7.6 Hz, 2H), 7.60 (t, *J* = 7.2 Hz, 1H), 7.48 (t, *J* = 7.6 Hz, 2H), 4.48 (q, *J* = 5.2 Hz, 2H), 4.40 (d, *J* = 6 Hz, 1H), 4.26 (q, *J* = 7.2 Hz, 1), 3.55 (m, 2H), 1.28 (t, *J* = 7.2 Hz, 3H), 1.17 (s, 9H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 196.3, 172.0, 136.3, 133.5, 128.7 (2C), 128.0 (2C), 62.0, 56.0, 53.6, 41.9, 22.4 (3C), 14.0. HRMS (ESI-TOF) *m/z:* $[M+Na]^+$ calcd for $C_{16}H_{23}NO_4S$+Na 348.1245; found: 348.1249.



3q

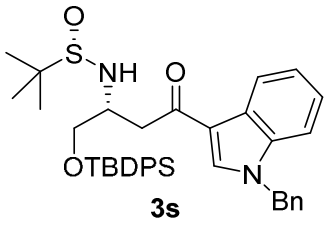
(*R*)-1-(anthracen-9-yl)-3-((*tert*-butyl(λ^1-oxidanyl)-λ^3-sulfanyl)amino)-4-((*tert*-butyldiphenylsilyl)oxy)butan-1-one (3q): Compound **3q** was prepared from 9-acetyl anthracene (0.10 g, 0.45 mmol) and sulfinimine **1a** (0.1 g, 0.25 mmol) using the general procedure **A** described above in 74% yield (0.106 g) as a gummy mass. $[\alpha]_D^{24}$ +17.4 (*c* 2.0, $CHCl_3$). IR (Neat) 3058, 2932, 2856, 2359, 1697, 1109^{-1}. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.49 (s, 1H), 8.02 (d, *J* = 8.4 Hz, 2H), 7.92 (d, *J* = 9.2 Hz, 0.4H minor), 7.84 (d, *J* = 8.4 Hz, 2H), 7.69-7.56 (m, 4.8H), 7.55-7.24 (m, 11.8H), 4.35 (d, *J* = 9.2 Hz, 0.2H minor), 4.25-4.20 (m, 1H), 4.14 (dd, *J* = 14.4, 8.0 Hz, 2H), 3.99 (dd, *J* = 10.0, 4.4 Hz, 1H), 3.80 (dd, *J* = 19.2, 6.4 Hz, 0.22H minor), 3.67 (dd, *J* = 19.2, 4.0 Hz, 0.22H minor), 3.53 (dd, *J* = 18.8, 6.8 Hz, 1H major), 3. 28 (dd, *J* = 18.8, 4.8 Hz, 1H major), 1.26 (s, 9H major), 1.21 (s, 1.8H minor), 1.06 (s, 10.7H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 208.1, 135.6 (2C), 135.5 (2C), 133.0, 132.7, 131.0, 129.8, 128.8 (2C), 128.5, 127.79 (2C), 127.77 (2C), 126.9, 126.8 (2C), 125.5 (2C), 124.1 (2C), 66.4, 55.9, 53.7, 48.8, 26.9 (3C), 22.6 (3C), 19.2. HRMS (ESI-TOF) *m/z:* $[M+Na]^+$ calcd for $C_{38}H_{43}NO_3SSi$+Na 644.2631; found: 644.2634.



3r

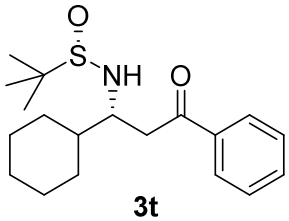
(*R*)-3-((*tert*-butyl(λ^1-oxidanyl)-λ^3-sulfanyl)amino)-4-((*tert*-butyldiphenylsilyl)oxy)-1-(pyridin-2-yl)butan-1-one (3r): Compound **3r** was prepared from 2-acetyl pyridine (0.06 g, 0.5 mmol) and sulfinimine **1a** (0.085 g, 0.21 mmol) using the general procedure **A** described above in 71% yield (0.078 g) as a gummy mass. $[\alpha]_D^{24}$ +32.8, (*c* 1.05, $CHCl_3$). IR (Neat) 3296, 2926, 2854, 1647, 1111 cm^{-1}. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.67 d, *J* = 4 Hz, 1H), 8.01 (d, *J* = 7.6 Hz, 1H), 7.82 (t, *J* = 8.0 Hz, 1H), 7.61 (t, *J* = t, 8.4 Hz, 4H), 7.53-7.24 (m, 7H), 4.32 (d, *J* = 8.0 Hz, 1H), 4.06-3.92 (m, 1H), 3.82 (dd, *J* =10, 4.4 Hz, 4H), 3.79-3.69 (m, 3H), 1.17 (s, 9H), 1.02 (s, 9H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 200, 153.2, 148.9, 136.8, 135.5 (3C), 133.1, 133.0, 129.7 (2C), 127.6 (5C), 127.2, 121.9, 66.4, 55.7, 54.7,

40.2, 26.7 (3C), 22.5 (3C), 19.2. HRMS (ESI-TOF) *m/z:* $[M+Na]^+$ calcd for $C_{29}H_{38}N_2O_3SSi+Na$ 545.2270; found: 545.2274.



3s

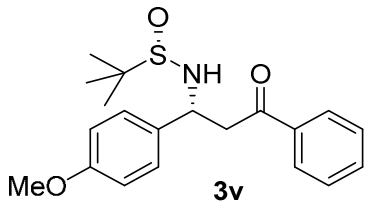
(*R*)-1-(1-benzyl-1H-indol-3-yl)-3-((*tert*-butyl(λ^1-oxidanyl)-λ^3-sulfanyl)amino)-4-((*tert*-butyldiphenylsilyl)oxy)butan-1-one (3s): Compound **3s** was prepared from 3-acetyl indole (0.075 g, 0.32 mmol) and sulfinimine **1a** (0.08 g, 0.2 mmol) using the general procedure **A** as a separable 90:10 diastereomeric mixture. The major isomer XX was isolated in 58% yield (0.075 g) as a gummy mass. $[\alpha]_D^{24}$ +22.6, (*c* 1.2, $CHCl_3$). IR (Neat) 3405, 2925, 2391, 2280, 1642, 1017 cm^{-1}. ^1H NMR (400 MHz, $CDCl_3$): δ 8.39 (d, *J* = 7.2 Hz, 1H), 7.84 (s, 1H), 7.56 (t, *J* = 8 Hz, 4H), 7.46-7.15 (m, 12H), 7.11 (t, *J* = 3.2 Hz, 2H), 5.26 (s, 2H), 4.47 (d, *J* = 8.8 Hz, 1H), 3.95 (m, 1H), 3.89 (dd, *J* = 10, 3.6 Hz, 1H), 3.79 (dd, *J* = 9.6, 5.2 Hz, 1H), 3.42 (m, 2H), 1.19 (s, 9H), 1.01 (s, 9H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 193.8, 137.0, 135.6, 135.4 (4C), 133.1, 133.0, 129.7 (2C), 129.0 (2C), 128.1, 127.7 (5C), 126.9 (2C), 126.4, 123.5, 122.8 (2C), 117.3, 110.2, 65.9, 55.8, 55.4, 50.8, 41.4, 26.8 (3C), 22.6 (3C), 19.2. HRMS (ESI-TOF) *m/z:* $[M+Na]^+$ calcd for $C_{39}H_{46}N_2O_3SSi+Na$ 673.2896; found: 673.2898.



3t

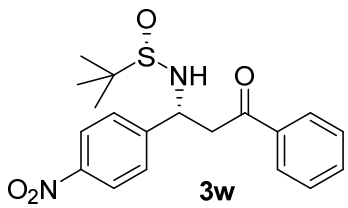
(*R*)-3-((*tert*-butyl(λ^1-oxidanyl)-λ^3-sulfanyl)amino)-3-cyclohexyl-1-phenylpropan-1-one (3t): Compound **3t** was prepared from acetophenone (0.167 g, 1.39 mmol) and sulfinimine **1f** (0.15 g, 0.70 mmol) using the general procedure **A** described above in 54% yield (0.125 g) as a gummy mass. $[\alpha]_D^{24}$

+47.5 (*c* 1.7, $CHCl_3$). IR (Neat) 2924, 2854, 1680, 1448, 1055 cm^{-1}. ^1H NMR (400 MHz, $CDCl_3$): δ 7.93 (d, *J* = 8.4 Hz, 2H), 7.54 (t, *J* = 7.6 Hz, 1H), 7.44 (t, *J* = 8.0 Hz, 2H), 4.16 (d, *J* = 8.8 Hz, 1H), 3.56-3.42 (m, 1H), 3.40 (dd, *J* = 9.6, 4.8 Hz, 2H), 1.92 (d, *J* = 11.6 Hz, 1H), 1.79-1.50 (m, 6H), 1.21 (s, 9H major), 1.15 (m, 1H), 1.10 (s, 1.5H minor), 1.08-0.80 (m, 3H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 199.6, 136.9, 133.3, 128.6 (2C), 128.0 (2C), 59.0, 56.0, 41.3, 41.0, 29.9, 29.3, 26.3, 26.0, 25.9, 22.7 (3C). HRMS (ESI-TOF) *m/z:* $[M+Na]^+$ calcd for $C_{19}H_{29}NO_2S$+Na 358.1817; found: 358.1817.



3v

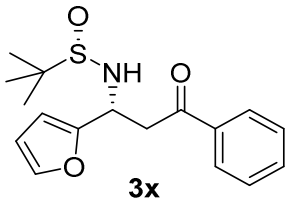
(*R*)-3-((*tert*-butyl(λ^1-oxidanyl)-λ^3-sulfanyl)amino)-3-(4-methoxyphenyl)-1-phenylpropan-1-one (3v): Compound **3v** was prepared from acetophenone (0.10 g, 0.84 mmol) and sulfinimine **3h** (0.1 g, 0.42 mmol) using the general procedure **A** described above in 33% yield (0.05 g) as a gummy mass. $[\alpha]_D^{24}$ +66.1 (*c* 1.1, $CHCl_3$). IR (Neat) 3277, 2966, 1680, 1514, 1035 cm^{-1}. ^1H NMR (400 MHz, $CDCl_3$): δ 7.91 (d, *J* = 8.4 Hz, 2H), 7.56 (t, *J* = 7.6 Hz, 1H), 7.44 (t, *J* = 7.6 Hz, 2H), 7.31 (d, *J* = 8.8 Hz, 2H), 4.98-4.85 (m, 1H), 4.79 (d, *J* = 2.8 Hz, 1H), 3.80 (s, 3H), 3.56 (dd, *J* = 17.2, 4.0 Hz, 1H), 3.44 (dd, *J* = 17.2, 8.0 Hz, 1H), 1.22 (s, 9H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 198.6, 159.2, 136.5, 133.5, 132.8, 128.7 (2C), 128.6 (2C), 128.1 (2C), 114.0 92C), 55.5, 55.2, 54.6, 46.0, 22.6 (3C). HRMS (ESI-TOF) *m/z:* $[M+Na]^+$ calcd for $C_{20}H_{25}NO_3S$+Na 382.1453; found: 382.1455.



3w

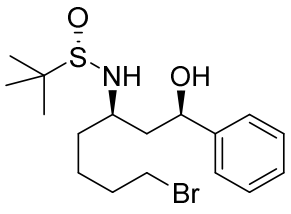
(*R*)-3-((*tert*-butyl(λ^1-oxidanyl)-λ^3-sulfanyl)amino)-3-(4-nitrophenyl)-1-phenylpropan-1-one (3w): Compound **3w** was prepared from acetophenone (0.094 g, 0.79 mmol) and sulfinimine **3i** (0.12 g, 0.47

mmol) using the general procedure **A** described above in 79% yield (0.133 g) as a gummy mass. $[\alpha]_D^{24}$ +66.0 (*c* 0.7, $CHCl_3$). IR (Neat) 3275, 2966, 2358, 2316, 1681, 1519, 1346, 1056 cm^{-1}. ^1H NMR (400 MHz, $CDCl_3$): δ 8.21 (d, *J* = 8.8 Hz, 2H), 7.89 (d, *J* = 7.2 Hz, 2H), 7.72-7.52 (m, 3H), 7.45 (t, *J* = 8.0 Hz, 2H), 5.15-5.0 (m, 1H), 4.89 (d, *J* = 4.4 Hz, 1H), 3.66 (dd, *J* = 17.6, 4.8 Hz, 1H), 3.55 (dd, *J* = 17.6, 7.6 Hz, 1H), 1.24 (s, 9H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 197.7, 148.5, 147.4, 136.1, 133.9, 128.8 (2C), 128.4 (2C), 128.1 (2C), 123.9 (2C), 56.0, 55.0, 45.3, 22.6 (3C). HRMS (ESI-TOF) *m/z:* $[M+Na]^+$ calcd for $C_{19}H_{22}N_2O_4S$+Na 397.1198; found: 397.1198.



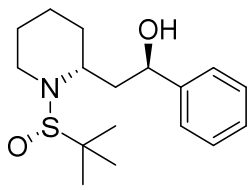
3x

(*R*)-3-((*tert*-butyl(λ^1-oxidanyl)-λ^3-sulfanyl)amino)-3-(furan-2-yl)-1-phenylpropan-1-one (3x): Compound **3x** was prepared from acetophenone (0.12 g, 1.o mmol) and sulfinimine **1j** (0.1 g, 0.5 mmol) using the general procedure **A** described above in 56% yield (0.09 g) as a gummy mass. $[\alpha]_D^{24}$ +75.3 (*c* 0.8, $CHCl_3$). IR (Neat) 2970, 2380, 2312, 1681, 1516, 1062 cm^{-1}. ^1H NMR (400 MHz, $CDCl_3$): δ 7.94 (d, *J* = 7.2 Hz, 2H), 7.57 (t, *J* = 7.6 Hz, 1H), 7.45 (t, *J* = 7.6 Hz, 2H), 7.34 (s, 1H), 6.31 (t, *J* = 2.4 Hz, 2H), 5.05 (q, *J* = 5.2 Hz, 1H), 4.62 (d, *J* = 6.8 Hz, 1H), 3.74 (dd, *J* = 17.6, 6.4 Hz, 1H), 3.63 (dd, *J* = 17.6, 4.8 Hz, 1H), 1.21 (s, 9H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 198.1, 153.4, 142.1, 136.4, 133.5, 128.6 (2C), 128.1 (2C), 110.3, 107.7, 55.8, 50.4, 42.9, 22.5 (3C). HRMS (ESI-TOF) *m/z:* $[M+Na]^+$ calcd for $C_{17}H_{21}NO_3S$+Na 342.1140; found: 342.1141.



4

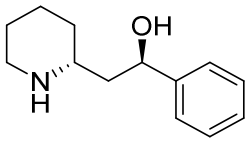
Preparation of (1*R*, 3*R*)-7-bromo-3-((*tert*-butyl(λ^1-oxidanyl)-λ^3-sulfanyl)amino)-1-phenylheptan-1-ol (4): To a stirred solution of **2q** (0.74 g 1.9 mmol) in MeOH (20 mL) at 0 °C was added $NaBH_4$ (0.145 g, 3.8 mmol), and stirring was continued for 0.5 h at 0 °C. After completion of the reaction (TLC), the solvent was removed under reduced pressure and the crude residue was diluted with water (20 mL) and extracted with EtOAc (2 × 30 mL). The combined organic layers were dried over anhyd. Na_2SO_4. Evaporation of solvent followed by careful separation of resultant crude using silica gel column chromatography with petroleum ether/EtOAc as eluent afforded the product **4** in 58% yield (0.39 g). Mp 80-85 °C. $[\alpha]_D^{24}$ +34.51, (*c* 1.33, $CHCl_3$). IR (Neat) 3296, 2928, 1646, 1452, 1020 cm^{-1}. ^1H NMR (400 MHz, $CDCl_3$): δ 7.41-7.19 (m, 5H), 4.81 (dd, *J* = 8.8, 4.0 Hz, 1H), 3.90 (d, *J* = 6.0 Hz, 1H), 3.71 (bs, 1H), 3.39 (m, 3H), 2.13 (dt, *J* = 19.2, 9.6 Hz, 1H), 1.94-1.75 (m, 4H), 1.69-1.49 (m, 3H), 1.24 (s, 9H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 144.8, 128.5 (2C), 127.5, 125.6 (2C), 73.9, 56.1, 56.0, 45.1, 34.8, 33.6, 32.3, 24.3, 22.6 (3C). HRMS (ESI-TOF) *m/z:* $[M+Na]^+$ calcd for $C_{17}H_{28}BrNO_2S$+Na 412.0922; found: 412.0921 .



5

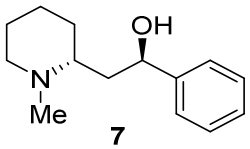
Preparation of (*R*)-2-((*R*)-1-(*tert*-butyl(λ^1-oxidanyl)-λ^3-sulfanyl)piperidin-2-yl)-1-phenylethan-1-ol (5): To a stirred solution of **4** (0.39 g, 1.0 mmol) in dry THF (35 mL) at 0 °C was added NaH (0.12 g, 5.0 mmol). The reaction mixture was stirred for 1 h at 0 °C. After completion of reaction (TLC) it was quenched with ice cold water and extracted with EtOAc (2 × 40 mL). The organic layer was washed with brine (30 mL) and dried over Na_2SO_4. Evaporation of solvent afforded the **5** in 99% yield (0.309 g). Mp: 108-110 °C. $[\alpha]_D^{24}$ +60.5, (*c* 0.7, $CHCl_3$). IR (KBr) 3396, 2923, 2859, 1451, 1046 cm^{-1}. ^1H NMR (400 MHz, $CDCl_3$): δ 7.43-7.18 (m, 5H), 4.69 (d, *J* = 10.8 Hz, 1H), 4.13 (bs, 1H), 3.94 (m, 1H), 3.28-3.07 (m, 2H), 2.15 (ddd, *J* = 14.4, 10.8, 4.0 Hz, 1H), 1.95 (ddd, *J* = 14.0, 10.4, 2.8, 1H), 1.90-1.73

(m, 1H), 1.71-1.54 (m, 5H), 1.21 (s, 9H).[13]C NMR (100 MHz, $CDCl_3$): δ 145.5, 128.4 (2C), 127.2, 125.5 (2C), 73.0, 58.6, 42.0, 29.1, 23.2 (3C), 19.3. HRMS (ESI-TOF) *m/z:* $[M+Na]^+$ calcd for $C_{17}H_{27}NO_2S$+Na 332.1660; found: 332.1662.



6

Preparation of (*R*)-1-phenyl-2-((*R*)-piperidin-2-yl) ethan-1-ol (6): To a precooled stirred solution of **5** (0.1 g, 0.3 mmol) in MeOH (7 mL) at 0 °C was added a saturated solution of HCl in MeOH (0.8 mL). The reaction mixture was stirred for 1 h at the same temperature. After completion of the reaction (TLC), the solvent was evaporated off, and the resultant residue was dissolved in THF (10 mL), solid $NaHCO_3$ (0.25 g, 3 mmol) was added. The reaction mixture was stirred for 2h at rt. The reaction mixture was filtered on a short celite pad. Evaporation of solvent followed by silica gel column chromatography of the resulting crude residue with petroleum EtOAc/MeOH as eluent afforded the products **6** in 99% yield (0.025 g) as a light brownish solid. Mp: 85-90 °C, [lit.[9] 82-84°C]. $[\alpha]_D^{24}$ +33.2, (*c* 1.25, MeOH), [lit.[7] +24.6, *c* 1.0, MeOH]. IR (KBr) 3383, 3299, 2929, 2854, 1443, 1064 cm^{-1}. ^1H NMR (400 MHz, $CDCl_3$): δ 7.42-7.16 (m, 5H), 4.92 (d, J = 6.8 Hz, 1H), 4.55 (bs, 2H), 3.13 (d, J = 13.2, 1H), 3.06-2.90 (m, 1H), 2.69 (m, 1H), 1.90-1.35 (m, 7H), 1.34-1.15 (m, 1H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 145.0, 128.3 (2C), 127.1, 125.6 (2C), 75.0, 58.1, 45.6, 44.3, 33.2, 26.1, 24.0. HRMS (ESI-TOF) *m/z:* $[M+H]^+$ calcd for $C_{13}H_{19}NO$+H 206.1545; found: 206.1546.

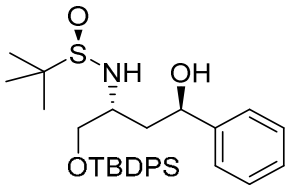


7

Preparation of (*R*)-2-((*R*)-1-methylpiperidin-2-yl)-1-phenylethan-1-ol (7): To a precooled stirred solution of **5** (0.06 g, 0.2 mmol) in MeOH (5 mL) at 0 °C was added a saturated solution of HCl in

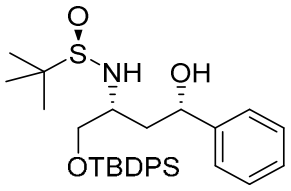
MeOH (0.6 mL). The reaction mixture was stirred for 1 h at the same temperature. After completion of the reaction (TLC), the solvent was evaporated off, and the resultant residue was dissolved in THF (10 mL), solid $NaHCO_3$ (0.25 g, 3 mmol) was added. The reaction mixture was stirred for 2h at rt. The reaction mixture was filtered on a short celite pad. Evaporation of solvent followed by the resultant crude was treated with 37% aq. HCHO (0.9 mL, 0.6 mmol), $NaCNBH_4$ (0.06 g, 0.6 mmol), followed by AcOH (0.06 mL), in acetonitrile 3 mL at 0 °C. The reaction mixture was stirred for 5h at room temperature. The volatiles were evaporated off and the resultant crude mixture was extracted with CH_2Cl_2 (2 × 10 mL) and dried over Na_2SO_4. Evaporation of solvent followed by silica gel column chromatography of the resulting residue with EtOAc/MeOH (100/0-50/50) as eluent afforded the product **7** in 52% yield (0.025 g) over 3 steps as a white solid. Mp: 58-61 °C, [lit.[9] 55-58°C]. $[\alpha]_D^{24}$ +82.4, (*c* 0.7, EtOH), [lit.[9] +82.1, *c* 1.0, EtOH]. IR (KBr) 3383, 3299, 2929, 2854, 1443, 1064 cm^{-1}. ^1H NMR (400 MHz, $CDCl_3$): δ 7.44-7.27 (m, 4H), 7.26-7.19 (m, 1H), 4.89 (dd, *J* = 10.8, 2.4 Hz, 1H), 3.16-3.02 (m, 1H), 2.92-2.79 (m, 1H), 2.64-2.50 (m, 1H), 2.49 (s, 3H), 2.12 (dt, *J* = 14.4, 10.4 Hz, 1H), 1.81-1.69 (m, 1H), 1.68-1.52 (m, 2H), 1.51-1.39 (m, 3H), 1.38-1.26 (m, 1H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 145.5, 128.2 (2C), 127.0, 125.5 (2C), 74.7, 60.8, 51.2, 39.9, 39.7, 25.77, 22.3, 20.4. HRMS (ESI-TOF) *m/z:* $[M+H]^+$ calcd for $C_{14}H_{21}NO$+H 220.1701; found: 220.1703.

Preparation of compounds 8a and **8b:** To a stirred solution of **2a'** (0.14 g 0.27 mmol) in MeOH (10 mL) at 0 °C was added NaBH4(0.012 g, 0.32 mmol), and stirring was continued for 0.5 h at 0 °C. After completion of the reaction (TLC), the solvent was removed under reduced pressure and the crude residue was diluted with water (10 mL) and extracted with EtOAc (2 × 15 mL). The combined organic layers were dried over anhyd. Na_2SO_4. Evaporation of solvent followed by silica gel column chromatography of the resulting crude residue with petroleum ether/EtOAc as eluent afforded the product **8a** in 44% yield (0.06 g) and **8b** in 46% yield (0.063 g).



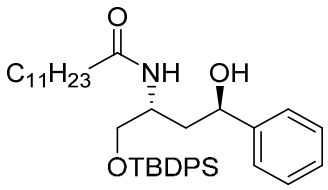
8a

(1*R*, *3R*)-3-((*tert*-butyl(λ^1-oxidanyl)-λ^3-sulfanyl)amino)-4-((*tert*-butyldiphenylsilyl)oxy)-1-phenylbutan-1-ol (8a): $[\alpha]_D^{24}$ –0.75, (*c* 1.2, $CHCl_3$). IR (Neat) 3377, 2930, 2859, 1426, 1110, 1046 cm^{-1}. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.72 (m, 4H), 7.48-7.20 (m, 11H), 4.88 (d, *J* = 9.2 Hz, 1H), 4.11 (d, *J* = 7.6 Hz, 1H), 3.94 (dd, *J* = 10, 4.8 Hz, 1H), 3.71 (dd, *J* = 10, 4.4 Hz, 1H), 3.68-3.57 (m, 1H), 2.76 (bs, 1H), 2.02 (ddd, *J* = 14.4, 8.4, 2.8 Hz, 1H), 1.86 (ddd, *J* = 13.6, 9.6, 4.0 Hz, 1H), 1.24 (s, 9H), 1.06 (s, 9H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 144.6, 135.6 (2C), 135.5 (2C), 133.1, 132.8, 129.8 (2C), 128.5 (2C), 127.74 (2C), 127.73 (2C), 127.4, 125.6 (2C), 71.1, 67.1, 56.0, 54.1, 42.1, 26.9 (3C), 22.7 (2C), 19.3. HRMS (ESI-TOF) *m/z:* $[M+Na]^+$ calcd for $C_{30}H_{41}NO_3SSi$+Na 546.2474; found: 546.2473.



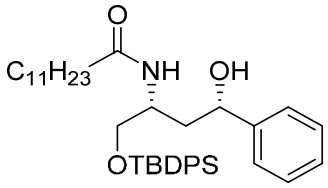
8b

(1*S*, *3R*)-3-((*tert*-butyl(λ^1-oxidanyl)-λ^3-sulfanyl)amino)-4-((*tert*-butyldiphenylsilyl)oxy)-1-phenylbutan-1-ol (8b): $[\alpha]_D^{24}$ –28.44, (*c* 0.9, $CHCl_3$). IR (Neat) 3415, 2926, 2856, 1426, 1111, 1018 cm^{-1}. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.65 (t, *J* = 8.0 Hz, 4H), 7.49-7.19 (m, 11H), 4.77 (d, *J* = 7.6 Hz, 1H), 4.07 (d, *J* = 7.6 Hz, 1H), 3.88 (dd, *J* = 10, 4.8 Hz, 1H), 3.71 (dd, *J* = 10, 4.0 Hz, 1H), 3.55-3.39 (m, 1H), 2.91 (bs, 1H), 2.13 (dt, *J* = 16.4, 8.0 Hz, 1H), 1.94 (dt, *J* = 14.4, 10 Hz, 1H), 1.25 (s, 9H), 1.07 (s, 9H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 144.2, 135.7 (2C), 135.5 (2C), 133.1, 132.7, 129.8 (2C), 128.5 (2C), 127.8 (4C), 127.6, 125.8 (2C), 72.6, 66.7, 55.9, 55.8, 42.0, 26.9 (3C), 22.6 (3C), 19.3. HRMS (ESI-TOF) *m/z:* $[M+Na]^+$ calcd for $C_{30}H_{41}NO_3SSi$+Na 546.2474; found: 546.2477.



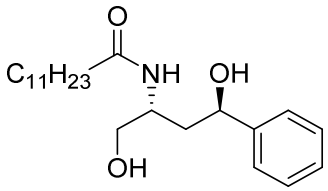
9a

Preparation of *N*-((2*R*, 4*R*)-1-((*tert*-butyldiphenylsilyl)oxy)-4-hydroxy-4-phenylbutan-2-yl)dodecanamide (9a): To a precooled, stirred solution of **8a** (0.1 g, 0.19 mmol) in MeOH (5 mL) at 0 °C was added a saturated solution of HCl in MeOH (0.5 mL). The reaction mixture was stirred for 1 h at the same temperature. After completion of the reaction (TLC), the solvent was evaporated off, and the resultant residue was dissolved in dry CH_2Cl_2 (5 mL), dodecanoic acid (0.08g, 0.4 mmol) followed by EDC.HCl (0.077g, 0.4 mmol), HOBt (0.054g, 0.4 mmol) and Et_3N (0.08mL, 0.6 mmol) was added. The reaction mixture was stirred for 5h at rt. After completion of reaction, it was diluted with water and extracted with EtOAc (2 × 20 mL). The combined organic layers were washed with brine and dried over anhyd. Na_2SO_4. Evaporation of solvent followed by silica gel column chromatography of the resulting crude residue with petroleum ether/EtOAc as eluent afforded the product **9a** in 64% yield (0.073 g) as a gummy mass. $[\alpha]_D^{24}$ +18.2, (*c* 0.9, $CHCl_3$). IR (Neat) 3330, 2985, 2859, 1648, 1111 cm^{-1}. ^1H NMR (400 MHz, $CDCl_3$): δ 7.68-7.54 (m, 4H), 7.50-7.20 (m, 11H), 5.97 (d, J = 8.4 Hz, 1H), 4.71 (d, J = 3.2 Hz, 1H), 4.59 (d, J = 10.8 Hz, 1H), 4.29 (m, 1H), 3.83 (dd, J = 10.4, 4 Hz, 1H), 3.70 (dd, J = 10.4, 3.6 Hz, 1H), 2.18 (t, J = 7.6 Hz, 2H), 1.96 (m, 1H), 1.79-1.56 (m, 3H), 1.40-1.21 (m, 16H), 1.08 (s, 9H), 0.88 (t, J = 6.8 Hz, 3H) .^{13}C NMR (100 MHz, $CDCl_3$): δ 174.6, 135.52 (2C), 135.50 (2 C), 132.9, 132.7, 130.05, 130.03, 128.3 (2C), 127.92 (2C), 127.90 (2C), 127.0, 125.7 (2C), 69.8, 66.2, 48.0, 42.7, 36.7, 31.9, 29.61, 29.60, 29.48, 29.34, 29.31, 29.3, 26.9 (4C), 25.8, 22.7, 19.3, 14.1. HRMS (ESI-TOF) *m/z:* $[M+Na]^+$ calcd for $C_{38}H_{55}NO_3Si$+Na 624.3849; found: 624.3850.



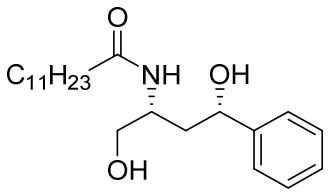
9b

Preparation of *N*-((2*R*, 4*S*)-1-((*tert*-butyldiphenylsilyl)oxy)-4-hydroxy-4-phenylbutan-2-yl)dodecanamide (9b): To a precooled, stirred solution of **8b** (0.1 g, 0.19 mmol) in MeOH (5 mL) at 0 °C was added a saturated solution of HCl in MeOH (0.5 mL). The reaction mixture was stirred for 1 h at the same temperature. After completion of the reaction (TLC), the solvent was evaporated off, and the resultant residue was dissolved in dry CH_2Cl_2 (5 mL), dodecanoic acid (0.08g, 0.4 mmol) followed by EDC.HCl (0.077g, 0.4 mmol), HOBt (0.054g, 0.4 mmol) and Et_3N (0.08mL, 0.6 mmol) was added. The reaction mixture was stirred for 5h at rt. After completion of reaction, it was diluted with water and extracted with EtOAc (2 × 20 mL). The combined organic layers were washed with brine and dried over anhyd. Na_2SO_4. Evaporation of solvent followed by silica gel column chromatography of the resulting crude residue with petroleum ether/EtOAc as eluent afforded the product **9b** in 69% yield (0.079 g) as a gummy mass. $[\alpha]_D^{24}$ –17.7, (*c* 1.05, $CHCl_3$). IR (Neat) 3313, 2925, 2854, 1646, 1427, 1111 cm^{-1}. ^1H NMR (400 MHz, $CDCl_3$): δ 7.62 (d, J = 6.8 Hz, 4H), 7.51-7.17 (m, 11H), 5.84 (d, J = 7.2 Hz, 1H), 4.74 (t, 6.4 Hz, 1H), 4.20-4.04 (m, 1H), 3.73 (m, 2H), 2.10-1.93 (m, 4H), 1.51 (m, 2H), 1.26 (m, 17H), 1.08 (s, 9H), 0.88 (t, J = 6.8 Hz, 3H).^{13}C NMR (100 MHz, $CDCl_3$): δ 173.3, 144.6, 135.53 (2C), 135.50 (2C), 133.0, 132.8, 130.0, 128.3 (2C), 127.86 (2C), 127.85 (2C), 127.2, 125.6 (2C), 71.9, 65.7, 48.6, 41.5, 36.8, 31.9, 29.65, 29.63, 29.60, 29.59, 29.44, 29.33, 29.24, 25.5 (4C), 22.7, 19.3, 14.1. HRMS (ESI-TOF) *m/z:* $[M+Na]^+$ calcd for $C_{38}H_{55}NO_3Si$+Na 624.3849; found: 624.3846.



10a

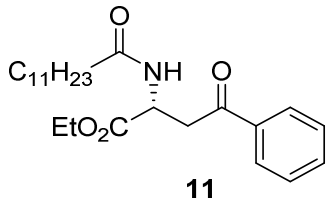
***N*-((2*R*, 4*R*)-1,4dihydroxy-4-phenylbutan-2-yl)dodecanamide (10a):** To a precooled solution (0 °C) of **9a** (0.075 g, 0.12 mmol) in dry THF (3 mL) was added TBAF (0.25 mL of 1.0 M solution in THF, 0.25mmol) dropwise under nitrogen atmosphere. The resulting solution was gradually warmed to room temperature and was stirred at the same temperature for 1.5 h. After completion of reaction (TLC), the reaction mixture was diluted with water (5 mL) and extracted with EtOAc (2 × 10 mL) and washed with brine (10 mL). The combined organic layers were dried over anhyd. Na_2SO_4, and the crude residue obtained after evaporation of solvent was purified by silica gel column chromatography using petroleum ether:EtOAc as eluent to afford **10a** in 95% yield (0.043 g) as a white solid. Mp: 50-55 °C, [lit.[8] 53-55 °C]. $[\alpha]_D^{24}$ +11.1, (*c* 1.0, $CHCl_3$), [lit.[11] +10.5 (c 0.44, CHCl3)]. IR (KBr) 3308, 2924, 2853, 1633, 1547, 1028 cm^{-1}. ^1H NMR (400 MHz, $CDCl_3$): δ 7.39-7.17 (m, 5H), 6.40 (d, J = 7.6 Hz, 1H), 4.64 (d, J = 8.8 Hz, 1H), 4.56 (bs, 1H), 4.27-412 (m, 1H), 3.66 (dq, 10.8, 2.8, 2H), 3.24 (bs, 1H), 2.21 (t, J = 7.2 Hz, 2H), 1.96-1.69 (m, 2H), 1.65-1.53 (m, 2H), 1.26 (m, 16H), 0.88 (t, J = 6.8 Hz, 3H).^{13}C NMR (100 MHz, $CDCl_3$): δ 175.1, 143.9, 128.3 (2C), 127.3, 125.6 (2 C), 70.4, 65.0, 48.8, 41.7, 36.7, 31.9, 29.6, 29.58, 29.5, 29.33, 29.3. 29.27, 25.8, 22.6, 14.1. HRMS (ESI-TOF) *m/z:* $[M+Na]^+$ calcd for $C_{22}H_{37}NO_3$+Na 386.2671; found: 386.2672.



10b

***N*-((2*R*, 4*S*)-1,4dihydroxy-4-phenylbutan-2-yl)dodecanamide (10b):** To a stirred solution of **9b** (0.07 g, 0.11 mmol) in dry THF (3 mL) at 0 °C was added TBAF (0.23 mL of 1.0 M solution in THF, 0.23mmol) dropwise under nitrogen atmosphere. The resulting solution was gradually warmed to room temperature and was stirred at the same temperature for 1.5 h. After completion of reaction (TLC), the reaction mixture was diluted with water (5 mL) and extracted with EtOAc (2 × 10 mL) and washed with brine (10 mL). The combined organic layers were dried over anhyd. Na_2SO_4, and the crude residue

obtained after evaporation of solvent was purified by silica gel column chromatography using petroleum ether:EtOAc as eluent to afford **10b** in 95% yield (0.04 g) as a white solid. Mp: 80-85 °C, [lit.[8] 81-82 °C]. $[\alpha]_D^{24}$ –37.2, (*c* 0.36, $CHCl_3$), [lit.[11] –34.4 (c 0.36, CHCl3)]. IR (KBr) 3287, 2917, 2850, 1639, 1547, 1046 cm^{-1}. ^1H NMR (400 MHz, $CDCl_3$): δ 7.40-7.23 (m, 5H), 6.37 (d, J = 6 Hz, 1H), 4.83 (dd, J = 9.2, 3.2, 1H), 4.06 (m, 1H), 3.70 (m, 2H), 2.96 (bs, 1H), 2.17 (t, J = 7.2 Hz, 2H), 2.14-1.86 (m, 2H), 1.61 (m, 3H), 1.26 (m, 16H), 0.88 (t, J = 6.8 Hz, 3H).^{13}C NMR (100 MHz, $CDCl_3$): δ 174.3, 144.2, 128.6 (2C), 127.7, 125.5 (2C), 72.6, 65.7, 50.5, 40.7, 36.8, 31.9, 29.62, 29.60, 29.5, 29.35, 29.32, 29.30, 25.7, 22.7, 14.1. HRMS (ESI-TOF) *m/z:* $[M+Na]^+$ calcd for $C_{22}H_{37}NO_3$+Na 386.2671; found: 386.2673.



11

Preparation of ethyl (*R*)-2-dodecanaido-4-oxo-4-phenylbutanoate (11): To a precooled, stirred solution of **2r'** (0.1 g, 0.31 mmol) in MeOH (5 mL) at 0 °C was added a saturated solution of HCl in MeOH (0.8 mL). The reaction mixture was stirred for 1 h at the same temperature. After completion of the reaction (TLC), the solvent was evaporated off, and the resultant residue was dissolved in dry CH_2Cl_2 (5 mL), dodecanoic acid (0.124g, 0.62mmol) followed by EDC.HCl (0.071g, 0.46 mmol), HOBt (0.07g, 0.46 mmol) and Et_3N (0.08mL, 0.6 mmol) was added. The reaction mixture was stirred for 5h at rt. After completion of reaction, it was diluted with water and extracted with EtOAc (2 × 20 mL). The combined organic layers were washed with brine and dried over anhyd. Na_2SO_4. Evaporation of solvent followed by silica gel column chromatography of the resulting crude residue with petroleum ether/EtOAc as eluent afforded the product **11** in 89% yield (0.110 g) as a white solid. Mp: 50-55 °C, [lit.[12] 50-51 °C]. $[\alpha]_D^{24}$ –60.4, (*c* 1.05, $CHCl_3$), [lit.[12] –58.5 (c 0.36, CHCl3)]. IR (KBr) 3336, 2917, 2849, 1729, 1681, 1296, 1180 cm^{-1}. ^1H NMR (400 MHz, $CDCl_3$): δ 7.94 (d, J = 7.6 Hz, 2H), 7.60 (t, J = 7.2 Hz, 1H), 7.48 (t, J = 7.6 Hz, 2H), 4.48 (q, J = 5.2 Hz, 2H), 4.40 (d, J = 6 Hz, 1H), 4.26 (q, J = 7.2

Hz, 1), 3.55 (m, 2H), 1.28 (t, J = 7.2 Hz, 3H), 1.17 (s, 9H). ^{13}C NMR (100 MHz, $CDCl_3$): δ 196.3, 172.0, 136.3, 133.5, 128.7 (2C), 128.0 (2C), 62.0, 56.0, 53.6, 41.9, 22.4 (3C), 14.0. HRMS (ESI-TOF) *m/z:* $[M+Na]^+$ calcd for $C_{24}H_{37}NO_4$+Na 426.2620; found: 426.2612.

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Supporting information: Supporting information containing ^{1}H and ^{13}C NMR spectra of all the new compounds, ORTEP image of compound **2l** and X-ray data for **2l** are provided. "This material is available free of charge via the Internet at http://pubs.acs.org."

References:

1) (a) Robak, M. T.; Herbage, M. A.; Ellman, J. A. *Chem. Rev.* **2010**, *110*, 3600. (b) Davis, F. A. *J. Org. Chem.* **2006**, *71*, 8993. (c) Zhou, P.; Chen, B.; Davis, F. A. *Tetrahedron*, **2004**, *60*, 8003.

2) (a) Davis, F. A.; Yang, B. *Org. Lett.* **2003**, *5*, 5011. (b) For an application of Davis's protocol in total synthesis of natural product merobatzelladine B see: Babij, N. R.; Wolfe, J. P. *Angew. Chem. Int. Ed.* **2012**, *51*, 4128.

3) (a) Xie, C.; Mei, H.; Wu, L.; Soloshonok, V. A.; Han, J.; Pan, Y. *RSC Adv.* **2014**, *4*, 4763. (b) Mei, H.; Xiong, Y.; Han, J.; Pan, Y. *Org. Biomol. Chem.* **2011**, *9*, 1402. For an indirect synthesis of β-sulfinamido ketones from chiral sulfinimines see: (c) Davis, F. A.; Gaspari, P. M.; Nolt, B. M.; Xu, P. *J. Org. Chem.* **2008**, *73*, 9619. (d) Lahosa, A.; Soler, T.; Arrieta, A.; Cossio, F. P.; Foubelo, F.; Yus, M. *J. Org. Chem.* **2017**, *82*, 7481. (e) Yang, C.-F.; Shen, C.; Wang, J.-Y.; Tian, S.-K. *Org. Lett.* **2012**, *14*, 3092-3095.

4) Reddy, A. A.; Reddy, P. O.; Prasad, K. R. *J. Org. Chem.* **2016**, *81*, 11363.

5) The low yield is perhaps due to the low nucleophilicity of silyl enol ether as well as the steric hindrance present in the sulfinimine. No reaction was observed with sulfinimine derived from pivalaldehyde clearly indicates that the substituents also play a major role.

6) No efforts were made either to determine the *E/Z* ratios of the formed silylenol ethers or the stereochemistry at the chiral center bearing the methyl group α-to the carbonyl.

7) Davies, S. G.; Fletcher, A. M.; Roberts, P. M.; Smith, A. D.; *Tetrahedron,* **2009**, *65*, 10192.

8) Duris, A.; Wiesenganger, T.; Moravcikova, D.; Baran, P.; Kozisek, J.; Daich, A.; Berkes, D. *Org. Lett.* **2011**, *13*, 1642.

9) Kobayashi, S.; Matsubara, R.; Kitagawa, H. *Org. Lett.* **2002**, *4*, 143.

10) (a) Liu, G.; Cogan, D. A.; Owens, T. D.; Tang, T. P.; Ellman, J. A. *J. Org. Chem.* **1999**, *64*, 1278. (b) Morgas, T.; Churcher, I.; Lewis, W.; Stockman, R.A. *Org. Lett.* **2014***, 16*, 6290-6293.