Supplementary Information

Deracemization and Transacetalization of aldehydes with enantiomers of Betti's base derivatives.

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Contents

I	General	S2
II	Synthesis of substrates	S2-S11

I. General

The ^1H and ^{13}C NMR spectra were recorded on Varian mercury 400, at 400 MHz and 100 MHz respectively. The chemical shifts (δ) for ^1H and ^{13}C are given in ppm relative to residual signals of the solvents (CDCl_3 , $\text{DMSO}-d_6$). The following abbreviations are used to indicate the multiplicity: s, singlet; d, doublet; t, triplet; q, quartet; m, multiplet; bs, broad signal. CDCl_3 was passed over a short pad of alumina before use. Coupling constants are given in Hz. Carbon multiplicities were determined by DEPT experiments. Mass spectra (MS) were obtained on a Thermo-Finnigan MAT 95 XP spectrometer. Optical rotations were measured on a Perkin-Elmer 341 polarimeter. Thin Layer Chromatography (TLC) was performed on commercially available Fluka TLC plates on aluminium or PET foils with fluorescent indicator at 254 nm, using UV light as the visualizing agent and an acidic mixture of ceric ammonium molybdate or basic aqueous potassium permanganate (KMnO_4), and heat as developing agents.

Purification of the products was carried out by flash chromatography (FC) on silica gel (Aldrich, 230-400 mesh) according to the method of Still. Organic solutions were concentrated under reduced pressure on a Büchi rotary evaporator.

II. Synthesis of substrates

2a.

2-methyl-3-phenylpropanal

Ref. Melpolder, J. B.; Heck, R. F. *J. Org Chem.* **1976**, *41*, 265–272.

2b, 2c, 2d, 2e.

Ref. Rosini, G.; Paolucci, C.; Boschi, F.; Marotta, E.; Righi, P.; Tozzi, F. *Green Chem.*

2010, 12, 1747–1757.

3a.

^1H NMR (400 MHz, CDCl_3) δ : 7.75–7.69 (m, 2H), 7.36–7.14 (m, 9H), 7.09–7.05 (m, 3H), 6.85–6.83 (m, 2H), 5.58 (s, 1H), 4.53 (d, 1H, $J = 3.6$ Hz), 2.77–2.72 (m, 1H), 2.50–2.44 (m, 1H), 2.22–2.16 (m, 1H), 1.02 (d, 3H, $J = 6.8$ Hz); ^{13}C NMR (100 MHz, CDCl_3) δ : 153.0, 142.9, 140.3, 131.7, 129.4, 129.3, 129.0, 128.9, 128.5, 128.4, 128.2, 128.1, 127.1, 126.4, 125.6, 123.0, 122.8, 119.2, 114.4, 83.6, 53.8, 39.3, 38.6, 13.6. m/z 380($M+1$).

3b.

^1H NMR (400 MHz, CDCl_3) δ : 7.76–7.68 (m, 2H), 7.35–7.06 (m, 9H), 6.72 (d, 2H, $J = 8.8$ Hz), 6.59 (d, 2H, $J = 8.8$ Hz), 5.55 (s, 1H), 4.51 (s, 1H), 3.71 (s, 3H), 2.66 (dd, 1H, $J_1 = 13.2$, $J_2 = 8$ Hz), 2.47–2.38 (m, 2H), 2.14 (m, 1H), 1.01 (d, 3H, $J = 7.2$ Hz); ^{13}C NMR (100 MHz, CDCl_3) δ : 157.5, 153.0, 142.9, 132.3, 131.6, 129.9, 129.5, 129.0, 128.6, 128.4, 128.2, 127.1, 126.4, 123.0, 122.9, 119.2, 114.4, 113.5, 83.6, 55.1, 53.8, 39.4, 37.7, 13.5. Minor isomer diagnostic signals ^1H NMR (400 MHz, CDCl_3) δ : 3.74 (s, 3H), 2.88 (dd, 1H, $J_1 = 13.2$, $J_2 = 4.4$ Hz), 2.02 (m, 1H), 0.92 (d, 3H, $J = 6.4$ Hz); ^{13}C NMR (100 MHz, CDCl_3) δ : 157.7, 152.8, 142.9, 132.1, 131.7, 130.2, 129.3, 128.9, 128.5, 128.4, 128.2,

127.6, 126.4, 123.0, 122.8, 119.3, 114.4, 113.5, 84.6, 55.2, 53.9, 39.5, 37.2, 13.5.

3c.

^1H NMR(400 MHz, CDCl_3) δ : 7.77–7.69 (m, 2H), 7.36–6.99(m, 9H), 6.91 (d, 2H, J = 7.6 Hz), 6.75 (d, 2H, J = 8.4 Hz), 5.57 (s, 1H), 4.52 (d, 1H, J = 3.6 Hz), 2.86–2.67 (m, 2H), 2.50–2.42 (m, 1H), 2.50–2.42 (m, 1H), 2.21–2.14 (m, 1H), 1.17 (d, 6H, J = 6.8 Hz), 1.02(d, 3H, J = 6.8Hz); ^{13}C NMR (100 MHz, CDCl_3) δ : 153.0, 146.0, 142.9, 137.5, 131.7, 129.5, 129.0, 128.9, 128.6, 128.4, 128.1, 127.1, 126.4, 126.1, 123.0, 122.8, 119.2, 114.4, 83.7, 53.8, 39.2, 38.2, 33.5, 24.0, 23.9, 13.5; Minor isomer diagnostic signals; ^1H NMR (400 MHz, CDCl_3) δ : 5.48(s, 1H), 2.92 (m, 1H), 2.03 (m, 1H), 1.21 (d, J = 6.8 Hz, 6H), 0.95 (d, J = 6.8 Hz, 3H); ^{13}C NMR (100 MHz, CDCl_3) δ : 152.9, 146.2, 142.9, 137.4, 131.7, 129.3, 129.2, 129.0, 128.6, 128.4, 128.2, 127.1, 126.5, 126.1, 123.0, 122.9, 119.2, 114.4, 84.6, 53.9, 39.4, 37.7, 33.6, 24.04, 23.96, 13.6.

3d.

^1H NMR(400 MHz, CDCl_3) δ : 7.78–7.70 (m, 2H), 7.37–7.31 (m, 1H), 7.31–6.98 (m, 12H), 5.54 (s, 1H), 4.52 (d, J = 5.0 Hz, 1H), 2.93 (dd, J = 13.3 and 4.6 Hz, 1H), 2.49 (bs, 1H),

2.47 (*dd*, $J = 13.3$ and 9.3 Hz, 1H), 2.05 (*m*, 1H), 1.28(*s*, 9H), 0.95 (*d*, $J = 6.8$ Hz, 3H); ^{13}C NMR (100 MHz, CDCl_3) δ : 152.9, 148.5, 142.9, 137.0, 131.7, 129.3, 129.0, 128.9, 128.6, 128.4, 128.2, 127.1, 126.5, 124.9, 123.0, 122.8, 119.3, 114.5, 84.6, 53.9, 39.3, 37.6, 34.3, 31.4, 13.6. Minor isomer diagnostic signals; ^1H NMR (400 MHz, CDCl_3) δ : 6.74(*d*, $J = 8.2$ Hz, 2H), 2.68(*dd*, $J = 13.4$ and 8.2 Hz, 1H), 2.18(*m*, 1H), 1.24(*s*, 9H), 1.01(*d*, $J = 6.9$ Hz, 3H); ^{13}C NMR (100 MHz, CDCl_3) δ : 153.1, 148.2, 142.9, 137.0, 131.6, 129.5, 129.0, 128.9, 128.6, 128.3, 128.1, 127.0, 126.4, 124.9, 123.0, 122.9, 119.2, 114.4, 83.6, 53.8, 39.2, 38.2, 34.2, 31.3, 13.6.

3e.

^1H NMR(400 MHz, CDCl_3) δ : 7.76–7.69 (*m*, 2H), 7.36–7.30 (*m*, 1H), 7.30–7.21 (*m*, 7H), 7.08 (*d*, $J = 9.0$ Hz, 1H), 6.45 (*d*, $J = 8.0$ Hz, 1H), 6.40 (*d*, $J = 1.6$ Hz, 1H), 6.18 (*dd*, $J = 7.8$ and 1.7 Hz, 1H), 5.84–5.81 (*m*, 2H), 5.51 (*s*, 1H), 4.51 (*d*, $J = 3.4$ Hz, 1H), 2.64 (*dd*, $J = 13.4$ and 8.1 Hz, 1H), 2.42 (*bs*, 1H), 2.38 (*dd*, $J = 13.4$ and 6.8 Hz, 1H), 2.18–2.06 (*m*, 1H), 0.99 (*d*, $J = 6.9$ Hz, 3H). ^{13}C NMR (100 MHz, CDCl_3) δ : 153.0, 147.3, 145.4, 142.9, 134.0, 131.7, 129.4, 129.0, 128.6, 128.4, 128.1, 127.2, 126.4, 123.0, 122.9, 121.9, 119.2, 114.5, 109.3, 107.8, 100.5, 83.6, 53.8, 39.4, 38.4, 13.5.

Minor isomer diagnostic signals; ^1H NMR (400 MHz, CDCl_3) δ : 7.77–7.65 (*m*, 2H), 7.35–7.28 (*m*, 1H), 7.28–7.18 (*m*, 7H), 7.13 (*d*, $J = 9.0$ Hz, 1H), 6.61 (*d*, $J = 7.9$ Hz, 1H), 6.58 (*d*, $J = 1.6$ Hz, 1H), 6.48 (*dd*, $J = 8.0$ and 1.7 Hz, 1H), 5.85 (*s*, 2H), 5.48 (*s*, 1H),

4.49 (*d*, $J = 5.1$ Hz, 1H), 2.87 (*dd*, $J = 13.4$ and 4.4 Hz, 1H), 2.41 (*bs*, 1H), 2.38 (*dd*, $J = 13.4$ and 9.5 Hz, 1H), 2.03–1.92 (*m*, 1H), 0.93 (*d*, $J = 6.8$ Hz, 3H). ¹³C NMR (100 MHz, CDCl₃) δ : 152.8, 147.3, 145.5, 142.9, 134.0, 131.9, 129.3, 129.0, 128.6, 128.4, 128.1, 127.1, 126.5, 123.1, 122.8, 122.1, 119.3, 114.5, 109.6, 107.9, 100.6, 84.5, 53.9, 39.6, 37.9, 13.4.

Except “**5d**” all aldehydes are commercial available.

5d.

Typical Procedure:

Ref. Selvama, P.; Sonavane, S. U.; Mohapatraa, S. K.; Jayaram, R. V. *Tetrahedron Lett.* **2004**, 45, 3071-3075.

Modified procedure is, the 4-methoxy-Cinnamaldehyde (16.2g, 100mmol) was dissolved in Ethyl acetate (100mL) in inert atmosphere (N₂) and added 10% Pd/Al₂O₃(0.05% of substrate weight (800mg) The progress of the reaction was monitored by GC, and the products were analyzed using GC. After completion (48 hrs) of the reaction filter and evaporate the solvent. (^ 9:1 aldehyde : alcohol) TLC 5% EA/PE R_f, 0.6) Purified by column chromatography and distilled with Kugelrohr (200°C at 7 bar) Yield 14.3 (87%).

GC Time of Cinnamaldehyde is 8.39 min.

GC Time of 3-(4-methoxyphenyl) propanal is 6.97 min.

GC Time of alcohol is 7.67 min.

NMR data matching with *Helvetica Chimica Acta* **2010**, 93, 1299-1312.

¹H NMR (400 MHz, CDCl₃) δ : 9.80 (s, 1H), 7.10 (d, $J = 8.4$ Hz), 6.83 (d, $J = 8.4$ Hz),

3.77 (s, 3H), 2.90 (t, 2H, $J = 7.4$ Hz), 2.73 (t, 2H, $J = 7.4$ Hz)

^{13}C NMR (100 MHz, CDCl_3) δ : 201.5, 157.8, 132.1, 129.0, 113.7, 54.9, 45.2, 27.0.

6a.

Tautomeric equilibria of imines

Ref Vladimir A. Alfonsov, *et al. Synlet* **2007**, 3, 488-490.

m.p. 159-160 °C

Diagnostic signals

Tautomer A 6.44 (s, CH-N), 74.6; 8.60 (s, CH=N), 161.9

Tautomer B 5.65 (s, CH-N), 82.4; 5.68 (s, N-CH-O) 54.0

Tautomer C 5.82 (s, CH-N), 86.7; 5.95 (s, N-CH-O), 57.6

7.86-7.17 (m, CH Ar) A+B+C

m/z 338 (M+H), 360 (M+Na).

6b.

(1*R*,3*S*)-3-isobutyl-1-phenyl-2,3-dihydro-1*H*-naphtho[1,2-*e*][1,3]oxazine(**6b**) (Note: This product more soluble in MeOH). m.p. 120-121 °C; ^1H NMR (300 MHz, CDCl_3) δ :

7.73-7.64 (m, 2H), 7.30-7.07 (m, 9H), 5.38 (s, 1H), 4.66 (t, 1H, $J = 8$ Hz), 2.21 (bs, 1H), 1.95-1.81 (m, 1H), 1.71-1.47 (m, 2H), 0.88 (d, 3H, $J = 8.4$ Hz), 0.75 (d, 3H, $J = 8.8$ Hz); ^{13}C NMR (75 MHz, CDCl_3) δ : 152.6, 142.9, 131.7, 129.1, 128.96, 128.90, 128.5, 128.3, 128.0, 127.9, 127.0, 126.4, 123.0, 122.8, 119.2, 114.3, 81.1, 53.6, 44.0, 24.3, 22.7, 22.3. m/z 318($M+1$), 340($M+23$).

6c.

(1*R*,3*S*)-3-(1-(4-isopropylphenyl)propan-2-yl)-1-phenyl-2,3-dihydro-1*H*-naphtho[1,2-*e*][1,3]oxazine (**6c**). 1:1 two diastereomers (d_1+d_2); ^1H NMR (400 MHz, CDCl_3) δ : 7.77-7.68 (m, 2H), 7.37-6.99 (m, 11H), 6.91 (d, 1H, $J = 8$ Hz), 6.75 (d, 1H, $J = 8$ Hz), 5.57 (s, 1H), 4.52 (almost s, 1H), 2.99-2.67 (m, 2H), 2.50-2.42 (m, 1H), 2.21-2.01(m, 1H), 1.54 (s, 1H), {1.22(d, $J = 6.8$ Hz) + 1.18 (d, $J = 6.8$ Hz) 6H}, {1.02 (d, $J = 6.8$ Hz) + 0.95 (d, $J = 6.8$ Hz), 3H}. ^{13}C NMR (100 MHz, CDCl_3) δ : $d_1(d_2)$ = 153.0, 146.2, 146.0, 142.9, 137.5, 131.7, 129.5, 129.3, 129.2, 128.97, 128.91, 128.5, 128.4, 128.17, 128.14, 127.1, 126.4, 126.3, 126.1, 123.0, 122.86, 122.83, 119.3, 119.2, 114.4, 84.6(83.6), 53.9(53.8), 39.3(39.2), 38.2(37.7), 33.6(33.5), 24.0(23.9), 13.6(13.5). m/z 422 ($M+1$).

6d.

(1*R*,3*S*)-3-(4-methoxyphenethyl)-1-phenyl-2,3-dihydro-1*H*-naphtho[1,2-*e*][1,3]oxazine
(6d). m.p. 162-164 °C; ¹H NMR (400 MHz, CDCl₃) δ: 7.76-7.71 (m, 2H), 7.35-7.08 (m, 9H), 6.92 (d, 2H, *J* = 8.8 Hz), 6.70 (d, 2H, *J* = 8.8 Hz), 5.53 (s, 1H), 4.63 (t, 1H, *J* = 5.6 Hz), 3.74 (s, 3H), 2.70 (t, 2H, *J* = 8 Hz), 2.46 (s, 1H), 2.10-1.92 (m, 2H). ¹³C NMR (100 MHz, CDCl₃) δ: 157.6, 152.7, 143.0, 133.4, 131.6, 129.3, 129.0, 128.6, 128.4, 128.2, 127.1, 126.4, 123.0, 122.8, 119.1, 114.3, 113.6, 81.5, 55.1, 53.9, 37.1, 29.9. m/z 418(M+Na).

6e.

(1*R*,3*S*)-3-benzyl-1-phenyl-2,3-dihydro-1*H*-naphtho[1,2-*e*][1,3]oxazine **(6e)**. m.p. 137-138 °C; ¹H NMR (400 MHz, CDCl₃) δ: 7.75-7.68 (m, 2H), 7.35-7.10 (m, 14H) 5.49 (s, 1H), 4.95 (t, 1H, *J* = 4.4 Hz), 3.15 (dd, 1H, *J*₁ = 14.4 Hz, *J*₂ = 4.4 Hz), 2.99 (dd, 1H, *J*₁ = 14.4 Hz, *J*₂ = 4.8 Hz), 2.38 (s, 1H). ¹³C NMR (100 MHz, CDCl₃) δ: 152.4, 142.7, 135.7, 131.7, 131.6, 130.1, 129.2, 129.0, 128.9, 128.6, 128.4, 128.19, 128.17, 127.2, 126.6, 126.4, 123.0, 122.7, 119.2, 114.0, 81.5, 53.6, 40.8. m/z 374 (M+23).

6f.

(1*R*,3*S*)-3-(4-nitrophenyl)-1-phenyl-2,3-dihydro-1*H*-naphtho[1,2-*e*][1,3]oxazine(**6f**). m.p.

191-192 °C; ^1H NMR (400 MHz, CDCl_3) δ : 8.18 (d, 2H, $J = 8.6$ Hz), 7.78 (m, 4H), 7.28-7.01 (m, 9H), 5.70 (s, 1H), 5.62 (s, 1H), 2.66 (bs, 1H). ^{13}C NMR (100 MHz, CDCl_3) δ : 151.8, 147.8, 145.9, 142.2, 131.5, 129.5, 129.3, 129.0, 128.4, 127.6, 127.3, 126.8, 123.6, 123.4, 122.9, 119.0, 114.5, 81.2, 54.0. m/z 405(M+Na), 421(M+K).

6g.

(1*R*,3*S*)-3-(1-(benzo[*d*][1,3]dioxol-5-yl)propan-2-yl)-1-phenyl-2,3-dihydro-1*H*-naphtho[1,2-*e*][1,3]oxazine(**6g**). 1:1 two diastereomers (d_1+d_2); ^1H NMR(400 MHz, CDCl_3) δ : 7.76–7.69 (*m*, 4H), 7.36–7.21 (*m*, 16H), 7.13 (*d*, $J = 9.0$ Hz, 1H), 7.08 (*d*, $J = 9.0$ Hz, 1H), 6.61 (*d*, $J = 7.9$ Hz, 1H), 6.58 (*d*, $J = 1.6$ Hz, 1H), 6.48 (*dd*, $J = 8.0$ and 1.7 Hz, 1H), 6.45 (*d*, $J = 8.0$ Hz, 1H), 6.40 (*d*, $J = 1.6$ Hz, 1H), 6.18 (*dd*, $J = 7.8$ and 1.7 Hz, 1H), 5.84–5.81 (*m*, 4H), 5.51 (*s*, 2H), 4.51 (*m*, 2H), 2.87 (*dd*, $J = 13.4$ and 4.4 Hz, 1H), 2.64 (*dd*, $J = 13.4$ and 8.1 Hz, 1H), 2.42 (*m*, 4H), 2.18–2.06 (*m*, 1H), 2.03–1.92 (*m*, 1H), 0.99 (*d*, $J = 6.9$ Hz, 3H), 0.93 (*d*, $J = 6.8$ Hz, 3H). ^{13}C NMR (100 MHz, CDCl_3) δ : $d_1(d_2)$ 153.0 (152.8), 147.3, 145.4, 142.9, 134.0, 131.7, 129.4, 129.0, 128.6, 128.4, 128.1, 127.2, 126.4, 123.0, 122.9, 121.9, 119.2, 114.5, 109.3, 107.8, 100.5, (84.5) 83.6, 53.8,(39.6) 39.4, 38.4 (37.9), 13.5.

6h.

(1*R*,3*S*)-3-(1-(4-(*tert*-butyl)phenyl)propan-2-yl)-1-phenyl-2,3-dihydro-1*H*-naphtho[1,2-*e*][1,3]oxazine (**6h**). 1:1 two diastereomers (d_1+d_2); ^1H NMR(400 MHz, CDCl_3) δ : 7.78–7.70 (*m*, 4H), 7.37–6.98 (*m*, 28H), 6.74 (*d*, $J = 8.2$ Hz, 2H) 5.54 (*s*, 2H), 4.52 (*m*, 2H), 2.93 (*dd*, $J = 13.3$ and 4.6 Hz, 1H), 2.68(*dd*, $J = 13.4$ and 8.2 Hz, 1H), 2.49 (*m*, 4H), 2.18(*m*, 1H), 2.05 (*m*, 1H), 1.28(*s*, 9H), 1.24 (*s*, 9H), 1.01(*d*, $J = 6.9$ Hz, 3H), 0.95 (*d*, $J = 6.8$ Hz, 3H); ^{13}C NMR (100 MHz, CDCl_3) δ : $d_1(d_2)$ 152.9 (153.1), 148.5 (148.3), 142.9, 137.0, 131.7, 129.3, 129.0, 128.9, 128.6, 128.4, 128.2, 127.1, 126.5, 124.9, 123.0, 122.8, 119.3, 114.5, 84.6 (83.6), (54.0) 53.9, 39.3(39.2), 37.6 (38.2), 34.3, 31.4, 13.6.