

General regioselective synthesis and crystal structure of racemic 5-substituted 2,2-dimethyl-3-hydroxyimidazolidin-4-ones

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Experimental

[†]*Characteristics and spectroscopic data.* The IR spectra of samples pressed in KBr pellets were recorded on a Specord-82M spectrophotometer in the 400-4000 cm⁻¹ range. NMR spectra were measured on a Bruker WM-400 and a Bruker AC-200 spectrometers operating at 400.14 MHz (¹H) and 50.32 MHz (¹³C), respectively. The starting compounds **8-10** were synthesized according to known procedures¹⁴.

11, 0.47 g (yield 54.7%), mp 127-128^oC (CH₃CN). Found (%): C, 55.73; H, 9.27; N, 16.03. Calc. for C₈H₁₆N₂O₂ (%): C, 55.79; H, 9.36; N, 16.27. ¹H NMR (CD₃OD), δ, ppm: 0.94 (d, 3H, Me^A (Prⁱ), ³J 6.8 Hz), 1.03 (d, 3H, Me^B (Prⁱ), ³J 6.8 Hz), 1.33 (s, 3H, Me^ACN₂), 1.42 (s, 3H, Me^BCN₂), 2.06 (m, 1H, CHMe₂), 3.40 (d, 1H, CHN, ³J 4.3 Hz). ¹H NMR ([²H₆]DMSO), δ, ppm: 0.88 (d, 3H, Me^A (Prⁱ), ³J 6.8 Hz), 0.97 (d, 3H, Me^B (Prⁱ), ³J 6.8 Hz), 1.24 (s, 3H, Me^ACN₂), 1.29 (s, 3H, Me^BCN₂), 1.91 (m, 1H, CHMe₂), 2.79 (d, 1H, NH, ³J_{CHN} 8.3 Hz), 3.25 (dd, 1H, CHN, ³J_{NH} 8.3 Hz, ³J_{CHMe₂} 4.5 Hz). ¹H NMR ([²H₆]acetone), δ, ppm: 0.89 (d, 3H, Me^A (Prⁱ), ³J 6.8 Hz), 0.99 (d, 3H, Me^B (Prⁱ), ³J 6.9 Hz), 1.33 (s, 3H, Me^ACN₂), 1.38 (s, 3H, Me^BCN₂), 1.95 (m, 1H, CHMe₂), 3.37 (d, 1H, CHN, ³J 4.5 Hz). ¹H NMR (CDCl₃), δ, ppm: 0.91 (d, 3H, Me^A(Prⁱ), ³J 6.8 Hz), 1.02 (d, 3H, Me^B (Prⁱ), ³J 6.8 Hz), 1.41 (s, 3H, Me^ACN₂), 1.48 (s, 3H, Me^BCN₂), 2.12 (m, 1H, CHMe₂), 3.46 (d, 1H, CHN, ³J 4.1 Hz). ¹³C NMR (CD₃OD), δ, ppm: 14.82 (CHMe^A), 16.53 (CHMe^B), 21.78 (CHMe₂), 24.19 (Me^ACN₂), 27.72 (Me^BCN₂), 59.13 (CHN), 74.39 (NCN), 169.44 (C=O). IR (KBr), ν/cm⁻¹: 3255m (NH), 3108b, 2974m (CH), 2960m (CH), 2932w (CH), 2893m (CH_{Alk}), 2730b (OH), 2615b (OH), 1732w (C=O), 1706s (C=O), 1670w (C=O), 1536m, 1521w, 1477m, 1467m, 1431w, 1384m (δ_{CH₃}), 1369m (δ_{CH₃}), 1348w, 1289w, 1258w, 1222w, 1168m, 1104w, 1094m, 1029m, 1009m, 993w, 957w, 913m, 877w, 811w, 798w, 628w, 582m, 522w.

12, 0.53 g (57%), mp 128-129⁰C (benzene). Found (%): C, 58.15; H, 9.49; N, 14.97; Calc. for C₉H₁₈N₂O₂ (%): C, 58.04; H, 9.74, N, 15.04. ¹H NMR (CD₃OD), δ, ppm: 0.94 (d, 3H, Me^A (Buⁱ), ³J 6.6 Hz), 0.97 (d, 3H, Me^B (Buⁱ), ³J 6.6 Hz), 1.32 (s, 3H, Me^ACN₂), 1.39 (m, 1H, CH_AH_BPrⁱ, overlaps with signal at 1.42 ppm), 1.42 (s, 3H, Me^BCN₂), 1.65 (ddd, 1H, CH_AH_BPrⁱ, ²J_{CHA} 13.5 Hz, ³J_{NCHD} 3.8 Hz, ³J_{CHCMe₂} 9.4 Hz), 1.86 (m, 1H, CH_CMe₂, ³J_{Me} 6.6 Hz), 3.45 (dd, 1H, NCH_D, ³J_{CHA} 10.1 Hz, ³J_{CHB} 3.8 Hz); ¹H NMR ([²H₆]DMSO), δ, ppm: 0.84 (d, 3H, Me^A (Buⁱ), ³J 6.6 Hz), 0.885 (d, 3H, Me^B (Buⁱ), ³J 6.6 Hz), 1.17 (s, 3H, Me^ACN₂), 1.25 (s, 3H, Me^BCN₂), 1.28 (m, 1H, CH_AH_BPrⁱ, overlaps with signal at 1.25 ppm), 1.48 (m, 1H, CH_AH_BPrⁱ) {(ddd, 1H, CH_AH_BPrⁱ, ²J_{CHA} 14.2 Hz, ³J 9.0 Hz, ³J 3.8 Hz), 1.77 (m, 1H, CH_CMe₂, ³J_{Me} 6.6 Hz), 2.81 (br. d, 1H, NH, ³J_{NCHD} 8.0 Hz), 3.24 (m, 1H, NCH_D), 9.43 (br. s, 1H, OH); ¹H NMR ([²H₆]acetone), δ, ppm: 0.89 (d, 3H, Me^A (Buⁱ), ³J 6.6 Hz), 0.92 (d, 3H, Me^B (Buⁱ), ³J 6.6 Hz), 1.30 (s, 3H, Me^ACN₂), 1.35 (ddd, 1H, CH_AH_BPrⁱ, ²J_{CHB} 13.6 Hz, ³J_{CHCMe₂} 5.2 Hz, ³J_{CHDN} 10.1 Hz), 1.38 (s, 3H, Me^BCN₂), 1.62 (ddd, 1H, CH_AH_BPrⁱ, ²J_{CHA} 13.4 Hz, ³J_{CHCMe₂} 9.0 Hz, ³J_{CHDN} 4.0 Hz), 1.87 (m, 1H, CH_CMe₂), 3.40 (dd, 1H, NCH_D, ³J_{CHA} 10.1 Hz, ³J_{CHB} 4.0 Hz); ¹H NMR (CDCl₃), δ, ppm: 0.92 (d, 3H, Me^A (Buⁱ), ³J 6.6 Hz), 0.95 (d, 3H, Me^B (Buⁱ), ³J 6.6 Hz), 1.32 (ddd, 1H, CH_AH_BPrⁱ, ²J_{CHB} 14.2 Hz, ³J_{CHDN} 10.0 Hz, ³J_{CHCMe₂} 5.2 Hz), 1.39 (s, 3H, Me^ACN₂), 1.47 (s, 3H, Me^BCN₂), 1.74 (ddd, 1H, CH_AH_BPrⁱ, ²J_{CHA} 14.2 Hz, ³J_{NCHD} 3.9 Hz, ³J_{CHCMe₂} 9.1 Hz), 1.84 (m, 1H, CH_CMe₂), 3.51 (dd, 1H, NCH_D, ³J_{CHA} 10.0 Hz, ³J_{CHB} 3.9 Hz); ¹H NMR ([²H₆]benzene), δ, ppm: 0.78 (d, 3H, Me^A (Buⁱ), ³J 6.1 Hz), 0.84 (d, 3H, Me^B (Buⁱ), ³J 6.3 Hz), 1.18 (m, 1H, CH_AH_BPrⁱ), 1.26 (s, 3H, Me^ACN₂), 1.30 (s, 3H, Me^BCN₂), 1.74-1.78 (m, 2H, CH_AH_BPrⁱ and CH_CMe₂), 3.35 (dd, 1H, NCH_D, ³J_{CH} 9.8 Hz, ³J_{CH} 3.7 Hz); ¹³C NMR (CD₃OD), δ, ppm: 21.54 (q m, Me^A (Buⁱ), ¹J 123.7 Hz), 23.44 (q m, Me^B (Buⁱ), ¹J 123.5 Hz), 23.93 (d m, CHMe₂ (Buⁱ), ¹J 127.1 Hz), 24.51 (q m, Me^ACN₂, ¹J 125.2 Hz), 26.64 (q m, Me^BCN₂, ¹J 127.8 Hz), 41.17 (tr m, CH₂ (Buⁱ), ¹J 123.7 Hz), 53.31 (d m, NCH, ¹J 137.7 Hz), 75.36 (m, NCN), 171.63 (m, C=O). IR (KBr), cm⁻¹: 3251m (NH), 3107w, 2991w (CH), 2959ms (CH), 2931m (CH), 2886m (CH), 2872m (CH), 2821b (OH), 2730b (OH), 1714sh (C=O), 1696s (C=O), 1648w, 1517w, 1476m, 1465m, 1386m, 1366m, 1342m, 1320w, 1301w, 1275w, 1256m, 1216w, 1176mw, 1130m, 1106w, 1083w, 1062m, 1015w, 994w, 930w, 906m, 886w, 825w, 810w, 779w, 742w, 651w, 625w, 589w, 560w, 515w.

13, 0.74 g (67.3%), mp 128-129⁰C (acetone). Found (%): C, 65.38; H, 7.26; N, 12.59. Calc. for C₁₂H₁₆N₂O₂ (%): C, 65.43; H, 7.32, N, 12.72. ¹H NMR (CD₃OD), δ, ppm: 1.23 (s, 3H, Me), 1.28 (s, 3H, Me), 2.92 (dd, 1H, CH_AH_BPh, ²J 14.2 Hz, ³J 7.6 Hz), 3.10 (dd, 1H, CH_AH_BPh, ²J 14.2 Hz, ³J 4.2 Hz), 3.74 (dd, 1H, NCH, ³J_{HA} 7.6 Hz, ³J_{HB} 4.2 Hz), 7.23 (m, 1H, *p*-H_{Ph}), 7.26-7.31 (m, 4H, *o,m*-H_{Ph}); ¹H NMR ([²H₆]DMSO), δ, ppm: 1.15 (s, 3H, Me), 1.20 (s, 3H, Me), 2.68

(dd, 1H, CH_AH_BPh , 2J 14.1 Hz, $^3J_{NCH}$ 9.5 Hz), 2.80 (d, 1H, NH, $^3J_{NCH}$ 9.8 Hz), 3.00 (dd, 1H, CH_AH_BPh , 2J 14.1 Hz, $^3J_{NCH}$ 3.4 Hz), 3.51 (m, 1H, NCH), 7.19 (m, 1H, p -H_{Ph}), 7.26-7.27 (m, 4H, o,m -H_{Ph}), 9.55 (br. s, 1H, OH); 1H NMR ($[^2H_6]$ acetone), δ , ppm: 1.26 (s, 3H, Me), 1.30 (s, 3H, Me), 2.82 (dd, 1H, CH_AH_BPh , 2J 14.1 Hz, 3J 8.4 Hz), 3.08 (dd, 1H, CH_AH_BPh , 2J 14.1 Hz, 3J 3.9 Hz), 3.65 (dd, 1H, NCH, $^3J_{HA}$ 8.4 Hz, $^3J_{HB}$ 3.9 Hz), 7.24 (m, 1H, p -H_{Ph}), 7.29-7.31 (m, 4H, o,m -H_{Ph}); 1H NMR (CDCl₃), δ , ppm: 1.28 (s, 3H, Me), 1.40 (s, 3H, Me), 3.03 (dd, 1H, CH_AH_BPh , 2J 14.2 Hz, 3J 6.4 Hz), 3.10 (dd, 1H, CH_AH_BPh , 2J 14.2 Hz, 3J 4.7 Hz), 3.83 (dd, 1H, NCH, $^3J_{HA}$ 6.4 Hz, $^3J_{HB}$ 4.7 Hz), 7.21 (m, 2H, o -H_{Ph}), 7.27 (m, 1H, p -H_{Ph}), 7.33 (m, 2H, m -H_{Ph}); $\Delta\delta_{Me} = 0.12$ ppm, $\Delta\delta_{CH_2} = 0.07$ ppm; 2J 14.2 Hz, $^3J_{HA,HC}$ 6.4 Hz, $^3J_{HB,HC}$ 4.7 Hz; 1H NMR ($[^2H_6]$ benzene), δ , ppm: 1.14 (s, 3H, Me), 1.22 (s, 3H, Me), 2.85 (dd, 1H, CH_AH_BPh , 2J 14.1 Hz, 3J 7.3 Hz), 3.00 (dd, 1H, CH_AH_BPh , 2J 14.1 Hz, 3J 4.2 Hz), 3.62 (dd, 1H, NCH, $^3J_{HA}$ 7.3 Hz, $^3J_{HB}$ 4.2 Hz), 7.04 (m, 1H, p -H_{Ph}), 7.11 (m, 4H, o,m -H_{Ph}); ^{13}C NMR (CD₃OD), δ , ppm: 23.92 (qq, Me, 1J 127.2 Hz, 3J 3.4 Hz), 26.48 (qq, Me, 1J 127.4 Hz, 3J 3.7 Hz), 37.77 (tr d, CH₂, 1J 128.6 Hz, 2J 3.2 Hz), 57.96 (q tr, NCH, 1J 141.8 Hz, $^2J_{CH_2}$ 4.9 Hz), 77.41 (m, NCN, J 4.6 Hz), 127.79 (d tr tr, p -C_{Ar}, 1J 160.2 Hz, 2J 4.2 Hz, 3J 8.4 Hz), 129.51 (ddm, 2C, o -C_{Ar}, 1J 159.7 Hz, J 6.1 Hz), 130.51 (dm, 2C, m -C_{Ar}, 1J 157.9 Hz, J 5.2 Hz), 138.24 (m, i -C_{Ar}), 171.88 (m, C=O). IR (KBr), cm^{-1} : 3254m (NH), 3133w (CH_{Ar}), 3062w (CH_{Ar}), 3031w (CH_{Ar}), 2985w (CH_{Alk}), 2973w (CH_{Alk}), 2926w (CH_{Alk}), 2908w (CH_{Alk}), 2877w (CH_{Alk}), 2747b (OH), 2624b (OH), 1700sh (C=O), 1688 vs (C=O), 1644sh (C=O), 1605w, 1541m, 1497m (C=C_{Ar}), 1452m (δ_{CH_2}), 1405m, 1397m, 1373m (δ_{CH_3}), 1328w, 1249m, 1186w, 1129w, 1105w, 1073m, 1032m, 1000w, 965w, 933w, 880m, 825w, 748w, 728m, 694m, 668w, 550w, 524w, 465w.