Supporting Information

Platinum – (Phosphinito - Phosphinous Acid) complexes as bi-talented catalyst for oxidative fragmentation of piperidinols: an entry to primary amines

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1. General information

1.1 Solvents

All solvents were purified by standard procedures or obtained from a Solvent Purification System (Braun SPS 800).

1.2 Thin layer chromatography

Thin layer chromatography (TLC) was carried out on Merck silica gel 60 F$_{254}$ and visualized under ultraviolet light (254nm and 366nm), and/or through spray with a basic KMnO$_4$ solution followed by heating with a heat gun. Flash chromatography was performed on Merck silica gel 60 (230-400Mesh) unless otherwise mentioned.

1.3 Nuclear Magnetic Resonance

$^1$H, $^{13}$C and $^{31}$P spectra were recorded on Bruker Avance III nanobay spectrometers operating at 400 and/or 300MHz.$^{13}$C and $^{31}$P nuclei were observed with proton decoupling. Unless otherwise specified NMR spectra have been recorded using CDCl$_3$ as solvent. 85% phosphoric acid was used as external reference for $^{31}$P spectra. Chemical shift ($\delta$) of $^1$H and $^{13}$C are reported in ppm relative to TMS (based on the signal of residual CHCl$_3$ in CDCl$_3$ at $\delta$=7.27 ppm). Coupling constants (J) values are given in Hz. Proton NMR information are given in the following format: mutiplicity (s, singlet; d, doublet; t, triplet; at, apparent triplet; q, quartet; m, multiplet), coupling constant J, integration. The prefix br indicates that the signal is broadened.

1.4 Physical and Analytical Measurements

Melting points (uncorrected) were determined in a capillary tube using a Büchi B545 apparatus. High Resolution MS experiments were performed with a SYNAPT G2 HDMS (Waters) equipped with an electrospray ionization (ESI) source. In the positive ion mode, the capillary voltage was set at 2800V and the cone voltage was set between 10-55V. In this hybrid instrument, ions were measured using an orthogonal acceleration time of flight (oa-TOF) mass analyzer. In MS, accurate mass measurements were performed using two reference ions from polyethylene glycol or polypropylene glycol internal standards.

1.5 Microwaves heating

Microwave assisted synthesis are conducted using an Anton Paar Monowave 300 device equipped with an IR temperature controller. G30 glass tubes are used as reactors.
2. Experimental Part

Ligands and catalysts synthesis have been done according to the procedures reported in our recent article.\[1\]

2.1 Ligands and Preligands Synthesis

H-adamantylphenylphosphinate was prepared according to a reported procedure from commercial adamantanol and dichlorophenylphosphine\[2\].

(R)-tert-butylphenyl phosphine oxide and (S)-tert-butylphenyl phosphine oxide were prepared according to a reported procedure from H-adamantylphosphinate\[1\].

2.2. Complexes synthesis

di-µ-acetatotetrakys-[(R)-tert-butylphenylphosphinito-κ-P]dipalladate(2-)1a was prepared according to a reported procedure.

di-µ-chlorotetrakys-[(R)-tert-butylphenylphosphinito-κ-P]dipalladate(2-)1b was prepared following reported procedure in a 95:5 meso / dl ratio.\[4\] NMR, 400 MHz, CDCl₃, δ(ppm): 15.74 (s, 1H) bridging H, 7.91 (m, 2H), 7.42 (m, 3H), 1.12 (d, J=16.1 Hz, 9H); \[31\]P{\[1\]H} NMR, 162MHz, CDCl₃, δ (ppm): 95.62 (s, 1P).

di-µ-chlorotetrakys-[(R)-tert-butylphenylphosphinito-κ-P]diplatinate(2-)1c was prepared following reported procedure in a 95:5 meso / dl ratio.\[4\] NMR, 400 MHz, CDCl₃, δ (ppm): 16.09 (s, 1H) bridging H, 7.86 (m, 2H), 7.43 (m, 3H), 1.09 (d, J=16.1 Hz, 9H); \[31\]P{\[1\]H} NMR, 162MHz, CDCl₃, δ (ppm): 65.0 (s, 0.7P), 65.0 (d, J_Pt(195)-H=4014Hz, 0.3P).

2.3 Precursors synthesis

Precursors synthesis have been done according to the previously reported procedure\[3\].

In a 500mL round bottom flask, 2,2,6,6-tetramethylpiperidin-4-one (15g, 96.8mmol) was dissolved in 200mL of anhydrousEtOH. The mixture was cooled to 0°C and NaBH₄ (1.5 equivalents, 5.5 g, 145 mmol) was carefully added portion wise (strong gas evolution). Reaction was allowed to reach room temperature under stirring for 2 hours and then cooled to 0°C. Distilled water was slowly added (150mL, white boron salt formation could be observed) and the mixture was warmed to room temperature overnight. After one extraction with AcOEt and concentration under vacuum the desired compound, was obtained as an orange solid (14.2g, 93%) and could be used without further purification. \[1\]H NMR, 400 MHz, CDCl₃, δ (ppm): 4.06 (m, 1H), 1.95 (dd, J=4.1,12.5Hz, 2H), 1.33 (s, 1H), 1.24 (s, 6H), 1.11 (s, 6H), 1.0 (t, J=11.6Hz, 2H); \[13\]C{\[1\]H} NMR, 101 MHz, CDCl₃, δ (ppm): 64.5, 51.66, 48.15, 34.91, 28.70.

General procedure for chemioselective N-alkylation with allylic and benzylic substrates

General procedure A

In a 30mL PARR autoclave were introduced 2,2,6,6-tetramethylpiperidin-4-ol 1 (2.0 g, 1 equiv.) and the allyl or benzyl bromide (0.5 equiv.) dissolved in dry toluene (13 mL). The autoclave was sealed and the mixture was heated to 130 °C. After 40 hours stirring, the mixture was cooled down to room
temperature then diluted in AcOEt and water. The aqueous layer was extracted 3 times with AcOEt (3x25 mL) and the combined organic phases were washed with water (20 mL), brine (20 mL) and dried over Na$_2$SO$_4$. After filtration and concentration under vacuum, the residue was purified by flash chromatography on silicagel using a combination of petroleum ether and ethyl acetate for benzylic products and dichloromethane and methanol for allylic products to yield the pure desired products 3.

**General procedure B**

**Microwaves assisted synthesis**

A G30 glass tube was charged with the 2,2,6,6-tetramethylpiperidin-4-ol (1.0 g, 1 equiv.) and the desired allyl or benzyl bromide (0.5 equiv.) dissolved in dry toluene (7.5 mL). Stirring speed and power were respectively fixed at 600 rpm and 230 W. The following method was applied:

| Step | Program             | Temperature | Duration | Cooling |
|------|---------------------|-------------|----------|---------|
| 1    | Fast heating        | 230 °C      | -        | Off     |
| 2    | Temperature range   | -           | 20 min   | Off     |
| 3    | Cooling             | 55 °C       | 5 min    | On      |

The aqueous layer was extracted 3 times with AcOEt (3x15 mL) and the combined organic phases were washed with water (10 mL), brine (10 mL) and dried over Na$_2$SO$_4$. After concentration under vacuum, the residue was purified by flash chromatography on silicagel using a combination of petroleum ether and ethyl acetate for benzylic products and dichloromethane and methanol for allylic products to yield the pure desired products.

*N*-methyl-2,2,6,6-tetramethylpiperidin-4-ol (1a, MW=171.3 g/mol) was purchased from commercial source.

*N*-benzyl-2,2,6,6-tetramethylpiperidin-4-ol (1b, MW=247.4 g/mol) was obtained from benzyl bromide as a white solid in 88% yield according to the general procedure A and in 90% yield according to the general procedure B after purification by flash chromatography (PE/AcOEt 80:20). Analyses are consistent with those described in the literature [4]. $^1$H NMR, 400 MHz, CDCl$_3$, δ (ppm): 7.43 (m, 2H), 7.28 (m, 2H), 7.15 (m, 1H), 4.05 (m, 1H), 3.83 (s, 2H), 1.91 (dd, J=4.1, 12.1 Hz, 2H), 1.5 (t, J=11.6 Hz, 2H), 1.26 (s, 1H), 1.21 (s, 6H), 0.95 (s, 6H); $^{13}$C($^1$H) NMR, 101 MHz, CDCl$_3$, δ(pppm): 145.3, 127.8, 125.6, 64, 56.2, 50.3, 47.2, 33.8, 22.5; IR (ATR) 3249, 2980, 2931, 1460, 1449, 1379, 1368, 1256, 1187, 1174, 1162, 1040, 1025, 955, 938, 844, 722, 605 cm$^{-1}$.

*N*-naphtyl-2,2,6,6-tetramethylpiperidin-4-ol (1c, MW=297g/mol) was obtained from naphtyl bromide as a white solid in 80% yield according to the general procedure A and in 90% yield according to the general procedure B after purification by flash chromatography (PE/AcOEt80:20). $^1$H NMR, 400 MHz, CDCl$_3$, δ (ppm): 7.87 (m, 1H),
7.75 (m, 3H), 7.5 (m, 1H), 7.39 (m, 2H), 4.05 (m, 1H), 3.95 (s, 2H), 1.90 (dd, J=4.0, 12.1Hz,2H), 1.53 (t, J=11.6Hz, 2H), 1.36 (s, 1H), 1.18 (s, 6H), 0.96 (s, 6H); \textsuperscript{13}C{\textsuperscript{1}H} NMR, 101 MHz, CDCl\textsubscript{3}, \(\delta\) (ppm): 43.1, 133.5, 132.4, 127.6, 127.2, 125.6, 124.9, 64, 56.3, 50.28, 47.4, 33.8, 22.6; IR (ATR) 3235, 2978, 2963, 2919, 2871, 1603, 1507, 1458, 1387, 1378, 1315, 1255, 1227, 1142, 1123, 1044, 951, 842, 809, 765, 736, 623, 580 cm\textsuperscript{-1}; HRMS (ESI-TOF) m/z: [M+H]\textsuperscript{+} Calcd for C\textsubscript{20}H\textsubscript{29}NO 298.2165; Found 298.2165.

\textbf{N-p-methylbenzyl-2,2,6,6-tetramethylpiperidin-4-ol} (1d, MW=261 g/mol) was obtained from o-p-methylbenzyl bromide as a white solid in 70% yield according to the general procedure A and in 85% yield according to the general procedure B after purification by flash chromatography (PE/AcOEt 80:20). \textsuperscript{1}H NMR, 400 MHz, CDCl\textsubscript{3}, \(\delta\) (ppm): 7.33 (d, J=7.8 Hz, 2H), 7.10 (d, J=7.1 Hz, 2H), 4.06 (m, 1H), 3.8 (s, 2H), 2.34 (s, 3H), 1.90 (dd, J=4.0,12.0 Hz, 2H), 1.63 (bs, 1H), 1.5 (t, J=11.6 Hz, 2H), 1.14 (s, 6H), 1.01 (s, 6H); \textsuperscript{13}C{\textsuperscript{1}H} NMR, 101 MHz, CDCl\textsubscript{3}, \(\delta\) (ppm): \(\delta\) 142.5, 135, 128.5, 126.5, 64, 56.2, 50.3, 46.9, 33.8, 22.5, 21; IR (ATR) 3259, 2979, 2931, 2869, 1509, 1460, 1343, 1316, 1229, 1175, 1111, 1017, 796, 653, 583 cm\textsuperscript{-1}; HRMS (ESI-TOF) m/z: [M+H]\textsuperscript{+} Calcd for C\textsubscript{18}H\textsubscript{25}NO 262.2165; Found 262.2166.

\textbf{N-o-bromobenzyl-2,2,6,6-tetramethylpiperidin-4-ol} (1e, MW=326.2g/mol) was obtained from o-bromobenzyl bromide as a white solid in 68% yield according to the general procedure A and in 78% yield according to the general procedure B after purification by flash chromatography (PE/AcOEt 10:1.5 > 10:2). \textsuperscript{1}H NMR, 400 MHz, CDCl\textsubscript{3}, \(\delta\) (ppm): 7.82 (m, 1H), 7.46 (m, 1H), 7.27 (m, 1H), 7.04 (m, 1H), 4.09 (m, 1H), 3.77 (s, 2H), 1.93 (dd, J=4.0, 12.1Hz, 2H), 1.51 (t, J=11.5 Hz, 2H), 1.29 (s, 1H), 1.23 (s, 6H), 0.92 (s, 6H); \textsuperscript{13}C{\textsuperscript{1}H} NMR, 101 MHz, CDCl\textsubscript{3}, \(\delta\) (ppm): 143.1, 131.8, 130.2, 127.3, 126.7, 122.2, 64, 56.3, 50.2, 48.1, 33.1, 22.8; IR (ATR) 3286, 2953, 1455, 1438, 1380, 1367, 1313, 1291, 1213, 1185, 1114, 1018, 994, 954, 749, 749, 670, 604, 545 cm\textsuperscript{-1}; HRMS (ESI-TOF) m/z: [M+H]\textsuperscript{+} Calcd for C\textsubscript{16}H\textsubscript{25}NBrO 326.1114; Found 326.1113.

\textbf{N-m-bromobenzyl-2,2,6,6-tetramethylpiperidin-4-ol} (1f, MW=326.27 g/mol) was obtained from o-bromobenzyl bromide as a white solid in 70% yield according to the general procedure A and in 80% yield according to the general procedure B after purification by flash chromatography (PE/AcOEt10:0.3). \textsuperscript{1}H NMR, 400 MHz, CDCl\textsubscript{3}, \(\delta\) (ppm): 7.58 (m, 1H), 7.31 (m, 2H), 7.15 (m, 1H), 4.05 (m, 1H), 3.8 (s, 2H), 1.91 (dd, J=4.0, 12.1Hz, 2H), 1.5 (t, J=11.6Hz, 2H), 1.28 (s, 1H), 1.2 (s, 6H), 0.9 (s, 6H); \textsuperscript{13}C{\textsuperscript{1}H} NMR, 101 MHz, CDCl\textsubscript{3}, \(\delta\) (ppm): 148.1, 129.7, 129.4, 128.7, 125.2, 122.2, 63.9, 56.3, 50.1, 46.9, 33.7, 22.5; IR (ATR) 3304, 2974, 2931, 1590, 1567, 1427, 1368, 1317, 1257, 1163, 1087, 1078, 1052, 1037, 992, 905, 935, 905, 868, 782, 682, 667, 604, 541 cm\textsuperscript{-1}; HRMS (ESI-TOF) m/z: [M+H]\textsuperscript{+} Calcd for C\textsubscript{16}H\textsubscript{25}NBrO 326.1114; Found 326.1114.
**N-p-bromobenzyl-2,2,6,6-tetramethylpiperidin-4-ol (1g, MW=326.2 g/mol)** was obtained from p-bromobenzyl bromide as a white solid in 70% yield according to the general procedure A and in 78% yield according to the general procedure B after purification by flash chromatography (PE/AcOEt 10:0.3).\(^1\)H NMR, 400 MHz, CDCl\(_3\), \(\delta\) (ppm): 7.39 (m, 2H), 7.32 (m, 2H), 4.05 (m, 1H), 3.76 (s, 2H), 1.90 (dd, J=4.0, 1Hz, 2H), 1.48 (t, J=11.5Hz, 2H), 1.29 (s, 1H), 1.17 (s, 6H), 0.90 (s, 6H); \(^{13}\)C\(^{(1)}\)H NMR, 101 MHz, CDCl\(_3\), \(\delta\) (ppm): 144.5, 130.8, 128.4, 119.0, 63.9, 56.2, 50.1, 46.7, 33.7, 22.5; IR (ATR) 3265, 2963, 2935, 1484, 1403, 1366, 1341, 1285, 1215, 1162, 1040, 1010, 956, 909, 858, 843, 800, 728, 685, 559 cm\(^{-1}\); HRMS (ESI-TOF) m/z: [M+H]\(^{+}\) Calcd for C\(_{16}\)H\(_{23}\)NOBrO 326.1114; Found 326.1113.

**N-p-nitrobenzyl-2,2,6,6-tetramethylpiperidin-4-ol (1h, MW= 292 g/mol)** was obtained from p-nitrobenzyl bromide as a white solid in 90% according to the general procedure A and in 50% yield according to the general procedure B after purification by flash chromatography (PE/AcOEt90:10).\(^1\)H NMR, 400 MHz, CDCl\(_3\), \(\delta\) (ppm): 8.16 (d, J=8.8 Hz, 2H), 7.62 (d, J=8.8 Hz, 2H), 4.09 (s, 2H), 3.92 (s, 2H), 1.94 (dd, J=4.1, 12.3 Hz, 2H), 1.5 (t, J=11.6 Hz, 2H), 1.39 (d, J=4.5 Hz, 1H), 1.16 (s, 6H), 0.98 (s, 6H); \(^{13}\)C\(^{(1)}\)H NMR, 101 MHz, CDCl\(_3\), \(\delta\) (ppm): 153.7, 146.4, 127.3, 123.3, 63.8, 56.4, 50.0, 47.2; IR (ATR) 3233, 2966, 2928, 2873, 1596, 1461, 1317, 1254, 1216, 1105, 1009, 858, 820, 744, 798, 680, 561cm\(^{-1}\); HRMS (ESI-TOF) m/z: [M+H]\(^{+}\) Calcd for C\(_{16}\)H\(_{23}\)NO\(_3\) 293.1860; Found 293.1861.

**N-p-trifluoromethane-2,2,6,6-tetramethylpiperidin-4-ol (1i, MW=315g/mol)** was obtained from p-trifluoromethane benzyl bromide as a brown solid in 81% according to the general procedure A and in 41% yield according to the general procedure B after purification by flash chromatography (PE/AcOEt10:1).\(^1\)H NMR, 400 MHz, CDCl\(_3\), \(\delta\) (ppm): 7.54 (m, 4H), 4.08 (m, 1H), 3.87 (s, 2H), 1.92 (dd, J=4.0, 12.2Hz, 2H), 1.66 (s, 1H), 1.51 (d, J=11.6Hz, 2H), 1.18 (s, 6H), 0.94 (s, 6H); \(^{13}\)C\(^{(1)}\)H NMR, 101 MHz, CDCl\(_3\), \(\delta\) (ppm): 149.77, 128.22, 127.8, 126.9, 126.3, 124.8, 122.7, 63.9, 56.3, 50.1, 47.0, 33.6, 22.5; IR (ATR) 3418, 2967, 2934, 1616, 1461, 1415, 1367, 1214, 1159, 1095, 1063, 1050, 948, 920, 860, 819, 750, 713, 636, 591, 571, 558 cm\(^{-1}\); HRMS (ESI-TOF) m/z: [M+H]\(^{+}\) Calcd for C\(_{17}\)H\(_{25}\)NO\(_3\)F\(_3\) 316.1883; Found 316.1880.

**N-p-trifluoromethoxybenzyl-2,2,6,6-tetramethylpiperidin-4-ol (1j, MW= 331.4 g/mol)** was obtained from p-trifluoromethoxy benzyl bromide as white solid in 86% yield according to the general procedure A and in 46% yield according to the general procedure B after purification by flash chromatography.\(^1\)H NMR, 400 MHz, CDCl\(_3\), \(\delta\) (ppm): 7.44 (d, J=8.2 Hz, 2H), 7.13 (d, J=8.2 Hz, 2H), 4.06 (m, 1H), 3.81 (s, 2H), 1.91 (dd, J=4.0, 12.2 Hz, 2H), 1.49 (t, J=11.6 Hz, 2H), 1.46 (bs, 1H), 1.13 (s, 6H), 0.97 (s, 6H); \(^{13}\)C\(^{(1)}\)H NMR, 101 MHz, CDCl\(_3\), \(\delta\) (ppm): 147.2, 144.1, 127.7, 127.7 (C\(_F\)) 120.3, 63.9, 56.3, 50.2, 46.6, 33.7, 22.5; IR (ATR) 3236, 2982, 2926, 2876, 1463, 1375, 1349, 1255, 1216, 1175, 1050, 984, 840, 741, 711, 692, 507; HRMS (ESI-TOF) m/z: [M+H]\(^{+}\) Calcd for C\(_{17}\)H\(_{25}\)NO\(_3\)F\(_3\) 332,1831; Found 332,1833.
**N-cinnamyl-2,2,6,6-tetramethylpiperidin-4-ol (1k, MW=273 g/mol)** was obtained from cinnamyl bromide as a white solid in 88% yield according to the general procedure A and in 95% yield according to the general procedure B after purification by flash chromatography (DCM/MeOH 10:0).\(^1\) ^1H NMR, 400 MHz, CDCl\(_3\), δ(ppm): 7.25 (m, 2H), 7.19 (m, 2H), 7.09 (m, 1H), 6.41 (d, J=15.9Hz, 1H), 6.13 (dt, J=5.2, 15.9Hz, 1H), 3.91 (m, 1H), 3.24 (dd, J=1.3, 5.1Hz, 2H), 1.76 (dd, J=4.0, 12.1Hz, 2H), 1.32 (t, J=11.6Hz), 1.3 (s, 1H), 1.05 (s, 6H), 1.0 (s, 6H); ^13C\(^{[1]H}\) NMR, 101 MHz, CDCl\(_3\), δ(ppm): 136.9, 133.9, 127.4, 127.1, 125.4, 125.3, 62.9, 55.1, 49.1, 44.5, 33, 21.28; IR (ATR) 3239, 2964, 2930, 2854, 1459, 1376, 1366, 1348, 1317, 1254, 1217, 1188, 1176, 1162, 1104, 1045, 955, 858, 787, 593, 580cm\(^{-1}\); HRMS (ESI-TOF) m/z: [M+H]\(^+\) Calcd for C\(_{18}\)H\(_{26}\)NO 274.2165; Found 274.2165

**N-geranyl-2,2,6,6-tetramethylpiperidin-4-ol (1l, MW=294 g/mol)** was obtained from geranyl bromide as a brown solid 77% yield according to the general procedure A and in 58% yield according to the general procedure B in a Z/E mixture after purification by flash chromatography (DCM/MeOH).\(^1\) ^1H NMR, 400 MHz, CDCl\(_3\), δ(ppm): 5.14 (at, 1H), 5.09 (at, 0.7 H), 4.68 (d, J= 10.6 Hz, 0.3 H), 3.96 (m, 1H), 3.09 (d, J=4.9 Hz, 2H), 2.06 (m, 2H), 1.96 (m, 2H), 1.82 (dd, J= 4.0 Hz, 12.0 Hz, 2H), 1.72 (s, 3H), 1.6 (d, J=3.1 Hz, 6H), 1.35 (t, J=11.6 Hz, 2H), 1.2 (bs, 1H), 1.08 (s, 6H), 1.05 (s, 6H); ^13C\(^{[1]H}\) NMR, 101 MHz, CDCl\(_3\), δ(ppm): 131, 124.4, 63.9, 50.14, 41.5, 39.5, 39.08, 37.3, 33.8, 26.5, 25.6, 22.4, 17.7; IR (ATR) 3238, 2964, 2924, 2854, 1459, 1376, 1366, 1348, 1317, 1254, 1217, 1188, 1176, 1162, 1104, 1045, 955, 858, 787, 593, 580cm\(^{-1}\); HRMS (ESI-TOF) m/z: [M+H]\(^+\) Calcd for C\(_{19}\)H\(_{30}\)NO 294.2791; Found 294.2788

**N-propylbenzene-2,2,6,6-tetramethylpiperidin-4-ol (1m, MW=275 g/mol)** was obtained by hydrogenation of compound 1k according to the following procedure. A 2 necked round bottom flask was charged with compound 1k (500 mg, 1.83 mmol), Pd/C (10% w/w, 580 mg) and dry EtOH (110 mL). After a stirring period of 48 h under hydrogen atmosphere (balloon) at room temperature, the catalyst was filtered and washed with dry EtOH. After concentration under vacuum, a 90:10 mixture of desired compound 1m / 2,2,6,6-tetramethylpiperidinol was obtained. A simple filtration on a short pad of silica gel using AcOEt as eluant gave the desired compound 1mas a white solid in 79% yield. \(^1\)H NMR, 400 MHz, CDCl\(_3\), δ(ppm): 7.27 (m, 2H), 7.19 (m, 2H), 3.94 (m, 1H), 2.55 (t, J=7.8 Hz, 2H), 1.77 (m, 4H), 1.31 (t, J=11.6 Hz, 2H), 1.25 (bs, 1H), 1.09 (s, 6H), 1.01 (s, 6H); ^13C\(^{[1]H}\) NMR, 101 MHz, CDCl\(_3\), δ(ppm): 142.4, 128.3, 128.2, 125.6, 64, 55.9, 50.1, 43.8, 37.0, 34.2, 33.8, 22.1; IR (ATR)3245, 2966, 2925, 2875, 1477, 1367, 1175, 1027, 998, 955, 840, 745, 710, 571 cm\(^{-1}\); HRMS (ESI-TOF) m/z: [M+H]\(^+\) Calcd for C\(_{19}\)H\(_{29}\)NO 276.2322; Found 276.2326

**N-p-ethylbenzoate-2,2,6,6-tetramethylpiperidin-4-ol (1o, MW=319 g/mol)** was obtained from ethyl 4-(bromomethyl)benzoate bromide as a white solid in 76% yield according to the general procedure A and in 80% yield according to the general procedure B after purification by flash chromatography (PE/AcOEt70:30). ^1H NMR, 400 MHz, CDCl\(_3\), δ(ppm): 7.96 (m, 2H), 7.5 (m, 2H), 4.35 (q, J=7.1Hz, 2H), 4.05 (m, 1H), 3.85 (s, 2H), 1.90 (dd, J= 4.0, 12.2Hz, 2H), 1.75 (s, 1H), 1.5 (t, J=11.6Hz, 2H), 1.38
(t, J = 7.1 Hz, 3H), 1.18 Hz (s, 6H), 0.89 (s, 6H); \( ^{13}C\{^1H\} \) NMR, 101 MHz, CDCl\(_3\), \( \delta \) (ppm): 166.8, 151.2, 129.2, 128.1, 126.6, 63.8, 60.7, 56.3, 50.1, 47.3, 33.6, 22.5, 14.3; IR (ATR) 3217, 2965, 2929, 1721, 1707, 1609, 1459, 1431, 1381, 1365, 1304, 1289, 1228, 1215, 1184, 1163, 1091, 1036, 1017, 956, 924, 861, 780, 750, 689, 574 cm\(^{-1}\); HRMS (ESI-TOF) m/z: [M+H]\(^+\) Calcd for C\(_{19}H\(_{30}\)NO\(_3\) 320.2220; Find 320.2221

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N-\{(4'-bromomethyl)\}-\{biphenyl\}-4-yl\}-2,2,6,6-tetramethylpiperidin-4-ol (1p, MW=415 g/mol) was obtained according to the general procedure B after purification by flash chromatography (PE/ACOEt 75:25). \( ^{1}H \) NMR, 400 MHz, CDCl\(_3\), \( \delta \) (ppm): 7.58 (d, J = 8.3 Hz, 2H), 7.50 (s, 4H), 7.45 (d, J = 8.2 Hz, 2H), 4.56 (s, 2H), 4.07 (m, 1H), 3.87 (s, 2H), 1.92 (dd, J = 4.1 Hz, 12.2 Hz, 2H), 1.52 (m, 2H), 1.27 (bs, 1H), 1.16 (s, 6H), 1.03 (s, 6H); \( ^{13}C\{^1H\} \) NMR, 101 MHz, CDCl\(_3\), \( \delta \) (ppm): 145.1, 141.5, 137.8, 136, 129.4, 127.4, 127.1, 126.5, 64, 56.3, 50.2, 47, 33.9, 33.6, 22.6; IR (ATR) 3257, 2967, 2931, 2869, 1509, 1460, 1434, 1175, 1111, 1017, 859, 774, 653, 611, 583 cm\(^{-1}\); HRMS (ESI-TOF) m/z: [M+H]\(^+\) Calcd for C\(_{23}H\(_{31}\)NOBr 416.1584; Found 416.1581

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N-\{(4'-piperidin-1-yl-methyl)\}-\{biphenyl\}-4-yl\}-2,2,6,6-tetramethylpiperidin-4-ol (1p', MW=420.6 g/mol) was obtained by nucleophilic substitution of piperidine on compound 1q according to the following procedure. A two necked round bottom flask (100 mL) was charged with a solution of 300 mg (0.72 mmol) of compound 3q in 10 mL of dry toluene. 0.3 mL (2.9 mmol) of piperidine was added dropwise at 0 °C and the reaction mixture was stirred at 40 °C for six hours. The mixture was cooled down to 0 °C and hydrolyzed by 20 mL of a 1M NaOH solution. Layers were separated and the aqueous layer was extracted three times by 5 mL of Et\(_2\)O, dried over Na\(_2\)SO\(_4\) and concentrated under vacuum. The crude mixture was purified by flash chromatography on deactivated silicagel to give the expected product as a white solid in 70% isolated yield. \( ^{1}H \) NMR, 400 MHz, CDCl\(_3\), \( \delta \) (ppm): 7.52 (m, 6H), 7.37 (m, 2H), 4.07 (m, 2H), 3.87 (s, 2H), 3.52 (s, 2H), 2.44 (m, 4H), 1.91 (dd, J = 4.1, 12.2 Hz, 2H), 1.59 (m, 6H), 1.45 (m, 2H), 1.16 (s, 6H), 1.03 (s, 6H); \( ^{13}C\{^1H\} \) NMR, 101 MHz, CDCl\(_3\), \( \delta \) (ppm): 144.6, 139.9, 138.4, 137, 129.6, 127, 126.7, 125.5, 64.4, 63.5, 56.3, 54.5, 50.3, 47, 34, 26, 24.4, 22.5; IR (ATR) 3257, 2967, 2931, 2869, 1509, 1460, 1343, 1229, 1175, 1111, 1017, 859, 774, 653, 611, 583 cm\(^{-1}\); HRMS (ESI-TOF) m/z: [M+H]\(^+\) Calcd for C\(_{28}H\(_{41}\)NO\(_2\) 421.3213; Found 421.3214

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N\)-diphenylmethyl-2,2,6,6-tetramethylpiperidin-4-ol (1q, MW=323 g/mol) was obtained from diphenylbromomethane as a brown solid in 79% yield according to the general procedure A and in 10% yield according to the general procedure B after purification by flash chromatography. \( ^{1}H \) NMR, 400 MHz, CDCl\(_3\), \( \delta \) (ppm): 7.28 (m, 8H), 7.2 (m, 2H), 5.54 (s, 1H), 3.76 (s, 2H), 1.93 (dd, J = 3.9, 12.6 Hz, 2H), 1.15 (d, J = 11.8 Hz, 2H), 1.12 (s, 6H), 0.99 (s, 6H); \( ^{13}C\{^1H\} \) NMR, 101 MHz, CDCl\(_3\), \( \delta \) (ppm): 142.9, 128.4, 127.0, 80.3, 70.6, 51.4, 45.1, 34.9, 29.0; IR (ATR) 3260, 2958, 2925,
1493, 1454, 1379, 1326, 1259, 1235, 1185, 1162, 1087, 1027, 1014, 987, 831, 784, 759, 740, 697, 656, 622, 581 cm$^{-1}$; HRMS (ESI-TOF) m/z: [M+H]$^+$ Calcd for C$_{22}$H$_{30}$NO$_3$ 324.2322; Found 324.2320

**General procedure for chemioselective N-alkylation with aliphatic substrates**

A 50mL Schlenk tube was charged with (2,2,6,6)-tetramethylpiperidin-4-ol (2 equiv.) and the appropriated bromide (1 equiv.) and the dissolved in NMP (10 equiv.) in presence of KI (1.2 equiv.). The tube was sealed and the mixture was heated to 130°C. After a 16 hours stirring period, the mixture was cooled down to room temperature diluted in AcOEt and water. The aqueous layer was extracted 3 times with AcOEt (3x15 mL). The combined organic layers were washed 3 times with water (3x15 mL), NaCl sat (15 mL) and dried over Na$_2$SO$_4$. After concentration under vacuum, the residue was distillated on Kugelrohr (Glass oven B-585 BUCHI) at 10$^{-2}$mbar and 130 °C to yield the pure desired products

**N-pentyl-2,2,6,6-tetramethylpiperidin-4-ol (1m, MW=227 g/mol)** was obtained from bromopentane as a white solid in 80% yield according to the general procedure. $^1$H NMR, 400 MHz, CDCl$_3$, δ(ppm) 3.94, (tt, J = 4.1, 11.4 Hz, 1H), 2.35 (m, 2H), 1.79 (dd, J=4.1, 12.2 Hz 2H), 1.40 (m, 2H), 1.31 (m, 4H), 1.19 (m, 2H), 1.11 (s, 6H), 1.02 (s, 6H), 0.88 (t, J = 7.2 Hz, 3H); $^{13}$C ($^1$H) NMR 101 MHz, CDCl$_3$, δ(ppm): 63.7, 55.8, 50.0, 42.2, 35.4, 35.2, 29.7, 22.6, 22, 14; IR (ATR) 3261, 2927, 1465, 1376, 1255, 1175, 1111, 1046, 955, 838, 721 cm$^{-1}$; HRMS (ESI-TOF) m/z: [M+H]$^+$ Calcd for C$_{14}$H$_{30}$NO$_2$ 228.2322; Found 228.2321

**N-ethylpentanoate-2,2,6,6-tetramethylpiperidin-4-ol (1r, MW=285 g/mol)** was obtained from 1-bromo-ethylpentanoate as a partially crystalline oil in 85% yield according to the general procedure. $^1$H NMR, 400 MHz, CDCl$_3$, δ(ppm) 4.12 (q, J = 7.1 Hz, 2H), 3.94, (m, 1H), 2.38 (br dd, J = 7.8; 8.3 Hz, 2H), 2.29 (t, J = 7.35 Hz, 2H), 1.79 (dd, J=4.1, 12.6 Hz 2H), 1.60 (br s, 1H, OH), 1.54 (m, 2H), 1.43 (m, 2H), 1.30 (m, 2H), 1.25 (t, J = 7.1 Hz, 3H), 1.10 (s, 6H), 1.01 (s, 6H); $^{13}$C ($^1$H) NMR 101 MHz, CDCl$_3$, δ(ppm): δ 173.7, 64.0, 60.2, 55.9, 50.1, 43.8, 35.2, 34.3, 34.2, 22.8, 22.0, 14.2; IR (ATR) 3402, 2963, 1934 1875, 1733, 1463, 1376, 1245, 1213, 1173, 1097, 1039, 1003, 905, 860, 735, 579cm$^{-1}$; HRMS (ESI-TOF) m/z: [M+H]$^+$ Calcd for C$_{16}$H$_{32}$NO$_3$ 286.2377; Found 286.2380
**N-benzyl-2,2,6,6-tetramethylpiperidin-4-one 2b** (MW=245.4 g/mol) was obtained according to a reported procedure as a white solid (94%) after purification by flash chromatography\(^1\). \(^1\)H NMR 400 MHz CDCl\(_3\): \(\delta\) 7.5 (m, 2H), 7.30 (m, 1H), 7.20 (m, 2H), 3.93 (s, 2H), 2.48 (s, 2H), 1.14 (s, 12H); \(^{13}\)C NMR 101 MHz CDCl\(_3\): \(\delta\) 209.9, 144.6, 128.0, 126.6, 125.9, 60.1, 55.9, 47.6

### 2.4 Primary Amines synthesis

**General procedure for sequential oxidation – ring opening process**

A flame dried 50mL Schlenk tube was charged with the appropriate \(N\)-alkyl-2,2,6,6-tetramethylpiperidin-4-ol 1 (200mg, 1 equiv.), the platinum catalyst 5c (5 mol%), the trans 4-phenylbut-3-en-2-one 6b (1.2 equiv.) and dissolved in 10mL of toluene and 1 mL of distilled water. After the addition of the NaOH 0.1 M solution (0.1 equiv.), the reaction mixture was stirred at 90°C for 4 hours. Then, 1mL of glacial AcOH was added and the mixture was stirred at 90 °C for 5 hours. The solution was cooled down to room temperature and treated by 2 mL of AcOEt and 1mL of concentrated HCl (37% w/w). After a few minutes stirring period at room temperature, the layers were separated and the aqueous phase was washed three times with 5 mL of AcOEt to remove all the traces of organic byproducts. The aqueous layer was basified by a K\(_2\)CO\(_3\) solution and then by solid K\(_2\)CO\(_3\) until pH>11. The free primary amine 4 was finally extracted three times from the aqueous layer using 5 mL of AcOEt. Combined organic phases were dried over Na\(_2\)SO\(_4\) and concentrated under reduced pressure to yield the pure desired product without further purification.

**Benzylamine** (4b, MW=107g/mol) was obtained from compound 1b according to the general procedure as a colorless oil without further purification in 88% isolated yield. \(^1\)H NMR, 400 MHz CDCl\(_3\), \(\delta\) (ppm): 7.29 (m, 4H), 7.21 (m, 1H), 3.84 (s, 2H), 1.43 (bs, 2H) NH\(_2\); \(^{13}\)C\{\(^1\)H\} NMR, 101 MHz CDCl\(_3\), \(\delta\) (ppm): 143.4, 128.5, 127.1, 126.8, 46.6; IR (ATR) 3365, 3061, 3026, 2919, 1859, 1603, 1452, 1384, 759 cm\(^{-1}\); HRMS (ESI-TOF) m/z: [M+H]\(^+\) Calcd for C\(_7\)H\(_{10}\)N 108.0808; Found 108.0909

**2-Naphthalenemethanamine** (4c, MW=157 g/mol) was obtained from compound 1c according to the general procedure as a white solid without further purification in 94% isolated yield. \(^1\)H NMR, 400 MHz CDCl\(_3\), \(\delta\) (ppm): 7.83 (m, 2H), 7.76 (s, 1H), 7.44-7.51 (m, 3H), 4.05 (s, 2H), 1.67 (bs, 2H) NH\(_2\); \(^{13}\)C\{\(^1\)H\} NMR, 101 MHz CDCl\(_3\), \(\delta\) (ppm): 140.8, 133.6, 132.6, 128.2, 127.7, 127.6,126.1, 125.8, 125.5, 125.1, 46.6; IR (ATR) 3351, 3265, 3051, 2919, 1859, 1603, 1452, 1384, 732, 695, 759 cm\(^{-1}\); HRMS (ESI-TOF) m/z: [M+H]\(^+\) Calcd for C\(_{11}\)H\(_{12}\)N 158.0964; Found 159.0960
**p-methylbenzylamine (4d, MW= 121.18 g/mol)** was obtained from compound 1d according to the general procedure as a colorless oil without further purification in 96% isolated yield. \(^1^H\) NMR, 400 MHz, CDCl\(_3\), \(\delta\)(ppm): 7.21 (d, \(J=8.0\) Hz, 2H), 7.16 (d, \(J=7.9\) Hz, 2H), 3.83 (s, 2H), 2.35 (s, 3H), 1.57 (bs, 2H) NH\(_2\); \(^{13}\)C\(^{\text{1}}\)H\) NMR, 101 MHz, CDCl\(_3\), \(\delta\)(ppm): 139.3, 135.4, 128.2, 126, 45.2; IR (ATR) 3367, 3288, 3042, 2918, 2857, 1660, 846, 551, 498 cm\(^{-1}\); HRMS (ESI-TOF) m/z: [M+H]\(^+\) Calcd for C\(_8\)H\(_{12}\)N 122.0964; Found 122.0961

**o-Bromobenzylamine (4e, MW= 184 g/mol)** was obtained from compound 1e according to the general procedure as a light brown oil without further purification in 96% isolated yield. \(^1\)H NMR, 400 MHz, CDCl\(_3\), \(\delta\)(ppm): 7.54 (dd, \(J=1.0, 7.9\) Hz, 1H), 7.35 (dd, \(J=1.6, 7.6\) Hz, 1H), 7.29 (td, \(J=1.0, 7.5\) Hz, 1H), 7.11 (td, \(J=1.7, 7.7\) Hz, 1H), 3.91 (s, 2H), 1.67 (bs, 2H) NH\(_2\); \(^{13}\)C\(^{\text{1}}\)H\) NMR, 101 MHz, CDCl\(_3\), \(\delta\)(ppm): 142.2, 132.8, 123.53, 47.0; IR (ATR) 3370, 3058, 2924, 1589, 1467, 1438, 1041, 1022, 941, 852, 745, 656, 589 cm\(^{-1}\); HRMS (ESI-TOF) m/z: [M+H]\(^+\) Calcd for C\(_9\)H\(_{13}\)NBr 185.9913; Found 185.9912

**m-Bromobenzylamine (4f, MW= 184 g/mol)** was obtained from compound 1f according to the general procedure as a light brown oil without further purification in 95% isolated yield. \(^1\)H NMR, 400 MHz, CDCl\(_3\), \(\delta\)(ppm): 7.49 (s, 1H), 7.38 (dt, \(J=1.6, 7.6\) Hz, 2H), 7.22 (m, 2H), 3.85 (s, 2H), 1.45 (bs, 2H) NH\(_2\); \(^{13}\)C\(^{\text{1}}\)H\) NMR, 101 MHz, CDCl\(_3\), \(\delta\)(ppm): 145.6, 130.2, 130.1, 125.7, 122.6, 45.9; IR (ATR) 3360, 3287, 3068, 2916, 2841, 1666, 1597, 1485, 1400, 1371, 1362 1060, 1008, 797; HRMS (ESI-TOF) m/z: [M+H]\(^+\) Calcd for C\(_9\)H\(_{13}\)NBr 185.9913; Found 185.9911

**p-Bromobenzylamine (4g, MW=184 g/mol)** was obtained from compound 1g according to the general procedure as a colorless oil without further purification in 90% isolated yield (with less than 1.5% of noconverted starting material). \(^1\)H NMR, 400 MHz, CDCl\(_3\), \(\delta\)(ppm): 7.44 (d, \(J=8.4\) Hz, 2H), 7.19 (d, \(J=8.4\) Hz, 2H), 3.82 (s, 2H), 1.43 (bs, 2H) NH\(_2\); \(^{13}\)C\(^{\text{1}}\)H\) NMR, 101 MHz, CDCl\(_3\), \(\delta\)(ppm): 142.2, 131.5, 128.8, 120.5, 45.83; IR (ATR) 3367, 3288, 3042, 2918, 2857, 1660, 1588, 1485, 1404, 1374, 1069, 1009, 797, 613 cm\(^{-1}\); HRMS (ESI-TOF) m/z: [M+H]\(^+\) Calcd for C\(_9\)H\(_{13}\)NBr 185.9913; Found 185.9912

**p-nitrobenzylamine (4h, MW= 152.15 g/mol)** was obtained from compound 1h according to the general procedure as a light brown oil without further purification in 78% isolated yield. \(^1\)H NMR, 400 MHz, CDCl\(_3\), \(\delta\)(ppm): 8.18 (d, \(J=8.1\) Hz, 2H), 7.50 (d, \(J=8.1\) Hz, 2H), 4.0 (s, 2H), 1.68 (bs, 2H) NH\(_2\); \(^{13}\)C\(^{\text{1}}\)H\) NMR, 101 MHz, CDCl\(_3\), \(\delta\)(ppm): 150.5, 127.7, 123.7, 45.7; IR (ATR) 2928, 2852, 2644, 1649, 1909, 1507, 1418, 1370, 1250, 1212, 1151, 1045, 921, 846, 813, 701, 672, 613 cm\(^{-1}\); HRMS (ESI-TOF) m/z: [M+H]\(^+\) Calcd for C\(_{10}\)H\(_{15}\)NO\(_2\) 153.0659; Found 153.0661

**p-trifluoromethanebenzylamine (4i, MW=175 g/mol)** was obtained from compound 1i according to the general procedure as a colorless oil without further purification in 93% isolated yield (with less than 1% of no converted
starting material). $^1$H NMR, 400 MHz, CDCl$_3$, $\delta$(ppm): 7.59 (d, $J$=8.1 Hz, 2H), 7.44 (d, $J$=8.1 Hz, 2H), 3.95 (s, 2H), 1.45 (bs, 2H) NH$_2$; $^{13}$C($^1$H) NMR, 101 MHz, CDCl$_3$, $\delta$(ppm): 147.1, 127.3, 125.4, 46.0; IR (ATR) 3298, 2928, 2921, 1650, 1619, 1581, 1320, 1160, 1017, 818, 622, 593 cm$^{-1}$; HRMS (ESI-TOF) m/z: [M+H]$^+$ Calcd for C$_8$H$_{17}$F$_3$N 176.0682; Found 176.0685

$p$-trifluoromethoxybenzylamine (4j, MW= 191 g/mol) was obtained from compound 1j according to the general procedure as a white solid without further purification in 97% isolated yield. $^1$H NMR, 400 MHz, CDCl$_3$, $\delta$(ppm): 7.34 (d, $J$= 8.6 Hz, 2H), 7.18 (d, $J$=8.6 Hz, 2H), 3.88 (s, 2H), 1.45 (bs, 2H) NH$_2$; $^{13}$C($^1$H) NMR, 101 MHz, CDCl$_3$, $\delta$(ppm): 160.6, 129.8, 129.2, 128.4, 121, 64.1; IR (ATR) 3308, 2967, 2926, 1735, 1659, 1442, 1376, 1260, 1149, 1089, 1026, 802 cm$^{-1}$; HRMS (ESI-TOF) m/z: [M+H]$^+$ Calcd for C$_9$H$_{19}$F$_3$N 192.0631; Found 192.0633

trans-Cinnamylamine (4k, MW=133 g/mol) was obtained from compound 1k according to the general procedure as a light brown oil without further purification in 81% isolated yield. $^1$H NMR, 400 MHz, CDCl$_3$, $\delta$(ppm): 7.32 (t, $J$=10.3 Hz, 2H), 7.24 (t, $J$=7.3 Hz, 2H), 6.51 (d, $J$=15.9 Hz, 1H), 6.33 (dt, $J$= 5.8, 15.9 Hz, 1H), 3.49 (dd, $J$= 1.4, 5.8 Hz, 2H), 1.34 (bs, 2H) NH$_2$; $^{13}$C($^1$H) NMR, 101 MHz, CDCl$_3$, $\delta$(ppm): 137.2, 131.3, 129.5, 128.6, 127.3, 126.2, 44.3; IR (ATR) 3290, 3080, 3057, 2923, 2849, 1656, 1598, 1493, 1477, 1352, 1306, 1112, 1070, 1027, 963, 737, 690 cm$^{-1}$; HRMS (ESI-TOF) m/z: [M+H]$^+$ Calcd for C$_{10}$H$_{12}$N 134.0964; Found 134.0959

geranylamine (4l, MW= 153.26 g/mol) was obtained from compound 1l according to a slightly modified procedure as a brown oil in 84% isolated yield. $^1$H NMR, 400 MHz, CDCl$_3$, $\delta$(ppm): 1.19 (bm, 2H) NH$_2$; $^{13}$C($^1$H) NMR, 101 MHz, CDCl$_3$, $\delta$(ppm): 135.4, 130.5, 124.9, 123.1, 38.6, 28.3, 25.5, 24.7, 16.7, 15; IR (ATR) 3293, 2976, 2933, 2640, 1713, 1611, 1562, 1451, 1424, 1366, 1268, 1190, 1171, 1098, 1018, 813, 750, 694, 623, 590 cm$^{-1}$; HRMS (ESI-TOF) m/z: [M+H]$^+$ Calcd for C$_{16}$H$_{18}$N 154.1590; Found 154.1593

3-phenylpropan-1-amine (4m, MW=135 g/mol) was obtained from compound 4k according to the general procedure as a white solid without further purification in 98% isolated yield. $^1$H NMR, 400 MHz, CDCl$_3$, $\delta$(ppm): 7.39 (m, 2H), 7.29 (m, 2H), 2.84 (t, $J$=7.0 Hz, 2H), 2.77 (t, $J$=7.0 Hz, 2H), 1.88 (quint, $J$=7.3 Hz, 2H), 1.34 (bs, 2H) NH$_2$; $^{13}$C($^1$H) NMR, 101 MHz, CDCl$_3$, $\delta$(ppm): 142.2, 128.4, 128.3, 41.8, 35.4, 33.3; IR (ATR) 3060, 3025, 2926, 2854, 1601, 1581, 1494, 1453, 1310, 1029, 908, 742, 697, 572 cm$^{-1}$; HRMS (ESI-TOF) m/z: [M+H]$^+$ Calcd for C$_{16}$H$_{19}$N 136.1121; Found 136.1123
pentylamine (4n, MW= 87 g/mol) was obtained from compound 1n according to the general procedure as a colorless oil without further purification in 56% isolated yield. \(^1\)H NMR, 400 MHz, CDCl\(_3\), \(\delta\)(ppm): 2.63 (t, \(J=6.9\) Hz, 2H), 1.67 (bs, 2H) NH\(_2\), 1.41 (m, 2H), 1.27 (m, 4H), 0.85 (t, \(J=6.9\) Hz, 3H); \(^13\)C\({^1}\)H NMR, 101 MHz, CDCl\(_3\), \(\delta\)(ppm): 42.1, 33.4, 29.0, 22.5, 14; IR (ATR) 3364, 2956, 2924, 2855, 1599, 1465, 1378, 1069, 983, 867, 728 

HRMS (ESI-TOF) m/z: [M+H]\(^+\) Calcd for \(\text{C}_9\text{H}_{12}\text{N}_2\) 180.1019; Found 180.1016

4-aminomethyl-benzoic acid ethyl ester (4o, MW=179 g/mol) was obtained from compound 1o according to a slightly modified procedure as a yellow oil without further purification in 71% yield. All the extractions were conducted with Et\(_2\)O instead of AcOEt and the basification of the reaction media by K\(_2\)CO\(_3\) at 0 °C instead of room temperature. \(^1\)H NMR, 400 MHz, CDCl\(_3\), \(\delta\)(ppm): 7.99 (d, \(J=8.4\) Hz, 2H), 7.36 (d, \(J=8.4\) Hz, 2H), 4.35 (q, \(J=7.1\) Hz, 2H), 3.91 (s, 2H), 1.57 (bs, 2H) NH\(_2\), 1.38 (t, \(J=7.1\) Hz, 3H); \(^13\)C\({^1}\)H NMR, 101 MHz, CDCl\(_3\), \(\delta\)(ppm): 168.5, 148.3, 129.8, 129, 60.8, 46.2, 14.3; IR (ATR) 3290, 3080, 3057, 3024, 2923, 2849, 1656, 1598, 1493, 1447, 1352, 1306, 1112, 1070, 963, 737, 690 cm\(^{-1}\); HRMS (ESI-TOF) m/z: [M+H]\(^+\) Calcd for \(\text{C}_{10}\text{H}_{16}\text{O}_2\) 281.2012; Found 281.2001

\(4'(\text{piperidin-1-yl})-[1,1'-\text{biphenyl}]-4\)-yl)methanamide (4p, MW= 280 g/mol) was obtained from 1p according to the general procedure as a white solid without further purification in 90% isolated. \(^1\)H NMR, 400 MHz, CDCl\(_3\), \(\delta\)(ppm): 7.56 (dd, \(J=8.2, 13.9\) Hz, 4H), 7.39 (dd, \(J=1.4, 8.0\) Hz, 4H), 3.92 (s, 2H), 3.52 (s, 2H), 2.54 (bs, 4H), 1.60 (bm, 6H) [NH\(_2\) and CH\(_2\)CH\(_2\)CH\(_2\)are overlapped], 1.45 (m, 2H); \(^13\)C\({^1}\)H NMR, 101 MHz, CDCl\(_3\), \(\delta\)(ppm): 142.2, 139.6, 139.5, 137.7, 129.6, 127.5, 127.2, 126.7, 63.6, 54.6, 46.2, 26.0, 24.4; IR (ATR) 3365, 3030, 2932, 2851, 2800, 1496, 1453, 1369, 1153, 992, 941, 865, 791, 781, 596 cm\(^{-1}\); HRMS (ESI-TOF) m/z: [M+H]\(^+\) Calcd for \(\text{C}_{19}\text{H}_{23}\text{N}_2\) 281.2012; Found 281.2001

benzyldiamine (4q, MW= 183.25 g/mol) was obtained from compound 1q according to the general procedure as a light yellow oil without further purification in 38% isolated yield. \(^1\)H NMR, 400 MHz, CDCl\(_3\), \(\delta\)(ppm): 7.35 (d, \(J=7.4\) Hz, 4H), 7.20 (d, \(J=7.2\) Hz, 4H), 7.21 (m, 2H), 5.19 (s, 1H), 2.25 (bs, 2H) NH\(_2\); \(^13\)C\({^1}\)H NMR, 101 MHz, CDCl\(_3\), \(\delta\)(ppm): 145.7, 128.5, 126.9, 59.8; IR (ATR) 3059, 3024, 1598, 1491, 1450, 1313, 1189, 1048, 1026, 1000, 893, 740, 695, 640, 618, 589, 550; HRMS (ESI-TOF) m/z: [M+Na]\(^+\) Calcd for \(\text{C}_{19}\text{H}_{23}\text{N}_2\) 206.0940; Found 206.0940

\(\delta\)-valerolactame (7, MW= 99 g/mol) was obtained from compound 1r according to the general procedure as a white solid after a slightly longer basification (20 min) by K\(_2\)CO\(_3\) without further purification in 98% isolated yield. \(^1\)H NMR, 400 MHz, CDCl\(_3\), \(\delta\)(ppm): 6.25 (bs, 1H) NH, 3.3 (m, 2H), 2.38 (t, \(J=10\) Hz, 2H), 1.79 (m, 4H); \(^13\)C\({^1}\)H NMR, 101 MHz, CDCl\(_3\), \(\delta\)(ppm): 178, 42.4, 31.5, 22.3, 20.9; IR (ATR) 3234, 2924, 2868, 1657, 1494, 1470, 1448,
1352, 1327, 1270, 1160, 989, 830, 659 HRMS (ESI-TOF) m/z: [M+H]⁺ Calcd for C₅H₁₀NO
100.0757; Found 100.0750
2.5 Complementary experiments

Procedure for the synthesis of compound 1q and 1r for control experiments

2,6-diphenylpiperidin-4-one and 3,5-dimethyl-2,6-diphenylpiperidin-4-one were prepared following literature method[5].

2,6-diphenylpiperidin-4-one (MW= 251.32 g/mol) was obtained as a white solid (6.2 g, 25% yield).

3,5-dimethyl-2,6-diphenylpiperidin-4-one (MW= 279.38 g/mol) was obtained as a white solid (17.2 g, 62% yield).

General procedure of reduction of 2,6-diphenylpiperidin-4-one and 3,5-dimethyl-2,6-diphenylpiperidin-4-one and benzylation of corresponding piperidinols for the synthesis of 1s and 1t.

In 50mL flask 2,6-diphenylpiperidin-4-one or 3,5-dimethyl-2,6-diphenylpiperidin-4-one (200mg, 1 equiv.) was dissolved in ethanol (8mL/mmol). The mixture was cooled to 0°C. NaBH₄ (2.4 equiv.) was carefully added portion wise and the mixture was stirred at room temperature for 2h. Mixture was cooled again to 0°C and distilled water (2mL/mmol) was slowly added. The mixture was stirred at room temperature for overnight. Ethanol was evaporated under vacuum. The reaction mixture was diluted with AcOEt (4mL/mmol) and was filtered through celite®. Water (2mL/mmol) was added and after extraction, the organic phase was separated off, and the aqueous phase was extracted with AcOEt (4mL/mmol). The combined organic layers were dried on Na₂SO₄, filtered, and concentrated under vacuum. In a 50 mL flask, the crude and K₂CO₃ (2 equiv.) were introduced. Acetone (5mL/mmol) was added and the mixture was shaken for 5 min. Benzyl bromide (3 equiv.) was added and the mixture was heating to 40 °C and was stirred for overnight. The reaction mixture was diluted with AcOEt (10mL/mmol) and distilled water (5 mL/mmol). The organic phase was separated off, and the aqueous phase was extracted with AcOEt (10mL/mmol). The combined organic layers were dried on Na₂SO₄, filtered, and concentrated under vacuum. The desired compound was obtained after purification by flash chromatography (PE/AcOEt 70:30).

1-benzyl-2,6-diphenylpiperidin-4-ol (1s, MW= 343.5 g/mol) was obtained as a white solid (183 mg, 74% yield); MP 53-57 °C; ¹H NMR, 400 MHz, CDCl₃, δ(ppm): 7.17 (m, 15H), 3.64 (m, 3H),3.56 (s, 2H), 2.08 (dd, J = 6.5, 9.8 Hz, 2H),1.63 (q, J = 11.7 Hz, 2H), 1.33 (bs, 1H);¹³C(¹H) NMR, 101 MHz, CDCl₃, δ(ppm): 144.5 (2C), 136.1 (1C), 130.2 (2C), 128.6 (4C), 127.8 (4C), 127.4 (2C), 127.0 (2C), 126.5 (1C), 68.3 (1C), 62.8 (2C), 52.4 (1C), 46.4 (2C); IR (ATR) 3319, 3059, 3026, 2937, 2811, 1600, 1491, 1453, 1094, 1064, 1010, 757, 697, 578, 525 cm⁻¹; HRMS (ESI-TOF) m/z: [M+H]⁺ Calcd for C₂₆H₂₆NO 344.2009; Found 344.2009

1-benzyl-3,5-dimethyl-2,6-diphenylpiperidin-4-ol (1t, MW= 371.5 g/mol) was obtained as a light yellow solid and a mixture of 2
diastereoisomers with a ratio 39:61 (200mg, 75% yield); MP 105°C; Major isomer (hydroxyl group on axial position)\[^1\]H NMR, 300MHz, CDCl\(_3\), δ(ppm): 7.11 (m, 15H), 3.65 (d, J = 10.7 Hz, 2H), 3.65 (bs, 1H), 3.63 (bs, 1H), 3.38 (s, 2H), 1.93 (m, 2H), 1.45 (bs, 1H).0.71 (d, J = 6.5 Hz, 6H); \[^13\]C NMR 75.5MHz CDCl\(_3\), δ143.6 (2C), 138.1(1C), 127.7 (m, 13C), 74.3 (2C), 65.1 (2C), 54.3 (2C), 43.5 (2C), 16.1 (2C); Minor isomer (hydroxyl group on equatorial position)\[^1\]H NMR 300MHz CDCl\(_3\), δ(ppm): 7.11 (m, 15H), 3.35 (s, 2H), 3.24 (d, J = 10.0 Hz, 2H), 2.89 (t, J = 10.0 Hz, 1H), 1.46 (m, 2H), 1.34 (bs, 1H), 0.69 (d, J = 6.9 Hz, 6H);

\[^13\]C\[^1\]H NMR, 75.5MHz, CDCl\(_3\), δ(ppm): 142.8 (2C), 137.9 (1C), 127.7 (m, 13C), 78.4 (1C), 71.0 (2C), 54.4 (2C), 45.9 (2C), 15.1 (2C); IR (ATR) 3357, 3061, 3028, 2963, 2928, 2890, 2814, 1600, 1493, 1452, 1441, 1377, 1090, 754, 691, 528 cm\(^{-1}\); HRMS (ESI-TOF) m/z: [M+H]\(^+\) Calcd for C\(_{26}\)H\(_{30}\)NO \(372.2322\); Found 372.2318

1-benzyl-3,5-dimethyl-2,6-diphenylpiperidin-4-one (2t, MW= 369.5g/mol) was obtained as a white solid in 89% isolated yield. MP 124°C; \[^1\]H NMR, 400MHz, CDCl\(_3\), δ(ppm): 7.21 (m, 15H), 3.43 (d, J = 11.8 Hz, 2H), 3.42 (bs, 2H), 2.81 (dq, J = 6.5,9.8 Hz, 2H), 0.66 (d, J = 6.5 Hz, 6H); \[^13\]C\[^1\]H NMR, 101 MHz, CDCl\(_3\), δ(ppm): 210.4 (1C), 142.0 (2C), 137.9 (1C), 129.6 (2C), 128.8 (4C), 128.4 (4C), 127.6 (2C), 127.5 (2C), 126.4 (1C), 73.5 (2C), 53.6 (1C), 51.5 (2C), 11.3 (2C); IR (ATR) 3061, 3028, 2970, 2930, 2894, 2823, 1716, 1599, 1491, 1451, 1440, 1377, 748, 696, 603, 532 cm\(^{-1}\); HRMS (ESI-TOF) m/z: [M+H]\(^+\) Calcd for C\(_{26}\)H\(_{28}\)N \(370.2165\); Found 370.2164

**Procedure for (2,2,6,6)-tetramethylpiperidin-4-one recycling**

At the end of the ring opening procedure, the first organic layers was dried over Na\(_2\)SO\(_4\), filtered and concentrated under vacuum. The residue was diluted into a solution of ammonia in MeOH (14.0 M) and stirred overnight at 50 °C. After complete disappearance of the phorone3 (monitoring by TLC) the reaction mixture was quenched by distilled water and diluted in DCM. The aqueous layer was removed, the organic layer was dried over Na\(_2\)SO\(_4\), filtered and concentrated under vacuum to give pure (2,2,6,6)-teramethylpiperidin-4-one in 95% isolated yield.

**Procedure for the cleavage of 2b in acidic medium (Table 3 in the text)**

A flame dried 50 mL Schlenk tube was charged with compound 2b (1 mmol) and the appropriated acid (1 mmol or 0.05 mmol). The mixture was dissolved in dry toluene (12 mL), treated with distilled water (1 mL) and glacial AcOH (5 mmol) and stirred at 105 °C for 5 h. The solution was cooled down to room temperature and treated by 5 mL of AcOEt. The layers were separated and the aqueous phase was washed three times with 7 mL of AcOEt to remove all the traces of organic byproducts. The aqueous layer was basified using a K\(_2\)CO\(_3\) solution and then by solid K\(_2\)CO\(_3\) until pH>11 and extracted three times with 7 mL of AcOEt. The combined organic phases were dried over Na\(_2\)SO\(_4\) and concentrated under vacuum. Both phases were analyzed by \[^1\]H NMR.

**Particular procedure for cationic [PtCl(dppp)]\(^+\) synthesis**

A 25 mL flame dried Schlenk tube was charged with PtCl\(_2\)(CH\(_3\)CN)\(_2\) (0.05 mmol) and dppp (0.11 mmol) and stirred for 2 h in dry toluene (2 mL). The reactor was protected from visible light and AgPF\(_6\) (exactly 0.05 mmol) was added to the mixture. After a 30 min stirring period, the white precipitate
was filtered on a short pad of Celite© and the filtrate was directly introduced in another Schlenktube to run the 2b cleavage experiment as described above.
3. NMR spectra
PE residue
4. Bibliography

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