Supporting Information

Pd/C-Catalyzed Chemoselective Hydrogenation in the Presence of Diphenylsulfide

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General experimental. 10% Pd/C was purchased from Aldrich (catalog No. 205699). MeOH, and AcOEt for HPLC, dehydrated THF and dehydrated DMF were purchased from Wako Pure Chemical Industries, Ltd. and used without purification. CH₂Cl₂ were distilled from calcium hydride. All other reagents were purchased from commercial sources and used without further purification. Flash column chromatography was performed with silica gel Merck 60 (230–400 mesh ASTM), or Kanto Chemical Co., Inc. 60N (63–210 μ m spherical, neutral). ¹H NMR and ¹³C NMR spectra were recorded on a JEOL AL 400 spectrometer or JEOL EX 400 spectrometer (400 MHz for ¹H NMR and 100 MHz for ¹³C NMR). Chemical shifts (δ) are expressed in ppm and are internally referenced (0.00 ppm for TMS for CDCl₃ for ¹H NMR and 77.0 ppm for CDCl₃ for ¹³C NMR). EI and FAB mass spectra were taken on a JEOL JMS-SX102A instrument.

Optimization of the reaction conditions (Table 1). After two vacuum/H₂ cycles to replace air inside the reaction tube with hydrogen, the mixture of **1a** (208 mg, 1.00 mmol), 10% Pd/C (20.9 mg, 10 wt % of **1a**), and an additive (10.0 μ mol) in MeOH (2.0 mL) was vigorously stirred at room temperature (*ca.* 20°C) under ordinary hydrogen pressure (balloon) for 24 h. The reaction mixture was filtered using a membrane filter (Millipore, Millex®-LH, 0.45 μ m) to afford the mixture of **1a-4a**. The ratio of the mixture was determined by ¹H NMR analysis.

Synthesis of the substrate (8c and 8d)

To a solution of the carboxylic acid (10.0 mmol), EDC·HCl (2.30 g, 12.0 mmol), and DMAP (122 mg, 1.00 mmol) in CH₂Cl₂ (15 mL) was added benzyl alcohol (1.04 g, 10.0 mmol). After a certain reaction time, the mixture was extracted with chloroform (50 mL x 2) and water (50 mL). The organic layer was washed with brine (100 mL), dried over MgSO₄ and concentrated under reduced pressure. The residue was applied to flash column chromatography on silica gel to afford **8c** or **8d**.

(2E,4E)-Benzyl hexa-2,4-dienoate (8c)

Obtained from sorbic acid (1.12 g, 10.0 mmol), EDC·HCl (1.92 g, 10.0 mmol), DMAP (122 mg, 1.00 mmol), and benzyl alcohol (1.04 mL, 10.0 mmol) according to the general procedure for the synthesis of the substrate after 48 h of the reaction followed by flash column chromatography on silica gel (*n*-hexane) in 90% yield (1.82 g) as a colorless oil. ¹H NMR (CDCl₃) δ 7.38–7.26 (m, 6H), 6.20–6.15 (m, 2H), 5.82 (d, 1H, *J* = 15.9 Hz), 5.19 (s, 2H), 1.85 (d, 3H, *J* = 5.6 Hz); MS (EI) *m/z* 202 (M⁺, 15), 157 (25), 91

(100); HRMS (EI) Calcd for C₁₃H₁₄O₂ (M⁺): 202.0994. Found: 202.0985.

Benzyl vinylbenzoate (8d)¹

Obtained from 4-vinylbenzoic acid (500 mg, 3.37 mmol), EDC·HCl (959 mg, 5.00 mmol), DMAP (61.1 mg, 0.500 mmol), and benzyl alcohol (0.350 mL, 3.38 mmol) according to the general procedure for the synthesis of the substrate after 43 h of the reaction followed by flash column chromatography on silica gel (*n*-hexane → *n*-hexane/Et₂O = 4/1) in 92% yield (737 mg) as a colorless oil. ¹H NMR spectrum of **8d** was identical with that in the literature.¹

Synthesis of the substrate (10a-10c)

To a solution of the amine (5.00 mmol) in THF was added *N*-(benzyloxycarbonyloxy)-succinimide (1.45 g, 6.00 mmol). After a certain reaction time, the mixture was extracted with AcOEt (150 mL) and water (100 mL x 2). The organic layer was washed with brine (100 mL), dried over MgSO₄ and concentrated under reduced pressure. If necessary, the residue was applied to flash column chromatography on silica gel to afford **10a-10c**

Benzyl diallylcarbamate (10a)¹

Obtained from diallylamine (1.23 mL, 10.0 mmol), and *N*-(benzyloxycarbonyloxy)-succinimide (2.91 g, 12.0 mmol) according to the general procedure for the synthesis of the substrate after 67 h of the reaction followed by flash column chromatography on silica gel (*n*-hexane) in 97% yield (2.24 g) as a colorless oil. ¹H NMR spectrum of **10a** was identical with that in the literature.¹

Benzyl 4-vinylphenylcarbamate (10b)¹

Obtained from 4-vinylaniline (1.00 g, 8.39 mmol), and *N*-(benzyloxycarbonyloxy)-succinimide (2.45 g, 10.1 mmol) according to the general procedure for the synthesis of the substrate after 7 h of the reaction without any purification in 92% yield (1.99 g) as a pale yellow solid. ¹H NMR spectrum of **10b** was identical with that in the literature.¹

Benzyl allylphenylcarbamate (10c)¹

Obtained from *N*-allylaniline (1.33 g, 10.0 mmol), and *N*-(benzyloxycarbonyloxy)-succinimide (2.91 g, 12.0 mmol) according to the general procedure for the synthesis of the substrate after 7 h of the reaction followed by flash column chromatography on

silica gel (*n*-hexane) in 81% yield (2.18 g) as a colorless oil. ¹H NMR spectrum of **10c** was identical with that in the literature.¹

Typical Procedure for the Chemoselective Hydrogenation of Olefins in the Presence of Ph₂S as a Catalyst Poison (Table 2-4). After two vacuum/H₂ cycles to replace air inside reaction tube with hydrogen, the mixture of the substrate (0.500 mmol), 10% Pd/C (10 wt % of the substrate), and diphenylsulfide (0.84 μL, 5.00 μmol) in MeOH (2 mL) was vigorously stirred at room temperature (*ca.* 20 °C) under ordinary hydrogen pressure (balloon) for 24 h. The reaction mixture was filtered using a membrane filter (Millipore, Millex®-LH, 0.45 μm), the filtrate was concentrated to provide the product.

3-Phenylpropiophenone (2a)¹

Obtained from **1a** (104 mg, 0.500 mmol), 10% Pd/C (10.5 mg, 10 wt % of **1a**), and diphenylsulfide (0.84 μL, 5.00 μmol) according to the typical procedure in quantitative yield (105 mg) as a colorless solid. ¹H NMR spectrum of **2a** was identical with that in the literature.¹

1,5-Diphenylpentane-1-one (2b)¹

Obtained from **1b** (117 mg, 0.500 mmol), 10% Pd/C (11.8 mg, 10 wt % of **1b**), and diphenylsulfide (0.84 μL, 5.00 μmol) according to the typical procedure in 99% yield (118 mg) as a yellow oil. ¹H NMR spectrum of **2b** was identical with that in the literature.¹

2-Propyloxybenzaldehyde (2d)¹

Obtained from **1d** (81.1 mg, 0.500 mmol), 10% Pd/C (8.2 mg, 10 wt % of **1d**), and diphenylsulfide (0.84 μL, 5.00 μmol) in AcOEt (2 mL) according to the typical procedure in 91% yield (74.7 mg) as a yellow oil. ¹H NMR spectrum of **2d** was identical with that in the literature.¹

4-(4-Chlorophenyl)-butan-2-one (6b)²

Obtained from **5b** (181 mg, 1.00 mmol), 10% Pd/C (18.1 mg, 10 wt % of **5b**), and diphenylsulfide (1.68 μL, 10.0 μmol) according to the typical procedure in 98% yield (178 mg) as a colorless oil. ¹H NMR spectrum of **6b** was identical with that in the literature.²

4'-Chloro-3-phenylpropiophenone (6c)¹

Obtained from **5c** (243 mg, 1.00 mmol), 10% Pd/C (24.3 mg, 10 wt % of **5c**), and diphenylsulfide (1.68 μ L, 10.0 μ mol) according to the typical procedure in 97% yield (236 mg) as a colorless oil. ¹H NMR spectrum of **6c** was identical with that in the literature.¹

3-(4-Chlorophenyl)propanamide (6d)

Obtained from **5d** (90.8 mg, 0.500 mmol), 10% Pd/C (9.1 mg, 10 wt % of **5d**), and diphenylsulfide (0.84 μ L, 5.00 μ mol) according to the typical procedure in 90% conversion yield. ¹H NMR (CDCl₃) δ 7.26 (d, 2H, J = 8.2 Hz), 7.15 (d, 2H, J = 8.2 Hz), 5.31 (br s, 2H), 2.95 (t, 2H, J = 7.5 Hz), 2.51 (t, 2H, J = 7.5 Hz).

4-(4-Chlorophenyl)-4-oxobutanoic acid (6e)

Obtained from **5e** (211 mg, 1.00 mmol), 10% Pd/C (21.1 mg, 10 wt % of **5e**), and diphenylsulfide (1.68 μ L, 10.0 μ mol) according to the typical procedure in 99% yield (211 mg) as a colorless oil. ¹H NMR (CDCl₃) δ 7.92 (d, 2H, J = 8.3 Hz), 7.45 (d, 2H, J = 8.3 Hz), 3.29 (t, 2H, J = 6.5 Hz), 2.82 (t, 2H, J = 6.5 Hz).

Benzyl propionate (9a)¹

Obtained from **8a** (81.1 mg, 0.500 mmol), 10% Pd/C (8.2 mg, 10 wt % of **8a**), and diphenylsulfide (0.84 μ L, 5.00 μ mol) in CD₃OD (1 mL) according to the typical procedure in 100% conversion yield. ¹H NMR spectrum of **9a** was identical with that in the literature.¹

Benzyl isobutylate (9b)¹

Obtained from **8b** (88.1 mg, 0.500 mmol), 10% Pd/C (8.9 mg, 10 wt % of **8b**), and diphenylsulfide (0.84 μ L, 5.00 μ mol) in CD₃OD (1 mL) according to the typical procedure in 100% conversion yield. ¹H NMR spectrum of **9b** was identical with that in the literature.¹

Benzyl hexanoate (9c)³

Obtained from **8c** (101 mg, 0.500 mmol), 10% Pd/C (10.2 mg, 10 wt % of **8c**), and diphenylsulfide (0.84 μ L, 5.00 μ mol) according to the typical procedure in quantitative yield (104 mg) as a colorless oil. ¹H NMR spectrum of **9c** was identical with that in the literature.³

Benzyl 3-phenylpropanoate (9d)¹

Obtained from **8d** (238 mg, 1.00 mmol), 10% Pd/C (23.8 mg, 10 wt % of **8d**), and diphenylsulfide (1.68 μ L, 10.0 μ mol) according to the typical procedure in 94% yield (225 mg) as a colorless oil. ¹H NMR spectrum of **9d** was identical with that in the literature.¹

Benzyl dipropylcarbamate (11a)⁴

Obtained from **10a** (116 mg, 0.500 mmol), 10% Pd/C (11.6 mg, 10 wt % of **10a**), and diphenylsulfide (0.84 μ L, 5.00 μ mol) according to the typical procedure in quantitative yield (117 mg) as a colorless oil. ¹H NMR spectrum of **11a** was identical with that in the literature.⁴

Benzyl 4-ethylphenylcarbamate (11b)¹

Obtained from **10b** (253 mg, 1.00 mmol), 10% Pd/C (25.3 mg, 10 wt % of **10b**), and diphenylsulfide (1.68 μ L, 10.0 μ mol) according to the typical procedure in 98% yield (251 mg) as a colorless oil. ¹H NMR spectrum of **11b** was identical with that in the literature.¹

Benzyl phenylpropylcarbamate (11c)¹

Obtained from **10c** (134 mg, 0.500 mmol), 10% Pd/C (13.5 mg, 10 wt % of **10c**), and diphenylsulfide (0.84 μ L, 5.00 μ mol) according to the typical procedure in 99% yield (134 mg) as a colorless oil. ¹H NMR spectrum of **11c** was identical with that in the literature.¹

References

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AM-958P/CDCL3

E0-99-2/CDCL3

E0-19-2/CDCL3

AM-964-2P/CDCL₃