Experimental Procedures

Chemistry

General Remarks

Melting points were obtained on a Yanagimoto micro melting point apparatus without correction. ^{1}H-NMR spectra and ^{13}C-NMR spectra were recorded on Bruker AVANCE 500 spectrometer. Chemical shifts are reported in ppm as δ values from tetramethylsilane. Data are reported as follows; chemical shift, multiplicity (s, singlet; d, doublet; t, triplet; q quartet; br, broad; m, multiplet), coupling constants (Hz), integration. Elemental analyses were carried out by Yanaco MT-6 CHN CORDER spectrometer.

1-Methoxycarbonyl-10-phenyl-1,10-dicarba-*closo*-decaborane (**19**)

To a solution of 1,10-dicarba-*closo*-decaborane (200 mg, 1.66 mmol) in 1,2-dimethoxyethane (2.0 mL) was added dropwise a 1.6 M solution of *n*-BuLi in hexane (1.14 mL, 1.82 mmol) at 0 °C under Ar. The mixture was stirred at room temperature for 20 min, then CuCl (213 mg, 2.16 mmol) was added in one portion and stirring was continued at room temperature for 1 h. Pyridine (0.8 mL) was added, then iodobenzene (203 μL, 1.82 mmol) was further added, and the mixture was heated at 80 °C for 20 h. After cooling, the reaction mixture was diluted with ether, insoluble materials were filtered off through celite. The filtrate was washed with 5% aqueous sodium thiosulfate, 1 M hydrochloric acid and brine, dried over sodium sulfate, then concentrated. Purification by silica gel column chromatography (hexane) gave **20** as a mixture with 1,10-dicarba-*closo*-decaborane. The obtained material was dissolved in ether (10 mL), then was added dropwise a 1.6 M solution of *n*-BuLi in hexane (2.1 mL, 3.32 mmol) at 0 °C under Ar. The mixture was stirred at room temperature for 30 min, then methyl chloroformate (380 μL, 5.00 mmol) was added at 0 °C. The mixture was stirred at room temperature for 2 h, then poured into saturated aqueous ammonium chloride, and extracted with ether. The organic layer was washed with aqueous sodium bicarbonate and brine, dried over sodium sulfate, then concentrated. Purification by silica gel column chromatography (15% dichloromethane-hexane) gave **19** (150 mg, 35.5% from 1,10-dicarba-*closo*-decaborane) as colorless oil: ^{1}H-NMR (500 MHz, $CDCl_3$) δ 7.81-7.76 (m, 2 H), 7.47-7.44 (m, 3 H), 4.05 (s, 3 H), 3.0-1.3 (br m, 8 H).

1-(4-Nitrophenyl)-10-methoxycarbonyl-1,10-dicarba-*closo*-decaborane (**20**) and 1-(2-Nitrophenyl)-10-methoxycarbonyl-1,10-dicarba-*closo*-decaborane (**21**)

A solution of **19** (150 mg, 0.589 mmol) in dichloromethane (4.0 mL) was added to a mixture of nitric acid (0.5 mL) and sulfuric acid (3.0 mL) at 0 °C. The mixture was stirred at room temperature for 20 min, then poured into ice water and extracted with ethyl acetate. The organic layer was washed with aqueous sodium bicarbonate and brine, dried over sodium sulfate, then concentrated. Purification by silica gel column chromatography (10% dichloromethane-hexane) gave **20** (85 mg, 48.2%) and **21** (15mg, 8.5%).
20: ^{1}H-NMR (500 MHz, $CDCl_3$) δ 8.31 (d, J = 8.7 Hz, 2 H), 7.95 (d, J = 8.7 Hz, 2 H), 4.05 (s, 3 H), 3.0-1.3 (br m, 8 H). ^{13}C-NMR (125 MHz, $CDCl_3$) δ 164.9, 148.3, 144.2, 129.7, 123.8,123.5, 112.0, 53.9.
21: ^{1}H-NMR (500 MHz, $CDCl_3$) δ 7.97 (dd, J = 7.7 Hz, 1.2 Hz, 1 H), 7.75 (dd, J = 7.7 Hz, 1.2 Hz, 1 H), 7.67 (ddd, J = 7.7 Hz, 7.7 Hz, 1.2 Hz, 1 H), 7.59 (ddd, J = 7.7 Hz, 7.7 Hz, 1.2 Hz, 1 H), 4.05 (s, 3 H),

3.0-1.3 (br m, 8 H). ^{13}C-NMR (125 MHz, $CDCl_3$) δ 165.0, 150.1, 133.5, 131.8, 129.9, 139.1, 124.3, 53.9.

1-(4-Nitrophenyl)-10-hydroxymethyl-1,10-dicarba-*closo*-decaborane (14)

To a suspension of lithium tetrahydroborate (17 mg, 0.667 mmol) in ether (4.0 mL) was added a solution of **20** (80 mg, 0.267 mmol) and stirred at room temperature for 3 h. The mixture was poured into diluted hydrochloric acid and extracted with ethyl acetate. The organic layer was washed with aqueous sodium bicarbonate and brine, dried over sodium sulfate, then concentrated. Purification by silica gel column chromatography (25% ethyl acetate-hexane) gave **14** (50 mg, 68.9%) as a colorless solid: colorless needles (hexane); mp 125.0-127.0 °C; ^{1}H-NMR (500 MHz, $CDCl_3$) δ 8.31 (d, J = 8.8 Hz, 2 H), 7.94 (d, J = 8.8 Hz, 2 H), 5.22 (s, 2 H), 3.0-1.3 (br m, 8 H). ^{13}C-NMR (125 MHz, $CDCl_3$) δ 148.3, 144.6, 129.9, 123.7, 122.7, 116.8, 63.9. Ana1.Calcd for: $C_9B_8H_{15}NO_3$: N, 5.16; C, 39.78; H, 5.56. Found: N, 5.14; C, 40.06; H, 5.79.

1-Hydroxymethyl-1,10-dicarba-*closo*-decaborane (23)

To a solution of 1,10-dicarba-*closo*-decaborane (300 mg, 2.49 mmol) in benzene (6.0 mL) and ether (3.0 mL) was added dropwise a 1.6 M solution of *n*-BuLi in hexane (1.63 mL, 2.61 mmol) at 0 °C under Ar. The mixture was stirred at room temperature for 20 min, then paraformaldehyde (150 mg, 1.1 mmol) was added in one portion at 0 °C. The mixture was stirred at room temperature for 3 h, then poured into saturated aqueous ammonium chloride, and extracted with ether. The organic layer was washed with brine, dried over sodium sulfate, then concentrated. Purification by silica gel column chromatography (15% ethyl acetate-hexane) gave **23** (260 mg, 69.4%) as colorless oil: ^{1}H-NMR (500 MHz, $CDCl_3$) δ 6.90 (br s, 1 H), 5.17 (s, 2 H), 3.0-1.3 (br m, 8 H). ^{13}C-NMR (125 MHz, $CDCl_3$) δ 124.6, 97.1, 64.3.

1-*tert*-Butyldimethylsilyloxymethyl-1,10-dicarba-*closo*-decaborane (24)

To a solution of **23** (250 mg, 1.66 mmol) in DMF (8.0 mL) was added imidazole (226 mg, 3.32 mmol) and TBSCl (375 mg, 2.49 mmol) at 0 °C and stirred at room temperature for 4 h. The reaction was quenched with aqueous sodium bicarbonate and extracted with ethyl acetate. The organic layer was washed with brine, dried over sodium sulfate, then concentrated. Purification by silica gel column chromatography (hexane) gave **16** (400 mg, 91.0%) as colorless oil: ^{1}H-NMR (500 MHz, $CDCl_3$) δ 6.84 (br s, 1 H), 5.14 (s, 2 H), 3.0-1.3 (br m, 8 H). 0.96 (s, 9 H), 0.18 (s, 6 H). ^{13}C-NMR (125 MHz, $CDCl_3$) δ 125.2, 96.4, 64.5, 25.9, 18.4.

General procedures of coupling reaction between 24 and iodobenzenes, and removal of TBS group.

To a solution of **24** (90 mg, 0.34 mmol) in 1,2-dimethoxyethane (0.5 mL) was added dropwise a 1.6 M solution of *n*-BuLi in hexane (0.234 mL, 0.374 mmol) at 0 °C under Ar. The mixture was stirred at room temperature for 20 min, then CuCl (44 mg, 0.442 mmol) was added in one portion and stirring was continued at room temperature for 1 h. Pyridine (0.2 mL) was added, then iodobenzene derivative (0.442 mmol) was further added, and the mixture was heated at 80 °C for 14 h. After cooling, the reaction mixture was diluted with ether, insoluble materials were filtered off through celite. The filtrate was washed with 5% aqueous sodium thiosulfate, 1 M hydrochloric acid and brine, dried over sodium sulfate, then concentrated. Purification by silica gel column chromatography (ethyl acetate-hexane) gave the

coupling product. To a solution of the coupling product (1 eq) in THF (0.1 M for substrate) was added 1.0 M TBAF solution in THF (1 eq) and stirred at room temperature for 20 min. The reaction was quenched with aqueous ammonium chloride and extracted with ethyl acetate. The organic layer was washed with brine, dried over sodium sulfate, then concentrated. Purification by silica gel column chromatography (ethyl acetate-hexane) gave the product.

1-(3-Nitrophenyl)-10-hydroxymethyl-1,10-dicarba-*closo*-decaborane (13)

colorless needles (hexane); mp 65.5-66.5 °C; ^{1}H-NMR (500 MHz, $CDCl_3$) δ 8.63 (dd, *J* = 2.0 Hz, 2.0 Hz, 1 H), 8.31 (ddd, *J* = 8.3 Hz, 2.0 Hz, 1.0 Hz, 1 H), 7.73 (ddd, *J* = 7.7 Hz, 2.0 Hz, 1.0 Hz, 1 H), 7.65 (dd, *J* = 8.0 Hz, 8.0 Hz, 1 H), 5.22 (s, 2 H), 3.0-1.3 (br m, 8 H). Ana1.Calcd for: $C_9B_8H_{15}NO_3$: N, 5.16; C, 39.78; H, 5.56. Found: N, 5.20; C, 39.81; H, 5.71.

1-(3-Cyanophenyl)-10-hydroxymethyl-1,10-dicarba-*closo*-decaborane (15)

colorless needles (hexane); mp 118.0-119.0 °C; ^{1}H-NMR (500 MHz, $CDCl_3$) δ 8.07 (dd, *J* = 1.5 Hz, 1.5 Hz, 1 H), 8.01 (ddd, *J* = 7.8 Hz, 1.5 Hz, 1.5 Hz, 1 H), 7.73 (ddd, *J* = 7.8 Hz, 1.5 Hz, 1.5 Hz, 1 H), 7.57 (dd, *J* = 7.8 Hz, 7.8 Hz, 1 H), 5.21 (s, 2 H), 3.0-1.3 (br m, 8 H). ^{13}C-NMR (125 MHz, $CDCl_3$) δ 139.4, 133.2, 132.3, 132.1, 129.4, 122.0, 118.3, 116.9, 112.8, 63.9. Ana1.Calcd for: $C_{10}B_8H_{15}NO$+0.5H_2O: N, 5.37; C, 46.07; H, 6.19. Found: N, 5.45; C, 46.03; H, 5.91.

1-(4-Cyanophenyl)-10-hydroxymethyl-1,10-dicarba-*closo*-decaborane (16)

colorless needles (hexane); mp 168.0-169.5 °C; ^{1}H-NMR (500 MHz, $CDCl_3$) δ 7.90 (d, *J* = 8.3 Hz, 2 H), 7.75 (d, *J* = 8.3 Hz, 2 H), 5.21 (s, 2 H), 3.0-1.3 (br m, 8 H). ^{13}C-NMR (125 MHz, $CDCl_3$) δ 142.8, 132.3, 129.7, 122.3, 118.4, 117.4, 112.5, 63.9. Ana1.Calcd for: $C_{10}B_8H_{15}NO$+0.5H_2O: N, 5.37; C, 46.07; H, 6.19. Found: N, 5.40; C, 46.14; H, 6.04.

1-(1,4-Dioxaspiro[4.5]octan-8-yl)-1,10-dicarba-*closo*-decaborane (28)

To a solution of 1,10-dicarba-*closo*-decaborane (100 mg, 0.829 mmol) in benzene (2 mL) and ether (1 mL) was added dropwise a 1.6 M solution of *n*-BuLi in hexane (544 μL, 0.871 mmol) at 0 °C under Ar. The mixture was stirred at room temperature for 20 min, then 1,4-cyclohexadione-*mono*-ethyleneketal (170 mg, 1.08 mmol) was added in one portion at 0 °C. The mixture was stirred at room temperature for 2 h, then poured into saturated aqueous ammonium chloride, and extracted with ethyl acetate. The organic layer was washed with aqueous sodium bicarbonate and brine, dried over sodium sulfate, then concentrated. Purification by silica gel column chromatography (20% ethyl acetate-hexane) gave **28** (185 mg, 80.6%) as colorless solid: ^{1}H-NMR (500 MHz, $CDCl_3$) δ 6.92 (br s, 1 H), 4.04-3.97 (m, 4 H), 2.46-2.39 (m, 2 H), 2.28-2.19 (m, 4 H), 1.81-1.76 (m, 2 H), 3.0-1.3 (br m, 8 H). ^{13}C-NMR (125 MHz, $CDCl_3$) δ 134.2, 108.4, 97.7, 71.9, 64.4, 64.3, 38.6, 31.0.

1-(4-Oxo-2-cyclohexenyl)-1,10-dicarba-*closo*-decaborane (29)

To concentrated sulfuric acid (4.0 mL) was added **28** (300 mg, 1.08 mmol) in one portion at 0 °C then stirred at 80 °C for 30 min. The mixture was poured into ice water, and extracted with ether. The organic layer was washed with aqueous sodium bicarbonate and brine, dried over sodium sulfate, then concentrated. Purification by silica gel column chromatography (5% ethyl acetate-hexane) gave **29** (225 mg, 97%) as colorless oil: ^{1}H-NMR (500 MHz, $CDCl_3$) δ 7.31 (ddd, *J* = 10.2 Hz, 2.0 Hz, 2.0 Hz, 1 H)

6.89 (br s, 1 H), 6.16 (dd, *J* = 10.2 Hz, 2.7 Hz, 1 H) 4.32-4.29 (m, 1 H), 2.77-2.69 (m, 2 H), 2.65-2.58 (m, 2 H), 2.50-2.41 (m, 1 H), 3.0-1.3 (br m, 8 H). ^{13}C-NMR (125 MHz, $CDCl_3$) δ 198.4, 153.0, 129.4, 125.2, 96.7, 40.3, 37.3, 32.3.

1-(4-Hydroxy-2-clohexenyl)-1,10-dicarba-*closo*-decaborane (30)

To a solution of **29** (200 mg, 0.932 mmol) in toluene (7.0 mL) was added dropwise a 0.99 M solution of DIBAL in toluene (1.0 mL, 1.0 mmol) at 0 °C under Ar. The mixture was stirred at room temperature for 20 min, the reaction was quenched with 2 M hydrochloric acid and extracted with ethyl acetate. The organic layer was washed with aqueous sodium bicarbonate and brine, dried over sodium sulfate, then concentrated. Purification by silica gel column chromatography (15% ethyl acetate-hexane) gave **30** (180 mg, 89.2%) as a mixture of two stereo isomers: isomer A (more polar fraction) 110 mg: ^{1}H-NMR (500 MHz, $CDCl_3$) δ 6.78 (br s, 1 H), 6.17-6.14 (m, 1 H) 5.90-5.86 (m, 1 H) 4.41-4.37 (m, 1 H), 4.01-3.97 (m, 1 H), 2.48-2.43 (m, 1 H), 2.31-2.25 (m, 1 H), 2.13-2.10 (m, 1 H), 2.06-1.98 (m, 1 H), 1.76-1.68 (m, 1 H), 3.0-1.3 (br m, 8 H). ^{13}C-NMR (125 MHz, $CDCl_3$) δ 133.7, 131.4, 128.5, 95.3, 66.6, 40.0, 32.3, 30.5. isomer B (less polar fraction) 70 mg: ^{1}H-NMR (500 MHz, $CDCl_3$) δ 6.79 (br s, 1 H), 6.26-6.22 (m, 1 H) 5.99-5.95 (m, 1 H) 4.30-4.27 (m, 1 H), 3.90-3.86 (m, 1 H), 2.30-2.14 (m, 2 H), 2.05-1.95 (m, 2 H), 3.0-1.3 (br m, 8 H). ^{13}C-NMR (125 MHz, $CDCl_3$) δ 135.2, 129.5, 128.2, 95.3, 64.1, 40.0, 30.5, 27.5.

1-(4-Methoxymethoxy-2-clohexenyl)-1,10-dicarba-*closo*-decaborane (31)

To a solution of **30** (isomer A; 90 mg, 0.415 mmol) in dichloromethane (2.0 mL) was added MOMCl (63 μL, 0.83 mmol) and diisopropylethylamine (0.250 mL, 1.43 mmol) at 0 °C. The mixture was stirred at room temperature for 20 h, the reaction was quenched with aqueous sodium bicarbonate and extracted with ethyl acetate. The organic layer was washed with brine, dried over sodium sulfate, then concentrated. Purification by silica gel column chromatography (10% ethyl acetate-hexane) gave **31** (98 mg, 90.5%) as a colorless oil. ^{1}H-NMR (500 MHz, $CDCl_3$) δ 6.79 (br s, 1 H), 6.21-6.17 (m, 1 H), 5.92-5.87 (m, 1 H), 4.78 (d, *J* = 6.9 Hz, 1 H) ,4.76 (d, *J* = 6.9 Hz, 1 H), 4.32-4.27 (m, 1 H), 4.03-3.99 (m, 1 H), 3.43 (s, 3 H), 2.50-2.45 (m, 1 H), 2.31-2.24 (m, 1 H), 2.06-1.98 (m, 1 H), 1.85-1.77 (m, 1 H), 3.0-1.3 (br m, 8 H). ^{13}C-NMR (125 MHz, $CDCl_3$) δ 134.1, 129.4, 128.7, 95.2, 95.1, 71.8, 55.3, 39.9, 30.4, 29.3.

1-Hydroxymethyl-10-(4-methoxymethoxy-2-clohexenyl)-1,10-dicarba-*closo*-decaborane (32)

To a solution of **31** (95 mg, 0.364 mmol) in ether (2.0 mL) was added dropwise a 1.6 M solution of *n*-BuLi in hexane (320 μL, 0.51 mmol) at 0 °C under Ar. The mixture was stirred at room temperature for 20 min, then paraformaldehyde (33 mg, 1.1 mmol) was added in one portion at 0 °C. The mixture was stirred at room temperature for 3 h, then poured into saturated aqueous ammonium chloride, and extracted with ether. The organic layer was washed with brine, dried over sodium sulfate, then concentrated. Purification by silica gel column chromatography (20% ethyl acetate-hexane) gave **32** (35 mg, 33%) as colorless oil. ^{1}H-NMR (500 MHz, $CDCl_3$) δ 6.18-6.14 (m, 1 H), 5.91-5.87 (m, 1 H), 5.14 (s, 2 H), 4.78 (d, *J* = 6.8 Hz, 1 H) ,4.75 (d, *J* = 6.8 Hz, 1 H), 4.32-4.26 (m, 1 H), 4.01-3.97 (m, 1 H), 3.42 (s, 3 H), 2.50-2.42 (m, 1 H), 2.31-2.24 (m, 1 H), 2.03-1.96 (m, 1 H), 1.84-1.76 (m, 1 H), 3.0-1.3 (br m, 8 H). ^{13}C-NMR (125 MHz, $CDCl_3$) δ 134.1, 129.5, 124.2, 118.1, 95.2, 71.8, 63.9, 55.3, 39.4, 30.5, 29.3.

1-(4-Hydroxy-2-clohexenyl)-10-hydroxymethyl-1,10-dicarba-*closo*-decaborane (33)

To a solution of **32** (35 mg, 0.120 mmol) in methanol (1.5 mL) was added 12 M hydrochloric acid (180 μL) at 0 °C. The mixture was stirred at 50 °C for 30 min, then the reaction was quenched with aqueous sodium bicarbonate and extracted with ethyl acetate. The organic layer was washed with brine, dried over sodium sulfate, then concentrated. Purification by silica gel column chromatography (33% ethyl acetate-hexane) gave **33** (30 mg, quant) as colorless solid: ^{1}H-NMR (500 MHz, $CDCl_3$) δ 6.16-6.12 (m, 1 H), 5.89-5.86 (m, 1 H), 5.14 (s, 2 H), 4.41-4.36 (m, 1 H), 4.00-3.95 (m, 1 H), 2.50-2.42 (m, 1 H), 2.31-2.25 (m, 1 H), 2.03-1.96 (m, 1 H), 1.75-1.68 (m, 1 H), 3.0-1.3 (br m, 8 H). ^{13}C-NMR (125 MHz, $CDCl_3$) δ 133.7, 131.3, 124.1, 118.2, 66.6, 63.8, 39.5, 32.2, 29.7.

1-(4-Oxo-2-cyclohexenyl)-10-hydroxymethyl-1,10-dicarba-*closo*-decaborane (17)

To a solution of **33** (30 mg, 0.108 mmol) in dichloromethane (1.5 mL) was added manganese oxide (300 mg) and the mixture was stirred at room temperature for 2 h. Insoluble materials were filtered off through celite, then the filtrate was concentrated. Purification by silica gel column chromatography (20% ethyl acetate-hexane) gave **17** (25 mg, 84.0 %) as colorless solid: colorless needles (hexane); mp 74.0-75.5 °C; ^{1}H-NMR (500 MHz, $CDCl_3$) δ 7.28 (ddd, J = 10.2 Hz, 2.5 Hz, 1.5 Hz, 1 H) 6.17 (ddd, J = 10.2 Hz, 2.7 Hz, 0.8 Hz, 1 H) 5.18 (d, J = 6.7 Hz, 2 H), 4.30-4.27 (m, 1 H), 2.77-2.60 (m, 4 H), 2.47-2.39 (m, 2 H), 3.0-1.3 (br m, 8 H). ^{13}C-NMR (125 MHz, $CDCl_3$) δ 198.7, 153.2, 129.5, 120.6, 119.8, 63.8, 39.9, 37.3, 32.3. Ana1.Calcd for: $C_{11}B_{10}H_{16}N_2O$+0.2H_2O: C, 43.53; H, 7.47. Found: C, 43.68; H, 7.29.

Biology

SC-3 Growth Promotion/Inhibition Assay

SC-3 cells were cultured in the presence of MEMα (Wako Co.) supplemented with 2% FBS and 1.0 nM DHT at 37°C under 5% CO_2. All experiments were performed in triplicate or more. Cells were trypsinized and diluted to 20000 cells/mL with MEMα supplemented with 2% stripped FBS. This cell suspension was seeded in 96-well plates at a volume of 100 μL and incubated at 24 h. After removal of 10 μL of medium from each well, 10 μL of the drug solution, which was supplemented with serial dilutions of the test compounds or DMSO as a dilution control in the presence or absence of 1.0 nM DHT, was added. Then the plates were incubated at 37°C under 5% CO_2 for 3 days, and the cell number was determined using a Cell Counting Kit-8 (DOJINDO). A 10 μL aliquot of WST-8 was added to each well of microcultures, and the cells were incubated for 4 h. The absorbance at 450 nm was measured with a model DTX880 microplate reader (Beckman Coulter). This parameter is related to the number of living cells in the culture.

Competitive Binding Assay for hAR-LBD

A hAR-LBD expression plasmid vector which encodes GST-hARLBD (627-919 aa, EF domain) fusion protein under the lac promoter (provided by Prof. S. Kato, University of Tokyo) was transfected into E. coli strain HB-101. An overnight culture (10 mL) of the bacteria was added to 1 L of LB medium and incubated at 27 °C until its optical density reached 0.6-0.7 at 600 nm. Following the addition of IPTG to a concentration of 1 mM, incubation was continued for an additional 4.5 h. Cells were harvested by

centrifugation at 4000 g at 4 °C for 15 min and stored at -80 °C until use. All subsequent operations were performed at 4 °C. The bacterial pellet obtained from 40 mL of culture was resuspended in 1 mL of ice-cold TEGDM buffer (10 mM Tris-HCl pH 7.4, 1 mM EDTA, 10% glycerol, 10 mM DTT, 10 mM sodium molybdate). This suspension was subjected to sonication using 10 × 10 s bursts on ice, and crude GST-hARLBD fraction was prepared by centrifugation of the suspension at 12000 g for 30 min at 4 °C. This crude receptor fraction was diluted with buffer (20 mM Tris-HCl pH 8.0, 0.3 M KCl, 1 mM EDTA) to a protein concentration of 0.3-0.5 mg/mL and used in binding assays as hAR-LBD fraction. Aliquots of the hARLBD fraction were incubated in the dark at 4 °C with [^{3}H]-DHT (PerkinElmer, 4 nM final concentration) and reference or test compounds (dissolved in DMSO). Nonspecific binding was assessed by addition of a 200-fold excess of nonradioactive DHT. After 15 h, a Dextran T-70/γ-globulin-coated-charcoal suspension was added to the ligand/protein mixture (1% Norit A, 0.05% γ-globulin, 0.05% Dextran T-70 final concentration each) and the whole was incubated at 4 °C for 10 min. The charcoal was removed by centrifugation for 10 min at 1300 g, and the radioactivity of the supernatant was measured in scintillation cocktail (Ultima Gold, PerkinElmer) by using a liquid scintillation counter.

Docking study

The binding models for **10** and **15** were estimated using a docking program GOLD version 5.0.1. [ref.20: G. Jones, P. Willett, R. C. Glen, *J. Mol. Biol.*, 1995, **245**, 43-53.] For the docking calculation, the quantum-chemically optimized structure of ligands **10** and **15** were used as the initial structure. The structure of the hAR LBD was obtained from the crystal structure of the hAR LBD-metribolone complex (PDB code: 1E3G) by removing the metribolone molecule. All hydrogen atoms that are missing in the crystal structure but should exist in the protein structure were computationally located at appropriate positions by use of the Biopolymer module of SYBYL 6.91. The active site of hAR LBD was defined as the collection of amino acids for which at least one atom was closer than 10 Å to any atom of the bound metribolone, and the maximum number of generated poses was set to 50. Default values were used for other parameters. The generated docking poses were evaluated by means of Goldscore, and the highest-ranked pose with the similar structure reported in ref. 15 [K. Ohta, T. Goto, S. Fujii, M. Kawahata, A. Oda, S. Ohta, K. Yamaguchi, S. Hirono, Y. Endo, *Bioorg. Med. Chem.*, 2011, **19**, 3540-3548.] was selected. Molecular volumes of compounds **10** and **15** were calculated using swiss PDB viewer and Discovery Studio Visualizer by means of inner volume of accessible surfaces generated by a spherical probe with 1.4 Å radius around the compounds.