Supporting Information

A 20*S* Combined with a 22*R* Configuration Markedly Increases both *in vivo* and *in vitro* Biological Activity of 1α,25-Dihydroxy-22-methyl-2-methylene-19-norvitamin D_3

Agnieszka Flores[a], Rafal R. Sicinski[b], Pawel Grzywacz[a], James B. Thoden[a], Lori A. Plum[a], Margaret Clagett-Dame[a], and Hector F. DeLuca[a]*

[a]*Department of Biochemistry, University of Wisconsin-Madison, 433 Babcock Drive, Madison, WI 53706, USA;* [b]*Department of Chemistry, University of Warsaw, Pasteura 1, 02-093 Warsaw, Poland*

Contents:

Purity criteria for the synthesized vitamin D compounds

All vitamin D analogs synthesized by us gave single sharp peaks on HPLC and they were judged at least 99% pure. Two HPLC systems (straight- and reversed-phase) were employed as indicated in the Table 1. The purity and identity of the synthesized vitamins were additionally confirmed by inspection of their ^{1}H NMR and high-resolution mass spectra.

Table 1. Purity Criteria for Target Vitamin D Compounds

Compound	Compd. No.	HPLC Retention Volumes	
		Straight-phase[a] (hexane/2-propanol)	Reversed-phase[b] (methanol/water)
(20*R*,22*R*)-1α,25-Dihydroxy-22-methyl-2-methylene-19-norvitamin D_3	**3a**	h/p (85:15) 32.5 mL	m/w (85:15) 39.6 mL
(20*R*,22*S*)-1α,25-Dihydroxy-22-methyl-2-methylene-19-norvitamin D_3	**3b**	h/p (85:15) 34 mL	m/w (85:15) 45.6 mL
(20*S*,22*R*)-1α,25-Dihydroxy-22-methyl-2-methylene-19-norvitamin D_3	**4a**	h/p (85:15) 31.6 mL	m/w (85:15) 44.1 mL
(20*S*,22*S*)-1α,25-Dihydroxy-22-methyl-2-methylene-19-norvitamin D_3	**4b**	h/p (85:15) 29.2 mL	m/w (85:15) 35.1 mL
(20*R*)-1α,25-Dihydroxy-22,22-dimethyl-2-methylene-19-norvitamin D_3	**5**	h/p (99.9:0.1) 12.8 mL	m/w (85:15) 39.9 mL
(20*S*)-1α,25-Dihydroxy-22,22-dimethyl-2-methylene-19-norvitamin D_3	**6**	h/p (99.9:0.1) 13.6 mL	m/w (85:15) 31.2 mL

[a]Zorbax-Sil 9.4 mm × 25 cm column. [b]Zorbax RX-C18 9.4 mm × 25 cm column.

Spectral data of the synthesized compounds

(8*S*,20*R*)-*Des*-A,B-20-(cyanomethyl)-8β-[(triethylsilyl)oxy]-pregnane (9): $[\alpha]_D$ +16.6 (*c* 1.0, $CHCl_3$); ^1H NMR (400 MHz, $CDCl_3$) δ 4.04 (1H, d, J = 2.1 Hz), 2.34 (1 H, dd, J = 16.6, 3.7 Hz), 2.23 (1H, dd, J = 16.6, 7.0 Hz), 1.92 (1H, m), 1.13 (3H, d, J = 6.6 Hz), 0.942 (9H, t, J = 7.9 Hz), 0.921 (3H, s), 0.55 (6H, q, J = 7.9 Hz); ^{13}C NMR (125 MHz, $CDCl_3$) δ 119.09 (0), 69.12 (1), 55.34 (1), 52.86 (1), 42.18 (0), 40.35 (2), 34.40 (2), 33.09 (1), 27.19 (2), 24.69 (2), 22.82 (2), 19.23 (3), 17.53 (2), 13.63 (3), 6.91 (3), 4.89 (2); MS (EI) m/z 335 (10, M^+), 320 (3), 306 (100), 292 (28), 225 (7), 202 (20), 188 (10), 161 (17), 135 (14), 103 (55); HRMS m/z calcd for $C_{20}H_{37}ONSi$ (M^+) 335.2644, found 335.2656.

(8*S*,20*S*)-*Des*-A,B-20-(cyanomethyl)-8β-[(triethylsilyl)oxy]-pregnane (10): $[\alpha]_D$ +17.3 (*c* 1.0, $CHCl_3$); ^1H NMR (400 MHz, $CDCl_3$) δ 4.04 (1H, d, J = 2.2 Hz), 2.44 (1 H, dd, J = 16.7, 4.0 Hz), 2.38 (1H, dd, J = 16.7, 6.6 Hz), 1.06 (3H, d, J = 6.7 Hz), 0.94 (9H, t, J = 7.9 Hz), 0.91 (3H, s), 0.55 (6H, q, J = 7.9 Hz); ^{13}C NMR (100 MHz, $CDCl_3$) δ 118.90 (0), 69.07 (1), 54.96 (1), 52.74 (1), 41.91 (0), 40.23 (2), 34.29 (2), 31.79 (1), 27.01 (2), 24.00 (2), 22.68 (2), 19.58 (3), 17.53 (2), 13.81 (3), 6.90 (3), 4.88 (2); MS (EI) m/z 335 (3, M^+), 320 (1), 306 (76), 292 (15), 271 (2), 225 (3), 202 (30), 161 (13), 103 (100), 75 (38); MS (ESI) m/z 336 (7, $[M+H]^+$), 358 (4, $[M+Na]^+$), 693 (100, $[2M+Na]^+$), 1028 (40, $[3M+Na]^+$); HRMS m/z calcd for $C_{18}H_{32}ONSi$ $[M-Et]^+$ 306.2253, found 306.2253.

(8*S*,20*R*,22*R*)- and (8*S*,20*R*,22*S*)-*Des*-A,B-22-cyano-8β,25-bis[(triethylsilyl)oxy]-cholestane (11a,b): ^1H NMR (400 MHz, $CDCl_3$) δ 4.03 (1H, s), 2.56 (1 H, m), 1.22 (3H, s), 1.21 (3H, s), *1.08 (3H, d, J = 6.8 Hz)*, 1.04 (3H, d, J = 6.6 Hz), 0.944 (18H, t, J = 7.8 Hz), 0.923 (3H, s), 0.57 (6H, q, J = 7.8 Hz), 0.55 (6H, q, J = 7.8 Hz); MS (EI) m/z no M^+, 492 (36), 478 (6), 390 (11), 374 (96), 351 (53), 322 (11), 271 (18), 225 (13), 201 (23), 185 (25), 173 (75), 131 (51), 103 (100); MS (ESI) m/z 558 (30, $[M+Na]^+$), 1093 (20, $[2M+Na]^+$); HRMS m/z calcd for $C_{31}H_{61}O_2NSi_2Na$ $[M+Na]^+$ 558.4139, found 558.4141.

(8*S*,20*S*,22*R*)- and (8*S*,20*S*,22*S*)-*Des*-A,B-22-cyano-8β,25-bis[(triethylsilyl)oxy]-cholestane (12a,b): ^1H NMR (400 MHz, $CDCl_3$) δ 4.04 (1H, s), 2.80 (1 H, m), 1.22 (3H, s), 1.21 (3H, s), 0.97 (3H, d, J = 7.0 Hz), 0.94 (18H, t, J = 7.9 Hz), 0.90 (3H, s), 0.57 (6H, q, J = 7.9 Hz), 0.55 (6H, q, J = 7.9 Hz); ^{13}C NMR (100 MHz, $CDCl_3$) δ 121.43 (0), 72.66 (0), 69.19 (1), 54.29 (1), 52.81 (1), 42.96 (2), 41.94 (0), 40.42 (2), 36.58 (1), 36.48 (1), 34.34 (2), 30.16 (3), 29.57 (3), 27.21 (2), 25.86 (2), 22.68 (2), 17.59 (2), 14.37 (3), 13.78 (3), 7.08 (3), 6.92 (3), 6.70 (2), 4.90 (2); MS (EI) m/z no M^+, 491 (3), 476 (100), 345 (6), 280 (16), 246 (5), 216 (3), 189 (8), 155 (7), 132 (22), 91 (24); HRMS m/z calcd for $C_{29}H_{56}O_2NSi_2$ $[M-Et]^+$ 506.3850, found 506.3848.

(8*S*,20*R*,22*R*)- and (8*S*,20*R*,22*S*)-*Des*-A,B-22-formyl-8β,25-bis[(triethylsilyl)oxy]-cholestane (13a,b): ^1H NMR (400 MHz, $CDCl_3$) δ 9.72 (1H, d, J = 3.2 Hz), *9.63 (1H, s)*, 4.03 (1H, br s), 1.20 (6H, s), 1.02 (3H, d, J = 7.0 Hz), 0.944 (9H, t, J = 7.8 Hz), 0.939 (9H, t, J = 7.8 Hz), 0.920 (3H, s), 0.563 (6H, q, J = 7.8 Hz), 0.554 (6H, q, J = 7.8 Hz); MS (EI) m/z no M^+, 453 (1), 377 (5), 353 (8), 321 (18), 295 (8), 257 (20), 201 (53), 173 (88), 163 (43), 135 (26), 115 (59), 103

(100); MS (ESI) m/z 561 (80, $[M+Na]^+$), 1099 (40, $[2M+Na]^+$); HRMS m/z calcd for $C_{31}H_{62}O_3Si_2Na$ $[M+Na]^+$ 561.4135 found 561.4139.

(8*S*,20*S*,22*R*)- and (8*S*,20*S*,22*S*)-*Des*-A,B-22-formyl-8β,25-bis[(triethylsilyl)oxy]-cholestane (14a,b): ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.78 (1H, d, J = 2.4 Hz), 4.04 (1H, d, J = 1.8 Hz), 2.52 (1H, m), 1.21 (3H, s), 1.20 (3H, s), 0.95 (3H, d, J = 8.0 Hz) overlapped with 0.95 (9H, t, J = 7.9 Hz), 0.94 (9H, t, J = 7.9 Hz), 0.92 (3H, s), 0.56 (6H, q, J = 7.9 Hz), 0.55 (6H, q, J = 7.9 Hz); ^{13}C NMR (100 MHz, $CDCl_3$) δ 206.75 (1), 73.08 (0), 69.23 (1), 54.52 (1), 53.87 (1), 52.86 (1), 42.95 (2), 42.53 (0), 40.63 (2), 36.04 (1), 34.53 (2), 30.07 (3), 29.56 (3), 27.02 (2), 22.79 (2), 22.08 (2), 17.67 (2), 14.40 (3), 14.07 (3), 7.11 (3), 6.94 (3), 6.75 (2), 4.92 (2); MS (ESI) m/z 539 (100, $[M+H]^+$), 561 (70, $[M+Na]^+$), 1099 (57, $[2M+Na]^+$); HRMS calcd for $C_{31}H_{62}O_3Si_2H$ $[M+H]^+$ 539.4316, found 539.4312.

(8*S*,20*R*,22*R*)- and (8*S*,20*R*,22*S*)-*Des*-A,B-22-(hydroxymethyl)-8β,25-[(triethylsilyl)oxy]-cholestane (15a,b): ^{1}H NMR (500 MHz, $CDCl_3$) δ 4.03 (1H, br s), 3.71 (1H, dd, J = 10.7, 4.2 Hz), *3.61 (1H, dd, J = 10.8, 4.8 Hz)*, *3.46 (1H, dd, J = 10.8, 9.2 Hz)*, 3.39 (1H, dd, J = 10.7, 8.0 Hz), 1.205 (6H, s), 0.946 (18H, t, J = 7.9 Hz), 0.909 (3H, s), 0.798 (3H, d, J = 7.1 Hz), *0.784 (1H, d, J = 7.3 Hz)*, 0.568 (6H, q, J = 7.9 Hz), 0.551 (6H, q, J = 7.9 Hz); MS (EI) m/z no M^+, 453 (1), 425 (2), 391 (40), 340 (5), 311 (57), 297 (27), 259 (35), 225 (37), 207 (24), 191 (40), 173 (72), 163 (46), 135 (100); MS (ESI) m/z 563 (100, $[M+Na]^+$), 1103 (50, $[2M+Na]^+$); HRMS calcd for $C_{31}H_{64}O_3Si_2Na$ $[M+Na]^+$ 563.4292 found 563.4298.

(8*S*,20*S*,22*R*)- and (8*S*,20*S*,22*S*)-*Des*-A,B-22-(hydroxymethyl)-8β,25-[(triethylsilyl)oxy]-cholestane (16a,b): ^{1}H NMR (500 MHz, $CDCl_3$) δ 4.03 (1H, d, J = 2.2 Hz), 3.75 (1H, dd, J = 10.5, 3.9 Hz), *3.61 (1H, dd, J = 10.9, 4.6 Hz)*, *3.47 (1H, dd, J = 10.9, 8.8 Hz)*, 3.41 (1H, dd, J = 10.5, 8.5 Hz), 1.96 (1H, m), 1.210 (3H, s), 1.206 (3H, s), 0.95 (18H, t, J = 7.9 Hz), 0.92 (3H, s), 0.73 (3H, d, J = 7.0 Hz), 0.57 (6H, q, J = 7.9 Hz), 0.55 (6H, q, J = 7.9 Hz); ^{13}C NMR (125 MHz, $CDCl_3$) δ 73.54 (0), 69.35 (1), 63.76 (2), 53.51 (1), 53.11 (1), 43.39 (1), 43.03 (2), 42.41 (0), 40.38 (2), 35.32 (1), 34.68 (2), 29.89 (3), 29.79 (3), 27.43 (2), 24.41 (2), 22.93 (2), 17.70 (2), 13.60 (3), 7.12 (3), 6.94 (3), 6.77 (2), 4.94 (2); MS (ESI) m/z 541 (29, $[M+H]^+$), 563 (100, $[M+Na]^+$), 1103 (14, $[2M+Na]^+$); HRMS calcd for $C_{31}H_{64}O_3Si_2Na$ $[M+Na]^+$ 563.4292, found 563.4313.

(8*S*,20*R*,22*R*)- and (8*S*,20*R*,22*S*)-*Des*-A,B-22-methyl-8β,25-[(triethylsilyl)oxy]-cholestane (19a,b): ^{1}H NMR (400 MHz, $CDCl_3$) δ 4.03 (1H, br s), 1.94 (1H, m), 1.182 (6H, s), 0.952 (18H, t, J = 7.9 Hz), 0.917 (3H, s), *0.902 (3H, s)*, *0.843 (3H, d, J = 6.8 Hz)*, *0.764 (3H, d, J = 6.5 Hz)*, 0.733 (3H, d, J = 6.6 Hz), 0.690 (3H, d, J = 6.7 Hz), 0.565 (6H, q, J = 7.9 Hz), 0.556 (6H, q, J = 7.9 Hz); MS (EI) m/z no M^+, 496 (62), 481 (6), 391 (11), 363 (60), 259 (28), 246 (42), 225 (25), 173 (90), 135 (66), 103 (100); MS (ESI) m/z 547 (5, $[M+Na]^+$); HRMS calcd for $C_{31}H_{64}O_2Si_2Na$ $[M+Na]^+$ 547.4343 found 547.4355.

(8*S*,20*S*,22*R*)- and (8*S*,20*S*,22*S*)-*Des*-A,B-22-methyl-8β,25-[(triethylsilyl)oxy]-cholestane (20a,b): ^{1}H NMR (400 MHz, $CDCl_3$) δ 4.03 (1H, d, J = 1.7 Hz), 1.93 (1H, m), 1.18 (6H, s), 0.95 (18H, t, J = 7.9 Hz), 0.90 (3H, s), 0.73 (3H, d, J = 6.7 Hz), 0.67 (3H, d, J = 6.8 Hz), 0.56 (6H, q, J = 7.9 Hz), 0.55 (6H, q, J = 7.8 Hz); ^{13}C NMR (100 MHz, $CDCl_3$) δ 73.48 (0), 69.47 (1), 53.62 (1), 53.23 (1), 43.29 (2), 42.25 (0), 40.39 (2), 38.10 (1), 34.74 (1 and 2), 30.31 (2), 29.89 (3),

27.57 (2), 22.91 (2), 17.78 (2), 13.93 (3), 13.50 (3), 12.14 (3), 7.13 (3), 6.95 (3), 6.82 (2), 4.95 (2); MS (EI) m/z no M^+, 506 (0.9), 495 (46), 481 (6), 391 (7), 363 (43), 349 (2), 307 (2), 259 (20), 245 (7), 225 (14), 173 (91), 135 (41), 103 (100); HRMS calcd for $C_{29}H_{59}O_2Si_2$ $[M\text{-}Et]^+$ 495.4054, found 495.4058.

(8*S*,20*R*,22*R*)- and (8*S*,20*R*,22*S*)-*des*-A,B-22-methyl-cholestane-8β,25-diol (21a and 21b):
21a (22*R*-isomer): $[\alpha]_D$ +34.0 (*c* 1.0, $CHCl_3$); m.p. 108-110 °C (EtOAc); ^1H NMR (500 MHz, $CDCl_3$) δ 4.06 (1H, s), 1.97 (1H, dm, J = 12.9 Hz), 1.209 (3H, s), 1.199 (3H, s), 0.922 (3H, s), 0.866 (3H, d, J = 6.8 Hz), 0.779 (3H, d, J = 6.6 Hz); ^{13}C NMR (125 MHz, $CDCl_3$) δ 71.17 (0), 69.39 (1), 54.25 (1), 52.57 (1), 42.78 (2), 41.78 (0), 40.89 (1), 40.46 (2), 35.03 (1), 33.60 (2), 29.55 (3), 29.00(3), 26.82 (2), 23.70 (2), 22.45 (2), 18.89 (3), 17.45 (2), 13.45 (3), 12.87 (3); MS (EI) m/z no M^+, 278 (53), 260 (22), 245 (17), 217 (7), 191 (12), 179 (13), 163 (52), 151 (31), 135 (48), 111 (100); MS (ESI) m/z 319 (45, $[M+Na]^+$), 615 (55, $[2M+Na]^+$), 911 (10, $[3M+Na]^+$); HRMS calcd for $C_{19}H_{36}O_2Na$ $[M+Na^+]$ 319.2613, found 319.2619.

21b (22*S*-isomer): $[\alpha]_D$ +15.4 (*c* 1.0, $CHCl_3$); m.p. 147-148 °C (EtOAc); ^1H NMR (500 MHz, $CDCl_3$) δ 4.07 (1H, s), 1.98 (1H, dm, J = 12.8 Hz), 1.209 (6H, s), 0.934 (3H, s), 0.750 (3H, d, J = 6.7 Hz), 0.711 (3H, d, J = 6.8 Hz); ^{13}C NMR (100 MHz, $CDCl_3$) δ 71.13 (0), 69.42 (1), 54.26 (1), 52.63 (1), 42.18 (2), 41.78 (0), 40.50 (2), 38.14 (1), 34.84 (1), 33.59 (2), 30.26 (2), 29.28 (3), 29.19 (3), 26.72 (2), 22.42 (2), 17.45 (2), 13.47 (3), 13.08 (3), 12.19 (3); MS (EI) m/z no M^+, 277 (45), 259 (36), 244 (23), 216 (16), 189 (19), 178 (35), 162 (72), 151 (33), 134 (100), 135 (33), 111 (72); MS (ESI) m/z 319 (60, $[M+Na]^+$), 615 (100, $[2M+Na]^+$), 911 (15, $[3M+Na]^+$); HRMS calcd for $C_{19}H_{36}O_2Na$ $[M+Na^+]$ 319.2613, found 319.2621.

(8*S*,20*S*,22*R*)- and (8*S*,20*S*,22*S*)-*des*-A,B-22-methyl-cholestane-8β,25-diol (22a and 22b):
22a (22*R*-isomer): m.p. 133-134 °C (EtOAc); $[\alpha]_D$ +32.5 (*c* 1.0, $CHCl_3$); ^1H NMR (500 MHz, $CDCl_3$) δ 4.07 (1H, d, J = 1.9 Hz), 1.95 (1H, m), 1.21 (6H, s), 0.93 (3H, s), 0.76 (3H, d, J = 6.8 Hz), 0.69 (3H, d, J = 6.8 Hz); ^{13}C NMR (125 MHz, $CDCl_3$) δ 71.08 (0), 69.41 (1), 53.42 (1), 52.70 (1), 42.13 (2), 41.95 (0), 39.97 (2), 38.04 (1), 34.65 (1), 33.59 (2), 30.27 (2), 29.30 (3), 29.15 (3), 27.42 (2), 22.36 (2), 17.49 (2), 13.80 (3), 13.52 (3), 12.06 (3); MS (EI) m/z no M^+, 278 (46), 260 (32), 245 (16), 217 (9), 179 (20), 163 (47), 151 (48), 145 (63), 125 (69), 111 (100); MS (ESI) m/z 319 (18, $[M+Na]^+$); HRMS calcd for $C_{19}H_{36}O_2Na$ $[M+Na]^+$ 319.2613, found 319.2623.

22b (22*S*-isomer): ^1H NMR (500 MHz, $CDCl_3$) δ 4.08 (1H, s), 1.93 (1H, m), 1.21 (6H, s), 0.92 (3H, s), 0.86 (3H,d, J = 6.8 Hz), 0.74 (3H, d, J = 6.8 Hz); ^{13}C NMR (125 MHz, $CDCl_3$) δ 71.28 (0), 69.40 (1), 53.03 (1), 52.56 (1), 42.34 (2), 41.91 (0), 40.49 (1), 39.83 (2), 34.99 (1), 33.54 (2), 29.21 (3), 29.12 (3), 27.05 (2), 24.62 (2), 22.46 (2), 18.35 (3), 17.49 (2), 13.60 (3), 13.07 (3); MS (EI) m/z 296 (15, M^+), 278 (33), 260 (15), 246 (100), 210 (6), 196 (18), 181 (36), 163 (29), 125 (28), 111 (65); HRMS calcd for $C_{19}H_{36}O_2Na$ $[M+Na]^+$ 319.2613, found 319.2605.

(20*R*,22*R*)-*Des*-A,B-22-methyl-25-[(triethylsilyl)oxy]-cholestan-8-one (23a): $[\alpha]_D$ +3.4 (*c* 1.0, $CHCl_3$); ^1H NMR (400 MHz, $CDCl_3$) δ 2.45 (1H, dd, J = 11.4, 7.6 Hz), 1.207 (3H, s), 1.183 (3H, s), 0.955 (9H, t, J = 7.9 Hz), 0.865 (3H, d, J = 6.8 Hz), 0.835 (3H, d, J = 6.8 Hz), 0.636 (3H,

s), 0.569 (6H, q, J = 7.9 Hz); ^{13}C NMR (100 MHz, $CDCl_3$) δ 212.19 (0), 73.49 (0), 62.01 (1), 54.55 (1), 49.87 (0), 43.90 (2), 41.28 (1), 40.99 (2), 39.12 (2), 35.31 (1), 30.42 (3), 29.46 (3), 27.28 (2), 24.10 (2), 23.61 (2), 18.96 (3 and 2), 13.06 (3), 12.37 (3), 7.14 (3), 6.83 (2); MS (EI) m/z no M^+, 393 (12), 379 (68), 350 (30), 259 (14), 203 (8), 173 (100), 163 (36), 135 (45), 103 (73); HRMS calcd for $C_{23}H_{43}O_2Si$ $[M - Et]^+$ 379.3032, found 379.3032.

(20*R*,22*S*)-*Des*-A,B-22-methyl-25-[(triethylsilyl)oxy]-cholestan-8-one (23b): $[\alpha]_D$ -7.8 (*c* 1.0, $CHCl_3$); ^{1}H NMR (400 MHz, $CDCl_3$) δ 2.46 (1H, dd, J = 11.4, 7.5 Hz), 1.176 (6H, s), 0.935 (9H, t, J = 7.9 Hz), 0.797 (3H, d, J = 6.6 Hz), 0.719 (3H, d, J = 6.7 Hz), 0.643 (3H, s), 0.553 (6H, q, J = 7.9 Hz); ^{13}C NMR (100 MHz, $CDCl_3$) δ 212.20 (0), 73.38 (0), 62.01 (1), 54.47 (1), 49.90 (0), 43.25 (2), 40.98 (2), 39.09 (2), 38.43 (1), 35.00 (1), 30.19 (2), 29.86 (3), 29.82 (3), 27.17 (2), 24.09 (2), 18.96 (2), 13.14 (3), 12.44 (3), 12.37 (3), 7.10 (3), 6.77 (2); MS (EI) m/z no M^+, 393 (13), 379 (38), 350 (35), 259 (43), 203 (17), 173 (100), 163 (64), 135 (84), 103 (99); MS (ESI) m/z 431 (2, $[M+Na]^+$), 839 (20, $[2M+Na]^+$), 1248 (60, $[3M+H+Na]^+$); HRMS calcd for $C_{25}H_{48}O_2SiNa$ $(M+Na)^+$ 431.3321, found 431.3318.

(8*S*,20*S*,22*R*)-*Des*-A,B-22-methyl-25-[(triethylsilyl)oxy]-cholestan-8-one (24a): $[\alpha]_D$ –4.0 (*c* 0.8, $CHCl_3$); ^{1}H NMR (400 MHz, $CDCl_3$) δ 2.46 (1H, dd, J = 11.4, 7.6 Hz), 1.19 (6H, s), 0.94 (9H, t, J = 7.9 Hz), 0.79 (3H, d, J = 6.8 Hz), 0.72 (3H, d, J = 6.7 Hz), 0.63 (3H, s), 0.56 (6H, q, J = 7.9 Hz); ^{13}C NMR (100 MHz, $CDCl_3$) δ 212.16 (0), 73.38 (0), 62.09 (1), 53.62 (1), 49.99 (0), 43.31 (2), 41.00 (2), 38.66 (2), 38.40 (1), 35.10 (1), 30.14 (2), 29.86 (3), 27.67 (2), 24.04 (2), 18.92 (2), 13.94 (3), 12.37 (3), 12.19 (3), 7.12 (3), 6.80 (2); MS (EI) m/z no M^+, 393 (17), 379 (83), 350 (38), 335 (2), 259 (24), 239 (7), 225 (4), 203 (15), 189 (11), 173 (95), 149 (17), 135 (75), 103 (100), 75 (52); MS (ESI) m/z 431 (40, $[M+Na]^+$), 839 (100, $[2M+Na]^+$), 1247 (93, $[3M+Na]^+$); HRMS calcd for $C_{25}H_{48}O_2SiNa$ $[M+Na]^+$ 431.3321, found 431.3340**.**

(8*S*,20*S*,22*S*)-*Des*-A,B-22-methyl-25-[(triethylsilyl)oxy]-cholestan-8-one (24b): ^{1}H NMR (500 MHz, $CDCl_3$) δ 2.45 (1H, dd, J = 11.5, 7.2 Hz), 1.207 (3H, s), 1.205 (3H, s), 0.96 (9H, t, J = 8.0 Hz), 0.85 (3H, d, J = 6.8 Hz), 0.76 (3H, d, J = 6.9 Hz), 0.62 (3H, s), 0.58 (6H, q, J = 8.0 Hz); ^{13}C NMR (125 MHz, $CDCl_3$) δ 212.11 (0), 73.46 (0), 61.90 (1), 53.21 (1), 50.04 (0), 43.50 (2), 41.00 (2), 40.66 (1), 38.44 (2), 35.50 (1), 30.09 (3), 29.62 (3), 27.17 (2), 24.81 (2), 24.03 (2), 19.01 (2), 18.29 (3), 13.19 (3), 12.49 (3), 7.14 (3), 6.81 (2); MS (EI) m/z no M^+, 393 (9), 379 (34), 350 (17), 335 (2), 293 (2), 259 (34), 239 (6), 225 (3), 206 (7), 191 (38), 173 (100), 149 (16), 135 (80), 103 (80), 75 (67); MS (ESI) m/z 431 (34, $[M+Na]^+$), 839 (100, $[2M+Na]^+$), 1248 (28, $[3M+H+Na]^+$); HRMS calcd for $C_{25}H_{48}O_2SiNa$ $[M+Na]^+$ 431.3321, found 431.3316.

(20*R*,22*R*)-1α-[(*tert*-Butyldimethylsilyl)oxy]-22-methyl-25-[(triethylsilyl)oxy]-2-methylene-19-norvitamin D_3 *tert*-butyldimethylsilyl ether (26a): UV (in hexane) λ_{max} 262.5, 253.0, 245.0 nm; ^{1}H NMR (500 MHz, $CDCl_3$) δ 6.22 and 5.84 (1H and 1H, each d, J = 11.2 Hz, 6- and 7-H), 4.97 and 4.92 (1H and 1H, each s, $=CH_2$), 4.43 (2H, m, 1β- and 3α-H), 2.82 (1H, dm, J = 12.4 Hz, 9β-H), 2.53 (1H, dd, J = 13.3, 5.9 Hz, 10α-H), 2.47 (1H, dd, J = 12.8, 4.5 Hz, 4α-H), 2.32 (1H, dd, J = 13.3, 2.9 Hz, 10β-H), 2.18 (1H, dd, J = 12.8, 8.4 Hz, 4β-H), 1.204 and 1.182 (3H and 3H, each s, 26- and 27-H_3), 0.955 (9H, t, J = 7.9 Hz, 3 × $SiCH_2CH_3$), 0.898 and 0.863 (9H and 9H, each s, Si-*t*-Bu), 0.858 (3H, d, J = 5.4 Hz), 0.808 (3H, d, J = 6.8 Hz), 0.569 (6H, q, J =

7.9 Hz, 3 × $SiCH_2$), 0.542 (3H, s, 18-H_3), 0.081, 0.065, 0.050, and 0.024 (each 3H, each s, 4 × $SiCH_3$); ^{13}C NMR (125 MHz, $CDCl_3$) δ 152.99 (0, C-2), 141.36 (0, C-8), 132.71 (0, C-5), 122.43 (1, C-6), 116.05 (1, C-7), 106.25 (2, $=CH_2$), 73.58 (0, C-25), 72.56 and 71.60 (each 1, C-1, C-3), 56.31 (1), 54.28 (1), 47.62 (2), 45.62 (0, C-13), 44.01 (2), 41.94 (1), 40.73 (2), 38.53 (2), 35.41 (1), 30.40 and 29.50 (each 3, C-26, C-27), 28.81 (2), 27.46 (2), 25.84 (3), 25.78 (3), 23.70 (2), 23.49 (2), 22.13 (2), 19.01 (3), 18.26 (0), 18.16 (0), 13.11 (3), 11.97 (3), 7.16 (3), 6.86 (2), -4.86 (3), -4.91 (3), -5.11 (3); MS (ESI) m/z 795 (50, $[M+Na^+]$); HRMS (ESI) calcd for $C_{46}H_{88}O_3Si_3Na$ $[M+Na]^+$ 795.5939, found 795.5916.

(20*R*,22*R*)-1α,25-Dihydroxy-22-methyl-2-methylene-19-norvitamin D_3 (3a): m.p. 159 °C (hexane/2-propanol); UV (in EtOH) λ_{max} 261.5, 252.5, 244.5 nm; ^1H NMR (500 MHz, $CDCl_3$) δ 6.35 and 5.89 (1H and 1H, each d, J = 11.3 Hz, 6- and 7-H), 5.11 and 5.08 (1H and 1H, each s, $=CH_2$), 4.46 (2H, m, 1β- and 3α-H), 2.85 (1H, dd, J = 13.2, 4.5 Hz, 10β-H), 2.83 (1H, dm, J = 13.6 Hz, 9β-H), 2.57 (1H, dd, J = 13.4, 3.8 Hz, 4α-H), 2.33 (1H, dd, J = 13.4, 6.1 Hz, 4β-H), 2.29 (1H, dd, J = 13.2, 8.4 Hz, 10α-H), 1.227 and 1.219 (each 3H, each s, 26- and 27-H_3), 0.882 (3H, d, J = 6.8 Hz), 0.818 (3H, d, J = 6.8 Hz), 0.549 (3H, s, 18-H_3); ^{13}C NMR (125 MHz, $CDCl_3$) δ 151.97 (0, C-2), 143.39 (0, C-8), 130.44 (0, C-5), 124.19 (1, C-6), 115.25 (1, C-7), 107.69 (2, $=CH_2$), 71.23 (0, C-25), 71.78 and 70.59 (each 1, C-1, C-3), 56.25 (1), 54.15 (1), 45.74 (2), 45.74 (0), 42.76 (2), 41.79 (1), 40.50 (2), 38.12 (2), 35.15 (1), 29.53 (3), 29.01 (3), 29.01 (2), 27.35 (2), 23.66 (2), 23.52 (2), 22.19 (2), 18.93 (3), 13.13 (3), 12.02 (3); MS (EI) m/z 430 (100, M^+), 412 (24, $M^+ - H_2O$), 394 (10, $M^+ - 2H_2O$), 379 (10, $M^+ - CH_3 - 2H_2O$), 343 (9), 315 (41), 297 (26), 262 (53), 183 (21), 161 (30), 135 (50); HRMS (ESI) calcd for $C_{28}H_{46}O_3$ $[M+Na]^+$ 453.3345 found 453.3344.

(20*R*,22*S*)-1α-[(*tert*-Butyldimethylsilyl)oxy]-22-methyl-25-[(triethylsilyl)oxy]-2-methylene-19-norvitamin D_3 *tert*-butyldimethylsilyl ether (26b): UV (in hexane) λ_{max} 262.5, 253.0, 245.0 nm; ^1H NMR (500 MHz, $CDCl_3$) δ 6.22 and 5.84 (1H and 1H, each d, J = 11.1 Hz, 6- and 7-H), 4.97 and 4.92 (1H and 1H, each s, $=CH_2$), 4.43 (2H, m, 1β- and 3α-H), 2.83 (1H, dm, J = 12.3 Hz, 9β-H), 2.53 (1H, dd, J = 13.3, 5.9 Hz, 10α-H), 2.47 (1H, dd, J = 13.0, 4.5 Hz, 4α-H), 2.33 (1H, dd, J = 13.3, 2.7 Hz, 10β-H), 2.18 (1H, dd, J = 13.0, 8.4 Hz, 4β-H), 1.188 (6H, s, 26- and 27-H_3), 0.949 (9H, t, J = 7.9 Hz, 3 × $SiCH_2C\mathit{H}_3$), 0.900 (9H, s, Si-*t*-Bu), 0.868 (9H, s, Si-*t*-Bu), 0.780 (3H, d, J = 5.5 Hz), 0.722 (3H, d, J = 6.7 Hz), 0.567 (6H, q, J = 7.9 Hz, 3 × $SiCH_2$), 0.559 (3H, s, 18-H_3), 0.083, 0.069, 0.052, and 0.029 (each 3H, each s, 4 × $SiCH_3$); ^{13}C NMR (100 MHz, $CDCl_3$) δ 152.98 (0, C-2), 141.33 (0, C-8), 132.69 (0, C-5), 122.43 (1, C-6), 116.05 (1, C-7), 106.24 (2, $=CH_2$), 73.52 (0, C-25), 72.55 and 71.60 (each 1, C-1, C-3); 56.32 (1), 54.23 (1), 47.61 (2), 45.65 (0, C-13), 43.35 (2), 40.74 (2), 39.07 (1), 38.53 (2), 35.01 (1), 30.37 (2), 29.90 and 29.80 (each 3, C-26, C-27), 28.80 (2), 27.33 (2), 25.84 (3), 25.77 (3), 23.49 (2), 22.13 (2), 18.26 (0), 18.16 (0), 13.19 and 12.53 and 11.96 (each 3, C-21, C-28, C-18), 7.13 (3), 6.81 (2), -4.87 (3), -5.10 (3); MS (ESI) m/z 795 (100, $[M+Na^+]$); HRMS (ESI) calcd for $C_{46}H_{88}O_3Si_3Na$ $[M+Na]^+$ 795.5939 found 795.5910.

(20*R*,22*S*)-1α,25-Dihydroxy-22-methyl-2-methylene-19-norvitamin D_3 (3b): UV (in EtOH) λ_{max} 261.5, 252.0, 244.5 nm; ^1H NMR (500 MHz, $CDCl_3$) δ 6.35 and 5.88 (1H, d, J = 11.3 Hz, 6- and 7-H), 5.10 and 5.08 (1H and 1H, each s, $=CH_2$), 4.46 (2H, m, 1β- and 3α-H), 2.85 (1H, dd, J

= 13.1, 4.5 Hz, 10β-H), 2.82 (1H, m, 9β-H), 2.57 (1H, dd, J = 13.4, 3.6 Hz, 4α-H), 2.33 (1H, dd, J = 13.4, 6.1 Hz, 4β-H), 2.28 (1H, dd, J = 13.1, 8.4Hz, 10α-H), 2.00 (2H, m), 1.21 (6H, s, 26- and 27-H_3), 0.78 (3H, d, J = 5.8 Hz), 0.73 (3H, d, J = 6.8 Hz), 0.554 (3H, s, 18-H_3); ^{13}C NMR (125 MHz, $CDCl_3$) δ 151.97 (0, C-2), 143.43 (0, C-8), 130.41 (0, C-5), 124.23 (1, C-6), 115.27 (1, C-7), 107.70 (2, =CH_2), 71.15 (0, C-25), 71.81 and 70.63 (each 1, C-1, C-3); 56.34 (1), 54.19 (1), 45.75 (0, C-13), 45.75 (2), 42.17 (2), 40.58 (2), 39.04 (1), 38.16 (2), 35.01 (1), 30.28 (2), 29.26 (3), 29.20 (3), 28.99 (2), 27.25 (2), 23.52 (2), 22.17 (2), 13.07 and 12.49 and 12.02 (each 3, C-21, C-28, C-18); MS (EI) m/z 430 (62, M^+), 412 (26, M^+ - H_2O), 394 (13, M^+ - $2H_2O$), 379 (24, M^+ - CH_3 - $2H_2O$), 351 (20), 315 (27), 293 (34), 259 (43), 173 (94), 149 (72), 135 (100); MS (ESI) m/z 453 (95, $[M+Na]^+$), 883 (50, $[2M+Na]^+$), 1314 (10, $[3M+H+Na]^+$); HRMS calcd for $C_{28}H_{46}O_3Na$ $[M+Na]^+$ 453.3345 found 453.3358.

(20*S*,22*R*)-1α-[(*tert*-Butyldimethylsilyl)oxy]-22-methyl-25-[(triethylsilyl)oxy]-2-methylene-19-norvitamin D_3 *tert*-butyldimethylsilyl ether (27a): UV (in hexane) λ_{max} 263.0, 253.0, 245.0 nm; ^{1}H NMR (500 MHz, $CDCl_3$) δ 6.22 and 5.84 (1H, d, J = 11.1 Hz, 6- and 7-H), 4.97 and 4.92 (1H and 1H, each s, =CH_2), 4.43 (2H, m, 1β- and 3α-H), 2.83 (1H, dm, J = 12.4 Hz, 9β-H), 2.52 (1H, dd, J = 13.3, 5.8 Hz, 10α-H), 2.46 (1H, dd, J = 12.5, 4.3 Hz, 4α-H), 2.33 (1H, dd, J = 13.3, 2.9 Hz, 10β-H), 2.18 (1H, dd, J = 12.5, 8.3 Hz, 4β-H), 2.00 (2H, m), 1.187 and 1.180 (3H and 3H, each s, 26- and 27-H_3), 0.94 (9H, t, J = 7.9 Hz, 3 × $SiCH_2CH_3$), 0.896 and 0.865 (9H and 9H, each s, Si-*t*-Bu), 0.762 (3H, d, J = 6.7 Hz), 0.706 (3H, d, J = 5.8 Hz), 0.561 (6H, q, J = 7.9 Hz, 3 × $SiCH_2$), 0.535 (3H, s, 18-H_3), 0.080, 0.067, 0.049, and 0.026 (each 3H, each s, 4 × $SiCH_3$); ^{13}C NMR (125 MHz, $CDCl_3$) δ 152.98 (0, C-2), 141.24 (0, C-8), 132.72 (0, C-5), 122.42 (1, C-6), 116.13 (1, C-7), 106.25 (2, =CH_2), 73.50 (0, C-25), 72.53 and 71.63 (each 1, C-1, C-3), 56.35 (1), 53.54 (1), 47.61 (2), 45.73 (0, C-13), 43.33 (2), 40.28 (2), 39.03 (1), 38.56 (2), 35.03 (1), 30.37 (2), 29.89 and 29.85 (each 3, C-26, C-27), 28.78 (2), 27.88 (2), 25.84 (3), 25.77 (3), 23.44 (2), 22.10 (2), 18.25 (0), 18.16 (0), 13.93 (3), 12.24 (3), 11.96 (3), 7.13 (3), 6.82 (2), -4.87 (3), -5.10 (3); MS (ESI) m/z 795 (20, $[M+Na^+]$); HRMS (ESI) calcd for $C_{46}H_{88}O_3Si_3Na$ $[M+Na]^+$ 795.5939, found 795.5946.

(20*S*,22*R*)-1α,25-Dihydroxy-22-methyl-2-methylene-19-norvitamin D_3 (4a): m.p. 117 °C (Et_2O); UV (in EtOH) λ_{max} 261.5, 252.0, 244.5 nm; ^{1}H NMR (500 MHz, $CDCl_3$) δ 6.35 and 5.89 (1H, d, J = 11.2 Hz, 6- and 7-H), 5.11 and 5.08 (1H and 1H, each s, =CH_2), 4.46 (2H, m, 1β- and 3α-H), 2.85 (1H, dd, J = 13.8, 4.4 Hz, 4α-H), 2.82 (1H, m, 9β-H), 2.56 (1H, dd, J = 13.3, 3.5 Hz, 10β-H), 2.33 (1H, dd, J = 13.3, 6.0 Hz, 10α-H), 2.29 (1H, dd, J = 13.8, 8.4 Hz, 4β-H), 1.21 (6H, s, 26- and 27-H_3), 0.78 (3H, d, J = 6.7 Hz), 0.71 (3H, d, J = 5.7 Hz), 0.54 (3H, s, 18-H_3); ^{13}C NMR (125 MHz, $CDCl_3$) δ 151.98 (0, C-2), 143.25 (0, C-8), 130.52 (0, C-5), 124.14 (1, C-6), 115.36 (1, C-7), 107.69 (2, =CH_2), 71.76 (1), 71.14 (0), 70.58 (1), 56.34 (1), 53.48 (1), 45.80 (0), 45.74 (2), 42.11 (2), 40.08 (2), 38.81 (1), 38.12 (2), 34.96 (1), 30.24 (2), 29.26 (3), 29.12 (3), 28.93 (2), 27.78 (2), 23.44 (2), 22.11 (2), 13.88 (3), 12.14 (3), 12.04 (3); MS (EI) m/z no M^+, 401 (100, M^+ - Et), 383 (52, M^+ - Et - H_2O), 351 (15), 314 (14), 289 (39), 272 (27), 236 (38), 202 (10), 173 (19), 144 (42), 120 (95), 94 (59); MS (ESI) m/z 453 (100, $[M+Na]^+$), 883 (25, $[2M+Na]^+$), 1314 (5, $[3M+H+Na]^+$); HRMS calcd for $C_{28}H_{46}O_3Na$ $[M+Na]^+$ 453.3345 found 453.3329.

(20*S*,22*S*)-1α-[(*tert*-Butyldimethylsilyl)oxy]-22-methyl-25-[(triethylsilyl)oxy]-2-methylene-19-norvitamin D_3 *tert*-butyldimethylsilyl ether (27b): UV (in hexane) λ_{max} 263.0, 253.5, 245.5 nm; ^{1}H NMR (500 MHz, $CDCl_3$) δ 6.22 and 5.84 (1H and 1H, each d, J = 11.2 Hz, 6- and 7-H), 4.97 and 4.92 (1H and 1H, each s, $=CH_2$), 4.43 (2H, m, 1β- and 3α-H), 2.83 (1H, dm, J = 12.5 Hz, 9β-H), 2.52 (1H, dd, J = 13.2, 6.1 Hz, 10α-H), 2.46 (1H, dd, J = 12.7, 4.1 Hz, 4α-H), 2.33 (1H, dd, J = 13.2, 2.9 Hz, 10β-H), 2.18 (1H, dd, J = 12.7, 8.4 Hz, 4β-H), 2.00 (1H, m), 1.19 (6H, s, 26- and 27-H_3), 0.95 (9H, t, J = 7.9 Hz), 0.897 and 0.865 (9H and 9H, each s, Si-*t*-Bu), 0.84 (3H, d, J = 6.8 Hz), 0.75 (3H, d, J = 6.8 Hz), 0.57 (6H, q, J = 7.9 Hz, 3 × $SiCH_2$), 0.53 (3H, s, 18-H_3), 0.080, 0.067, 0.049, and 0.026 (each 3H, each s, 4 × $SiCH_3$); ^{13}C NMR (125 MHz, $CDCl_3$) δ 152.98 (0, C-2), 141.24 (0, C-8), 132.71 (0, C-5), 122.43 (1, C-6), 116.08 (1, C-7), 106.25 (2, $=CH_2$), 73.57 (0, C-25), 72.53 and 71.63 (each 1, C-1, C-3), 56.21 (1), 53.17 (1), 47.61 (2), 45.74 (0, C-13), 43.50 (2), 41.31 (1), 40.09 (2), 38.55 (2), 35.34 (1), 29.96 (3) and 29.73 (each 3, C-26 and C-27), 28.80 (2), 27.45 (2), 25.84 (3), 25.78 (3), 24.82 (2), 23.44 (2), 22.17 (2), 18.43 (3), 18.25 (0), 18.16 (0), 13.17 (3), 12.10 (3), 7.15 (3), 6.82 (2), -4.87 (3), -5.10 (3).

(20*S*,22*S*)-1α,25-Dihydroxy-22-methyl-2-methylene-19-norvitamin D_3 (4b): UV (in EtOH) λ_{max} 261.5, 252.5, 245.0 nm; ^{1}H NMR (500 MHz, $CDCl_3$) δ 6.35 and 5.89 (1H and 1H, each d, J = 11.2 Hz, 6- and 7-H), 5.11 and 5.09 (1H and 1H, each s, $=CH_2$), 4.46 (2H, m, 1β- and 3α-H), 2.85 (1H, dd, J = 13.0, 4.4 Hz, 4α-H), 2.82 (1H, dm, J = 13.7 Hz, 9β-H), 2.57 (1H, dd, J = 13.4, 3.8 Hz, 10β-H), 2.33 (1H, dd, J = 13.4, 6.2 Hz, 10α-H), 2.29 (1H, dd, J = 13.0, 8.4 Hz, 4β-H), 2.03 (1H, m), 1.91 (dm, J = 12.1 Hz), 1.22 (6H, s, 26- and 27-H_3), 0.86 (3H, d, J = 6.8 Hz), 0.76 (3H, d, J = 6.8 Hz), 0.54 (3H, s, 18-H_3); ^{13}C NMR (125 MHz, $CDCl_3$) δ 151.96 (0, C-2), 143.31 (0, C-8), 130.46 (0, C-5), 124.22 (1, C-6), 115.32 (1, C-7), 107.71 (2, $=CH_2$), 71.79 and 70.66 (each 1, C-1, C-3), 71.25 (0, C-25), 56.21 (1), 53.06 (1), 45.86 (0, C-13), 45.78 (2), 42.36 (2), 41.15 (1), 39.93 (2), 38.14 (2), 35.40 (1), 29.19 (3, C-26 and C-27), 28.95 (2), 27.37 (2), 24.80 (2), 23.47 (2), 22.23 (2), 18.32 (3), 13.20 (3), 12.14 (3); MS (EI) m/z 430 (9, M^+), 412 (3, M^+ - H_2O), 328 (7), 313 (8), 297 (5), 251 (5), 227 (3), 211 (5), 194 (48), 161 (12), 135 (51), 105 (100); HRMS calcd for $C_{28}H_{46}O_3$ $[M]^+$ 430.3447 found 430.3447.

(8*S*,20*R*)-*Des*-A,B-20-(cyano-dimethyl-methyl)-8β-[(triethylsilyl)oxy]-pregnane (28): $[\alpha]_D$ + 30.9 (*c* 1.0, $CHCl_3$); ^{1}H NMR (400 MHz, $CDCl_3$) δ 4.06 (1H, d, J = 2.2 Hz), 1.30 (3H, s), 1.26 (3H, s), 0.97 (3H, d, J = 7.1 Hz), 0.95 (9H, t, J = 7.9 Hz), 0.84 (3H, s), 0.55 (6H, q, J = 7.9 Hz); ^{13}C NMR (100 MHz, $CDCl_3$) δ 126.16 (0), 68.91 (1), 52.01 (1), 50.84 (1), 42.88 (0), 37.84 (1), 37.77 (2), 34.88 (2), 24.97 (3), 23.88 (3), 23.17 (2), 21.81 (2), 17.36 (2), 14.54 (3), 13.03 (3), 6.92 (3), 4.90 (2); MS (EI) m/z 363 (13, M^+), 334 (72), 320 (12), 295 (4), 261 (4), 249 (15), 234 (29), 191 (100), 163 (72), 111 (81), 93 (28), 81 (39), 57 (49); MS (ESI) m/z 364 (11, $[M+H]^+$), 749 (62, $[2M+Na]^+$), 1113 (100, $[3M+Na+H]^{2+}$); HRMS calcd for $C_{22}H_{42}ONSi$ $[M+H]^+$ 364.3031, found 364.3044.

(8*S*,20*S*)-*Des*-A,B-20-(cyano-dimethyl-methyl)-8β-[(triethylsilyl)oxy]-pregnane (29): $[\alpha]_D$ +34.5 (*c* 1.0, $CHCl_3$); ^{1}H NMR (400 MHz, $CDCl_3$) δ 4.04 (1H, d, J = 2.5 Hz), 1.37 (3H, s), 1.28 (3H, s), 0.99 (3H, d, J = 6.9 Hz), 0.97 (3H, s), 0.95 (9H, t, J = 7.9 Hz), 0.55 (6H, q, J = 7.9 Hz); ^{13}C NMR (100 MHz, $CDCl_3$) δ 127.28 (0), 69.26 (1), 54.06 (1), 52.33 (1), 43.55 (0), 42.77 (1), 41.17 (2), 35.67 (0), 34.48 (2), 27.97 (2), 27.43 (3), 23.45 (2), 22.70 (3), 17.69 (2), 14.60 (3), 13.17 (3), 6.92 (3), 4.91 (2); MS (EI) m/z 363 (28, M^+), 349 (14), 334 (100), 321 (65), 306 (27),

261 (11), 225 (27), 183 (14), 163 (36), 135 (47), 103 (99), 75 (58); HRMS calcd for $C_{22}H_{41}ONSi$ (M^+) 363.2957, found 363.2957.

(8*S*,20*R*)-*Des*-A,B-20-(1',1'-dimethyl-2'-oxo-ethyl)-8-[(triethylsilyl)oxy]-pregnane (30): $[\alpha]_D$ +35.0 (*c* 1.0, $CHCl_3$). ^1H NMR (400 MHz, $CDCl_3$) δ 9.40 (1H, s), 4.04 (1H, d, J = 2.2 Hz), 0.95 (6H, s), 0.94 (9H, t, J = 7.8 Hz), 0.85 (3H, d, J = 7.00 Hz), 0.85 (3H, s), 0.55 (6H, q, J = 7.8 Hz); ^{13}C NMR (100 MHz, $CDCl_3$) δ 207.49 (1), 68.91 (1), 51.96 (1), 50.79 (1), 50.68 (0), 42.89 (0), 38.34 (2), 34.88 (2), 33.78 (1), 23.18 (2), 22.13 (2), 19.41 (3), 18.09 (3), 17.40 (2), 14.48 (3), 12.29 (3), 6.92 (3), 4.90 (2); MS (EI) m/z 366 (1, M^+), 337 (31), 307 (37), 295 (12), 251 (13), 225 (30), 203 (22), 186 (9), 171 (14), 163 (74), 135 (43), 103 (100); MS (ESI) m/z 389 (29, $[M+Na]^+$), 755 (73, $[2M+Na]^+$), 1121 (15, $[3M+Na]^+$); HRMS (ESI) calcd for $C_{22}H_{42}O_2SiNa$ $[M+Na]^+$ 389.2847, found 389.2838.

(8*S*,20*S*)-*Des*-A,B-20-(1',1'-dimethyl-2'-oxo-ethyl)-8-[(triethylsilyl)oxy]-pregnane (31): m.p. 71-72 °C (EtOAc); $[\alpha]_D$ +12.8 (*c* 1.0, $CHCl_3$); ^1H NMR (400 MHz, $CDCl_3$) δ 9.48 (1H, s), 4.00 (1H, d, J = 2.2 Hz), 2.00 (1H, m), 0.95 (6H, s), 0.94 (9H, t, J = 7.8 Hz), 0.94 (3H, d, J = 6.9 Hz), 0.93 (3H, s), 0.54 (6H, q, J = 7.8 Hz); ^{13}C NMR (100 MHz, $CDCl_3$) δ 207.03 (1), 69.30 (1), 54.46 (1), 52.65 (1), 50.05 (0), 43.02 (0), 41.22 (2), 40.21 (1), 34.57 (2), 28.73 (2), 23.34 (2), 22.74 (3), 17.72 (2), 15.20 (3), 13.61 (3), 13.22 (3), 6.92 (3), 4.92 (2); MS (EI) m/z 366 (3, M^+), 337 (10), 323 (4), 295 (10), 281 (5), 253 (6), 239 (8), 225 (38), 203 (6), 186 (22), 163 (100), 135 (56), 103 (87), 75 (63); HRMS (ESI) calcd for $C_{22}H_{42}O_2SiNa$ $[M+Na]^+$ 389.2852, found 389.2855.

(8*S*,20*R*)-*Des*-A,B-20-(1',1'-dimethyl-3'-ethoxycarbonyl-allyl)-8β-[(triethylsilyl)oxy]-pregnane (32): $[\alpha]_D$ +18.1 (*c* 1.0, $CHCl_3$); ^1H NMR (400 MHz, $CDCl_3$) δ 6.92 and 5.69 (1H and 1H, each d, J = 15.9 Hz), 4.19 (2H, m), 4.03 (1H, d, J = 2.0 Hz), 1.29 (3H, t, J = 7.1 Hz), 0.98 (3H, s), 0.96 (3H, s), 0.94 (9H, t, J = 7.9 Hz), 0.81 (3H, d, J = 7.0 Hz), 0.80 (3H, s), 0.54 (6H, q, J = 7.9 Hz); ^{13}C NMR (100 MHz, $CDCl_3$) δ 167.19 (0), 159.65 (1), 117.69 (1), 69.04 (1), 60.07 (2), 52.08 (1), 50.18 (1), 42.83 (0), 41.16 (0), 38.53 (1), 38.19 (2), 35.00 (2), 24.64 (3), 23.30 (3), 22.14 (2), 17.49 (2), 14.50 (3), 14.29 (3), 13.02 (3), 6.94 (3), 4.93 (2); MS (EI) m/z 436 (0.3, M^+), 407 (3), 334 (2), 286 (10), 257 (18), 229 (100), 206 (16), 191 (99), 163 (26), 142 (16); MS (ESI) m/z 459 (99, $[M+Na]^+$), 896 (100, $[2M+Na+H]^{2+}$), 1332 (47, $[3M+Na+H]^{2+}$), HRMS (ESI) calcd for $C_{26}H_{48}O_3SiNa$ $[M+Na]^+$ 459.3265, found 459.3259.

(8*S*,20*S*)-*Des*-A,B-20-(1',1'-dimethyl-3'-ethoxycarbonyl-allyl)-8β-[(triethylsilyl)oxy]-pregnane (33): $[\alpha]_D$ -4.6 (*c* 1.0, $CHCl_3$); ^1H NMR (400 MHz, $CDCl_3$) δ 7.07 and 5.64 (1H and 1H, each d, J = 16.0 Hz), 4.19 (2H, q, J = 7.1 Hz), 4.00 (1H, d, J = 2.1 Hz), 2.00 (1H, m), 1.30 (3H, t, J = 7.1 Hz), 1.00 (3H, s), 0.98 (3H, s), 0.94 (9H, t, J = 7.9 Hz), 0.93 (3H, s), 0.93 (3H, d, J = 8.0 Hz), 0.54 (6H, q, J = 7.9 Hz); ^{13}C NMR (100 MHz, $CDCl_3$) δ 167.52 (0), 162.38 (1), 115.17 (1), 69.44 (1), 60.04 (2), 54.44 (1), 52.45 (1), 45.28 (1), 43.45 (0), 41.30 (2), 40.91 (0), 34.59 (2), 29.75 (2), 27.44 (3), 23.79 (2), 21.34 (3), 17.74 (2), 15.03 (3), 14.29 (3), 13.01 (3), 6.92 (3), 4.92 (2); MS (EI) m/z 437 (4, MH^+), 421 (4), 407 (43), 366 (5), 337 (5), 295 (42), 281 (13), 256 (42), 225 (18), 191 (27), 163 (100); MS (ESI) m/z 459 (81, $[M+Na]^+$), 895 (75, $[2M+Na]^+$), 1331 (94, $[3M+Na]^+$), HRMS (ESI) calcd for $C_{26}H_{48}O_3SiNa$ $[M+Na]^+$ 459.3270,found 459.3254.

(8*S*,20*R*)-*Des*-A,B-20-(1',1'-dimethyl-3'-ethoxycarbonyl-propyl)-pregnan-8β-ol (34): $[\alpha]_D$ +15.3 (*c* 1.0, $CHCl_3$). ^1H NMR (400 MHz, $CDCl_3$) δ 4.12 (2H, q, J = 7.1 Hz), 4.09 (1H, s), 2.25 (3H, m), 1.26 (3H, t, J = 7.1 Hz), 0.85 (3H, s), 0.80 (3H, s), 0.79 (3H, d, J = 7.6 Hz), 0.78 (3H, s); ^{13}C NMR (100 MHz, $CDCl_3$) δ 174.60 (0), 69.07 (1), 60.21 (2), 51.69 (1), 49.40 (1), 42.60 (0), 37.93 (2), 37.07 (1), 36.04 (0), 34.57 (2), 33.92 (2), 29.54 (2), 24.82 (3), 24.56 (3), 22.90 (2), 22.26 (2), 17.26 (2), 14.49 (3), 14.20 (3), 12.62 (3); MS (EI) m/z 324 (3, M^+), 278 (7), 261 (8),224 (7), 210 (5), 181 (15), 163 (70), 143 (100), 129 (33), 111 (72), 97 (44), 69 (48); MS (ESI) m/z 342 (100, $[M+NH_4]^+$), 671 (11, $[2M+Na]^+$), HRMS calcd for $C_{20}H_{37}O_3$ $[M+H]^+$ 325.2738, found 325.2727.

(8*S*,20*S*)-*Des*-A,B-20-(1',1'-dimethyl-3'-ethoxycarbonyl-propyl)-pregnan-8β-ol (35): $[\alpha]_D$ +7.1 (*c* 1.0, $CHCl_3$); ^1H NMR (500 MHz, $CDCl_3$) δ 4.12 (2H, q, J = 7.1 Hz), 4.07 (1H, d, J = 2.1 Hz), 2.25 (2H, m), 2.10 (1H, m), 1.26 (3H, t, J = 7.1 Hz), 0.99 (3H, s), 0.92 (3H, d, J = 7.1 Hz), 0.91 (3H, s), 0.86 (3H, s); ^{13}C NMR (125 MHz, $CDCl_3$) δ 174.60 (0), 69.47 (1), 60.23 (2), 53.30 (1), 51.90 (1), 43.53 (0), 43.14 (1), 40.90 (2), 36.34 (0), 36.25 (2), 33.57 (2), 29.94 (2), 29.44 (2), 27.49 (3), 26.21 (3), 23.36 (2), 17.48 (2), 14.89 (3), 14.22 (3), 13.08 (3); MS (EI) m/z 325 (3, MH^+), 306 (5), 278 (8), 261 (7), 224 (7), 181 (15), 163 (56), 143 (100), 111 (76), 97 (62); MS (ESI) m/z 347 (85, $[M+Na]^+$), 671 (9, $[2M+Na]^+$), HRMS calcd for $naC_{20}H_{36}O_3Na$ $[M+Na]^+$ 347.2562, found 347.2556.

(8*S*,20*R*)-*Des*-A,B-22,22-dimethyl-cholestane-8β,25-diol (36): m.p. 122-124 °C (from ethyl acetate/ hexane); $[\alpha]_D$ +21.2 (*c* 0.988, $CHCl_3$). ^1H NMR (400 MHz, $CDCl_3$) δ 4.10 (1H, d, J = 1.8 Hz), 1.21 (6H, s), 0.85 (3H, s), 0.81 (3H, s), 0.78 (3H, d, J = 7.3 Hz), 0.76 (3H, s); ^{13}C NMR (100 MHz, $CDCl_3$) δ 71.15 (0), 69.13 (1), 51.71 (1), 49.44 (1), 42.62 (0), 38.06 (2), 37.73 (2), 36.96 (1), 35.90 (0), 34.17 (2), 33.92 (2), 29.24 (3), 29.15 (3), 25.38 (3), 24.81 (3), 22.94 (2), 22.36 (2), 17.27 (2), 14.50 (3), 12.62 (3); MS (EI) m/z no M^+, 292 (5), 223 (3), 205 (9), 163 (43), 149 (9), 135 (21), 129 (41), 111 (100), 95 (25), 81 (20); MS (ESI) m/z 310 (84, $[M]^+$), 328 (88, $[M+NH_4]^+$), 643 (24, $[2M+Na]^+$), HRMS (ESI) calcd for $naC_{20}H_{38}O_2Na$ $[M+Na]^+$ 333.2765, found 333.2764.

(8*S*,20*S*)-*Des*-A,B-22,22-dimethyl-cholestane-8β,25-diol (37): $[\alpha]_D$ +4.8 (*c* 1.0, $CHCl_3$); ^1H NMR (400 MHz, $CDCl_3$) δ 4.07 (1H, d, J = 2.1 Hz), 2.10 (1H, m), 1.21 (6H, s), 0.99 (3H, s), 0.91 (3H, s), 0.90 (3H, d, J = 8.2 Hz), 0.84 (3H, s); ^{13}C NMR (100 MHz, $CDCl_3$) δ 71.19 (0), 69.51 (1), 53.43 (1), 51.91 (1), 43.51 (0), 42.65 (1), 40.91 (2), 37.59 (2), 36.29 (2), 36.24 (0), 33.55 (2), 29.89 (2), 29.23 (3), 29.17 (3), 28.04 (3), 26.29 (3), 23.38 (2), 17.49 (2), 14.87 (3), 13.10 (3); MS (EI) m/z no M^+, 292 (5), 259 (2), 223 (3), 205 (7), 181 (8), 163 (28), 129 (25), 111 (100), 95 (23); MS (ESI) m/z 333 (95, $[M+Na]^+$), 643 (11, $[2M+Na]^+$), HRMS (ESI) calcd for $naC_{20}H_{38}O_2Na$ $[M+Na]^+$ 333.2770, found 333.2774.

(20*R*)-*Des*-A,B-22,22-dimethyl-25-[(triethylsilyl)oxy]-cholestan-8-one (38): $[\alpha]_D$ -8.8 (*c* 1.0, $CHCl_3$); ^1H NMR (400 MHz, $CDCl_3$) δ 2.44 (1H, dd, J = 11.5, 7.5 Hz), 1.20 (6H, s), 0.95 (9H, t, J = 7.9 Hz), 0.82 (3H, s), 0.79 (3H, d, J = 7.5 Hz), 0.78 (3H, s), 0.58 (3H, s), 0.57 (6H, q, J = 7.9 Hz); ^{13}C NMR (100 MHz, $CDCl_3$) δ 212.18 (0), 73.42 (0), 60.66 (1), 51.10 (0), 49.73 (1), 41.01 (2), 38.88 (2), 38.26 (1), 36.76 (2), 35.95 (0), 33.93 (2), 29.89 (3), 25.17 (3), 24.91 (3), 23.66 (2), 22.68 (2), 19.47 (2), 12.99 (3), 12.33 (3), 7.14 (3), 6.82 (2); MS (EI) m/z no M^+, 407 (33), 393 (68), 364 (54), 323 (11), 293 (25), 253 (42), 173 (82), 163 (70), 111 (78), 107 (100); MS (ESI)

m/z 423 (27, $[M+H]^+$), 445 (47, $[M+Na]^+$), 867 (26, $[2M+Na]^+$), 1290 (8, $[3M+Na+H]^{2+}$), HRMS (ESI) calcd for $C_{26}H_{51}O_2Si$ $[M+H]^+$ 423.3653, found 423.3649.

(20*S*)-*Des*-A,B-22,22-dimethyl-25-[(triethylsilyl)oxy]-cholestan-8-one (39): $[\alpha]_D$ -19.2 (*c* 1.0, $CHCl_3$); ^1H NMR (400 MHz, $CDCl_3$) δ 2.33 (1H, d, J = 11.5, 7.5 Hz), 2.24 (3H, m), 1.19 (6H, s), 0.95 (9H, t, J = 7.9 Hz), 0.95 (3H, d, J = 6.9 Hz), 0.89 (3H, s), 0.84 (3H, s), 0.71 (3H, s), 0.56 (6H, q, J = 7.9 Hz); ^{13}C NMR (100 MHz, $CDCl_3$) δ 212.46 (0), 73.40 (0), 61.73 (1), 53.18 (1), 51.09 (0), 43.36 (1), 41.08 (2), 39.48 (2), 38.77 (2), 36.15 (0), 35.76 (2), 30.76 (2), 29.87 (3), 27.70 (3), 26.24 (3), 23.94 (2), 19.96 (2), 14.72 (3), 12.87 (3), 7.14 (3), 6.81 (2); MS (EI) m/z no M^+, 407 (10), 393 (28), 364 (11), 294 (12), 273 (10), 173 (48), 163 (28), 111 (100); MS (ESI) m/z 445 (8, $[M+Na]^+$), HRMS (ESI) calcd for $C_{26}H_{50}O_2SiNa$ $[M+Na]^+$ 445.3478, found 445.3486.

(20*R*)-1α-[(*tert*-Butyldimethylsilyl)oxy]-22,22-dimethyl-25-[(triethylsilyl)oxy]-2-methylene-19-norvitamin D_3 *tert*-butyldimethylsilyl ether (40): UV (in hexane) λ_{max} 262.5, 252.5, 244.5 nm; ^1H NMR (400 MHz, $CDCl_3$) δ 6.22 and 5.84 (1H and 1H, each d, J = 11.1 Hz, 6- and 7-H), 4.97 and 4.92 (1H and 1H, each s, $=CH_2$), 4.42 (2H, m, 1β- and 3α-H), 2.85 (1H, dd, J = 12.8, 3.6 Hz, 9β-H), 2.52 (1H, dd, J = 13.2, 6.0 Hz, 10α-H), 2.46 (1H, dd, J = 12.6, 4.3 Hz, 4α-H), 2.34 (1H, dd, J = 13.2, 2.7 Hz, 10β-H), 2.18 (1H, dd, J = 12.6, 8.4 Hz, 4β-H), 1.96 (1H, m), 1.19 (6H, s, 26- and 27-H_3), 0.95 (9H, t, J = 7.9 Hz, 3 × $SiCH_2CH_3$), 0.897 and 0.866 (9H and 9H, each s, 2 × Si-*t*-Bu), 0.80 and 0.77 (each 3H, each s, 28- and 30-H_3), 0.79 (3H, d, J = 8.2 Hz, 21-H_3), 0.57 (6H, q, J = 7.9 Hz, 3 × $SiCH_2$), 0.46 (3H, s, 18-H_3), 0.080, 0.069, 0.049, and 0.029 (each 3H, each s, 4 × $SiCH_3$); ^{13}C NMR (100 MHz, $CDCl_3$) δ 152.98 (0, C-2), 141.35 (0, C-8), 132.64 (0, C-5), 122.44 (1, C-6), 115.77 (1, C-7), 106.24 (2, $=CH_2$), 73.51 (0, C-25), 72.50 and 71.64 (each 1, C-1, C-3), 55.06 (1), 49.61 (1), 47.59 (2), 46.71 (0, C-13), 38.92 (2), 38.55 (2), 38.29 (2), 38.09 (1), 35.96 (0, C-22) , 34.08 (2), 29.93 and 29.88 (each 3, C-26, C-27), 28.93 (2), 25.84 (3), 25.77 (3), 25.25 (3), 25.02 (3), 23.05 (2), 22.68 (2), 22.63 (2), 18.26 (0), 18.17 (0), 12.81 (3), 12.44 (3), 7.16 (3), 6.84 (2), -4.86 (3), -4.91 (3), -5.08 (3); MS (ESI) m/z 809 (40, $[M+Na]^+$), HRMS (ESI) calcd for $C_{47}H_{90}O_3Si_3Na$ $[M+Na]^+$ 809.6091, found 809.6101.

(20*R*)-1α,25-Dihydroxy-22,22-dimethyl-2-methylene-19-norvitamin D_3 (5): m.p. 154 °C (from 2-propanol/hexane); UV (in EtOH) λ_{max} 261.0, 252.0, 244.0 nm; ^1H NMR (500 MHz, $CDCl_3$) δ 6.35 and 5.88 (1H and 1H, each d, J = 11.2 Hz, 6- and 7-H), 5.11 and 5.08 (1H and 1H, each s, $=CH_2$), 4.48 (2H, m, 1β- and 3α-H), 2.86 (1H, dd, J = 13.0, 4.7 Hz, 10β-H), 2.84 (1H, m,9β-H), 2.56 (1H, dd, J = 13.3, 3.5 Hz, 4α-H), 2.33 (1H, dd, J = 13.3, 6.0 Hz, 4β-H), 2.28 (1H, dd, J = 13.0 Hz, 8.4 Hz, 10α-H), 1.96 (2H, m), 1.88 (1H, m), 1.21 (6H, s, 26- and 27-H_3), 0.83 and 0.78 (3H and 3H, each s, 28- and 30-H_3), 0.79 (3H, d, J = 7.4 Hz, 21-H_3), 0.48 (3H, 18-H_3); ^{13}C NMR (125 MHz, $CDCl_3$) δ 151.98 (0, C-2), 143.27 (0, C-8), 130.51 (0, C-5), 124.09 (1, C-6), 115.02 (1, C-7), 107.66 (2, $=CH_2$), 71.74 and 70.51 (each 1, C-1, C-3), 71.23 (0, C-25), 55.05 (1), 49.52 (1), 46.81 (0, C-13), 45.70 (2), 38.10 (2 × 2), 37.73 (1 and 2), 35.95 (0, C-22), 34.17 (2), 29.20 (3), 29.13 (3), 29.06 (2), 25.35 (3), 24.83 (3), 23.05 (2), 22.65 (2 × 2), 12.82 (3), 12.41 (3); MS (EI) m/z 444 (6, M^+), 426 (3, M^+- H_2O), 393 (2), 341 (2), 313 (6), 269 (5), 251 (6), 199 (6), 191 (15), 161 (10), 145 (19), 111 (43), 107 (100), 89 (80), 79 (78), 75 (43); MS (ESI) m/z

467 (100, $[M+Na]^+$), 911 (55, $[2M+Na]^+$), 1355 (15, $[3M+Na]^+$, HRMS (ESI) calcd for $C_{29}H_{48}O_3Na$ $[M+Na]^+$ 467.3496, found 467.3483.

(20*S*)-1α-[(*tert*-Butyldimethylsilyl)oxy]-22,22-dimethyl-25-[(triethylsilyl)oxy]-2-methylene-19-norvitamin D_3 *tert*-butyldimethylsilyl ether (41): UV (in hexane) λ_{max} 263.5, 253.5, 245.5 nm; ^1H NMR (400 MHz, $CDCl_3$) δ 6.22 and 5.85 (1H, d, J = 11.1 Hz, 6- and 7-H), 4.97 and 4.92 (1H and 1H, each s, $=CH_2$), 4.43 (2H, m, 1β- and 3α-H), 2.81 (1H, dm, J = 12.6 Hz, 9β-H), 2.52 (1H, dd, J = 13.3, 5.9 Hz, 10α-H), 2.47 (1H, dd, J = 12.6, 4.5 Hz, 4α-H), 2.34 (1H, dd, J = 13.3, 2.8 Hz, 10β-H), 2.18 (1H, dd, J = 12.6, 8.3 Hz, 4β-H), 2.09 (1H, m), 1.97 (2H, m), 1.19 (6H, bs, 26- and 27-H_3), 0.95 (9H, t, J = 7.9 Hz, 3 × $SiCH_2C\mathit{H}_3$), 0.93 (3H, d, J = 6.8 Hz, 21-H_3), 0.897 and 0.868 (9H and 9H, s, 2 × Si-*t*-Bu), 0.889 and 0.833 (3H and 3H, each s, 28- and 30-H_3), 0.62 (3H, s, 18-H_3), 0.57 (6H, q, J = 7.9 Hz, 3 × $SiCH_2$), 0.080, 0.068, 0.049, and 0.027 (each 3H, each s, 4 × $SiCH_3$); ^{13}C NMR (100 MHz, $CDCl_3$) δ 152.98 (0, C-2), 141.40 (0, C-8), 132.77 (0, C-5), 122.46 (1, C-6), 116.43 (1, C-7), 106.25 (2, $=CH_2$), 73.52 (0, C-25), 72.53 and 71.64 (each 1, C-1, C-3), 56.02 (1), 52.84 (1), 47.60 (2), 46.96 (0, C-13), 44.18 (1), 41.14 (2), 38.84 (2), 38.57 (2), 36.23 (0, C-22) , 35.85 (2), 31.28 (2), 29.91 and 29.86 (each 3, C-26, C-27), 28.84 (2), 27.75 (3), 26.22 (3), 25.84 (3), 25.78 (3), 23.53 (2), 23.17 (2), 18.25 (0), 18.17 (0), 14.70 (3), 12.53 (3), 7.15 (3), 6.84 (2), -4.86 (3), -5.10 (3); MS (ESI) m/z 809 (2, $[M+Na]^+$), HRMS (ESI) calcd for $C_{47}H_{90}O_3Si_3Na$ $[M+Na]^+$ 809.6096, found 809.6086.

(20*S*)-1α,25-Dihydroxy-22,22-dimethyl-2-methylene-19-norvitamin D_3 (6): m.p. 99 °C (from diethyl ether); UV (in EtOH) λ_{max} 261.5, 252.0, 244.5 nm; ^1H NMR (500 MHz, $CDCl_3$) δ 6.35 and 5.89 (1H and 1H, each d, J = 11.2 Hz, 6- and 7-H), 5.10 and 5.08 (1H and 1H, each s, $=CH_2$), 4.48 (2H, m, 1β- and 3α-H), 2.84 (1H, dd, J = 13.0, 4.3 Hz, 10β-H), 2.80 (1H, dd, J = 13.3, 4.1 Hz, 9β-H), 2.56 (1H, dd, J = 13.4, 3.3 Hz, 4α-H), 2.32 (1H, dd, J = 13.4, 6.1 Hz, 4β-H), 2.28 (1H, dd, J = 13.0 Hz, 8.4 Hz, 10α-H), 2.08 (1H, m), 1.21 (6H, s, 26- and 27-H_3), 0.92 (3H, d, J = 7.0 Hz, 21-H_3), 0.91 and 0.84 (each 3H, each s, 28- and 30-H_3), 0.62 (3H, 18-H_3); ^{13}C NMR (125 MHz, $CDCl_3$) δ 151.97 (0, C-2), 143.44 (0, C-8), 130.52 (0, C-5), 124.23 (1, C-6), 115.65 (1, C-7), 107.71 (2, $=CH_2$), 71.79 and 70.63 (each 1, C-1, C-3), 71.23 (0, C-25), 56.01 (1), 52.77 (1), 47.07 (0, C-13), 45.77 (2), 43.90 (1), 40.98 (2), 38.15 (2), 37.64 (2), 36.28 (0, C-22), 36.00 (2), 31.20 (2), 29.23 and 29.20 (each 3, C-26, C-27), 29.02 (2), 27.77 (3), 25.97 (3), 23.55 (2), 23.22 (2), 14.71 (3), 12.59 (3); MS (EI) m/z 444 (30, M^+), 426 (7, M^+- H_2O), 411 (2), 341 (4), 315 (20), 297 (10), 269 (12), 247 (20), 223 (4), 192 (4), 175 (6), 161 (14), 135 (40), 111 (56), 91 (100), 69 (24); MS (ESI) m/z 467 (49, $[M+Na]^+$), 911 (11, $[2M+Na]^+$), HRMS (ESI) calcd for $C_{29}H_{48}O_3Na$ $[M+Na]^+$ 467.3501, found 467.3507.

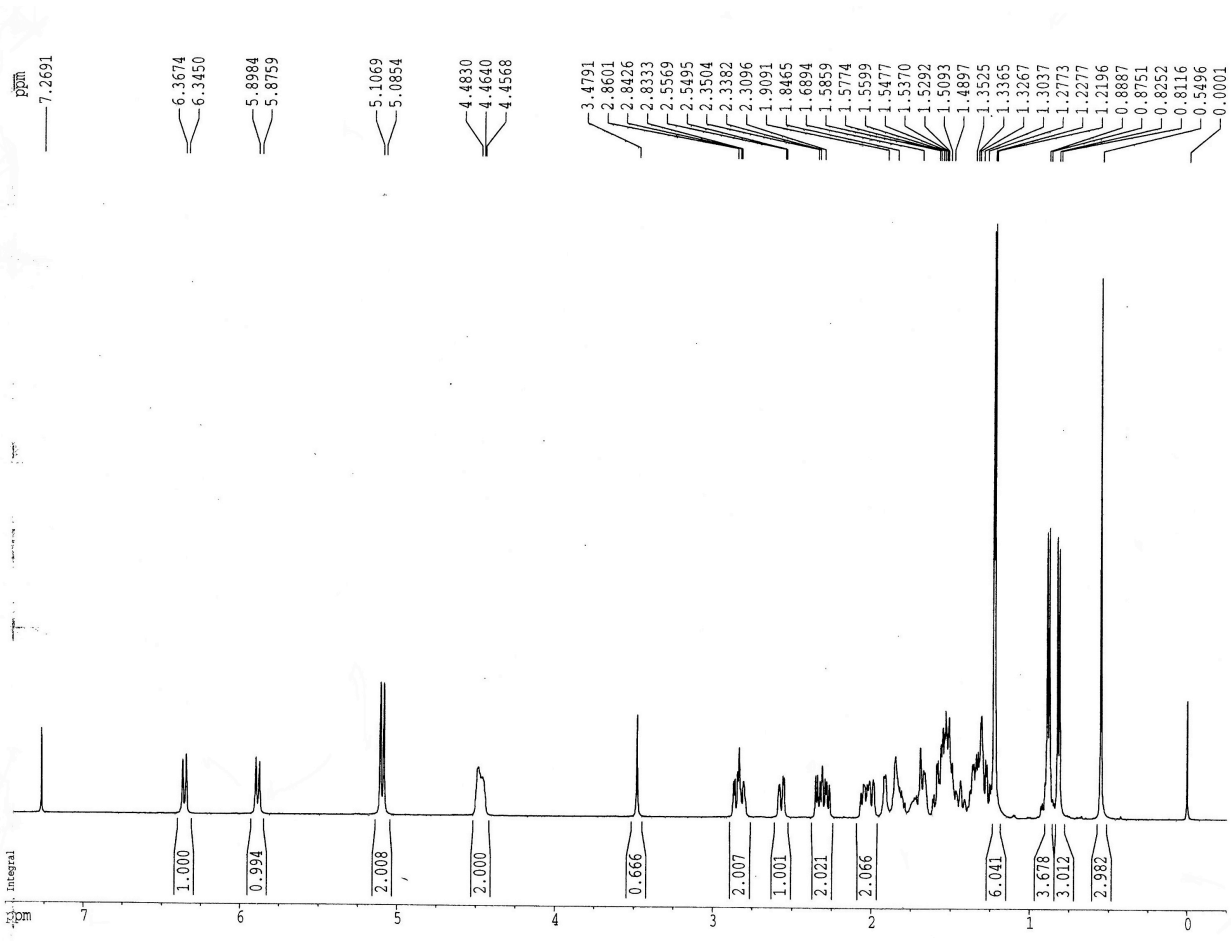


Figure 7. ^{1}H NMR spectrum of the vitamin D analog **3a**

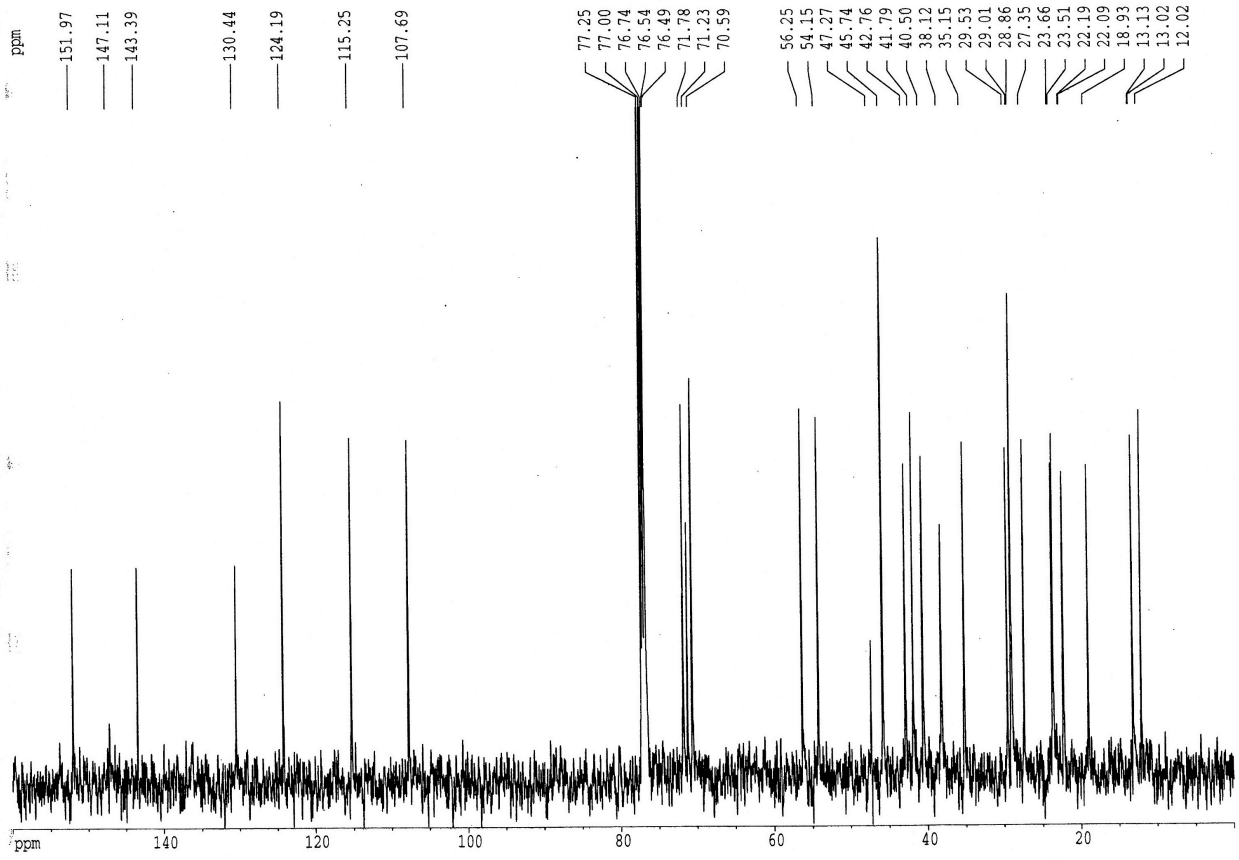


Figure 8. ^{13}C NMR spectrum of the vitamin D analog **3a**

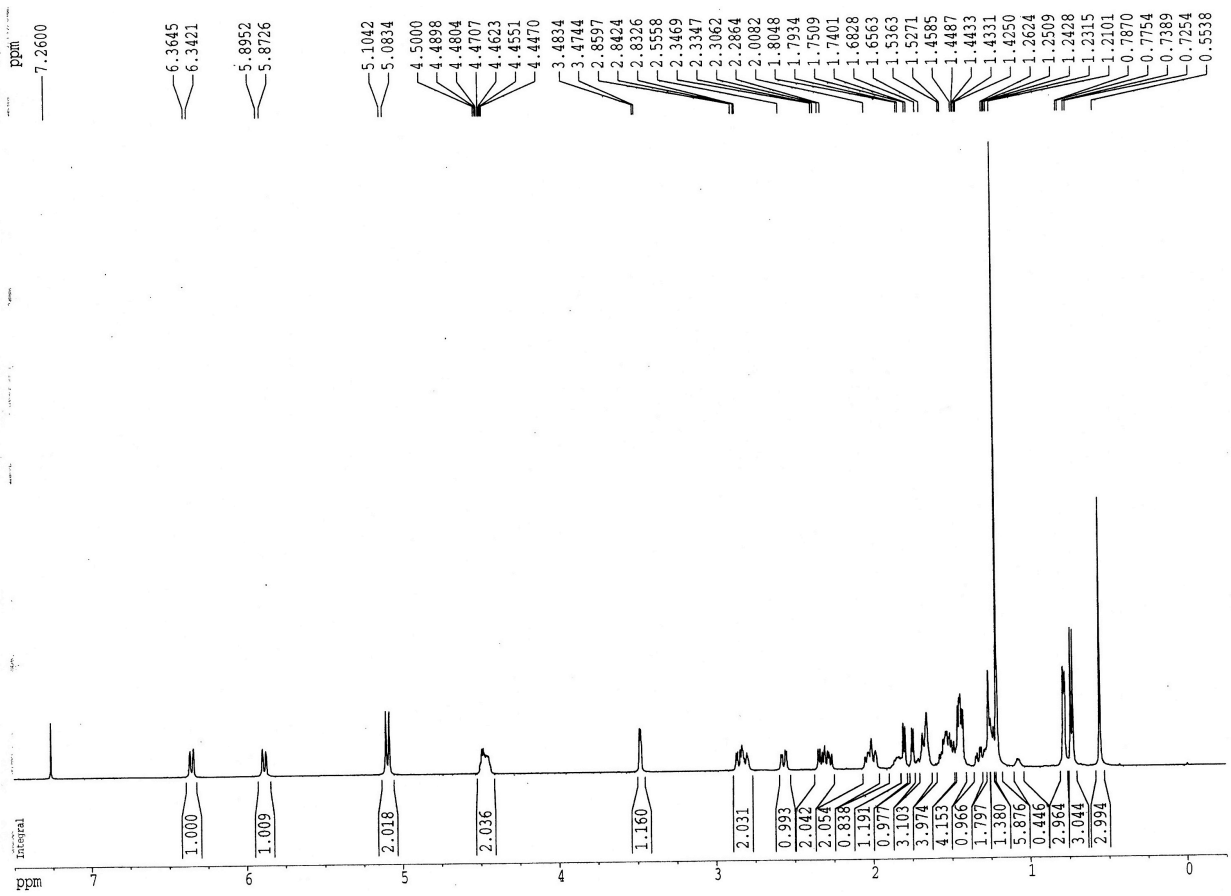


Figure 9. ^{1}H NMR spectrum of the vitamin D analog **3b**

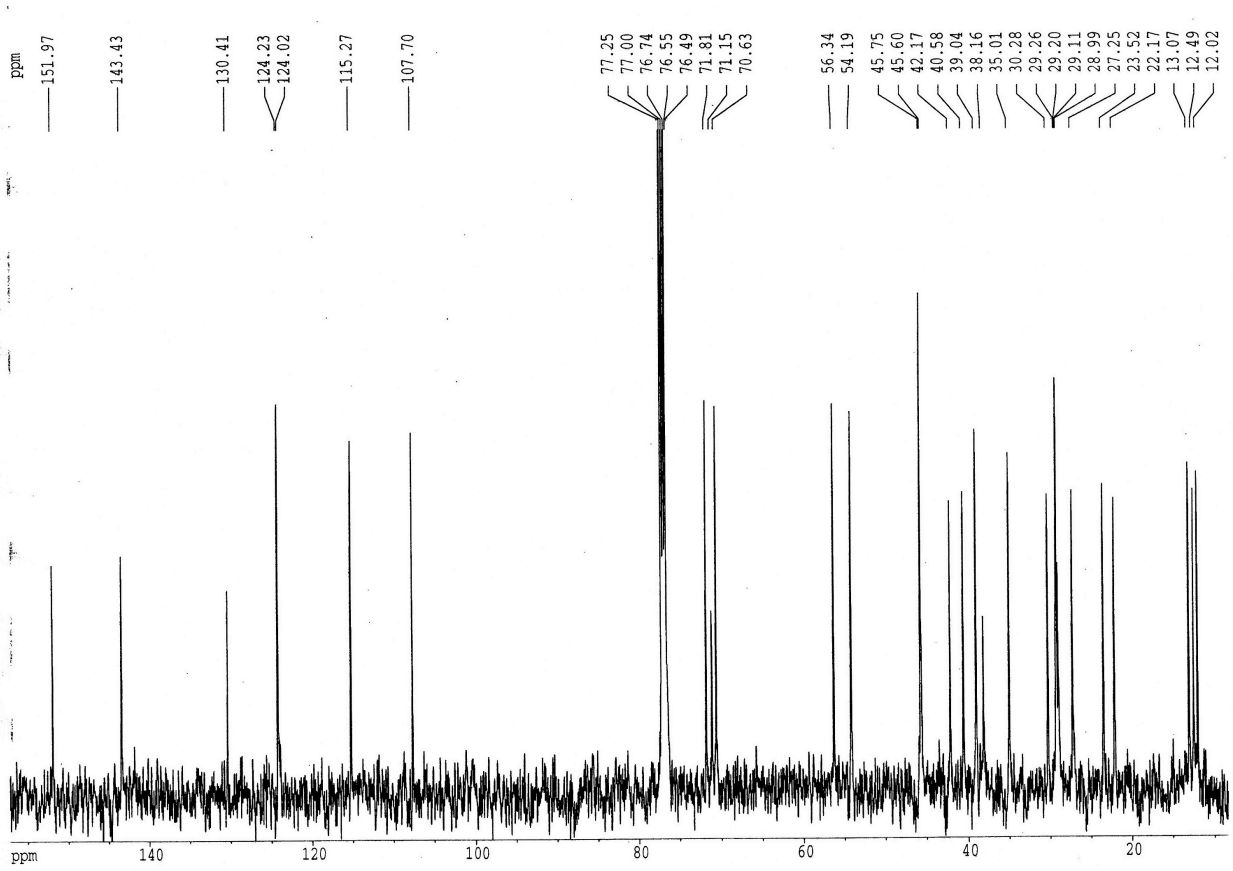


Figure 10. ^{13}C NMR spectrum of the vitamin D analog **3b**

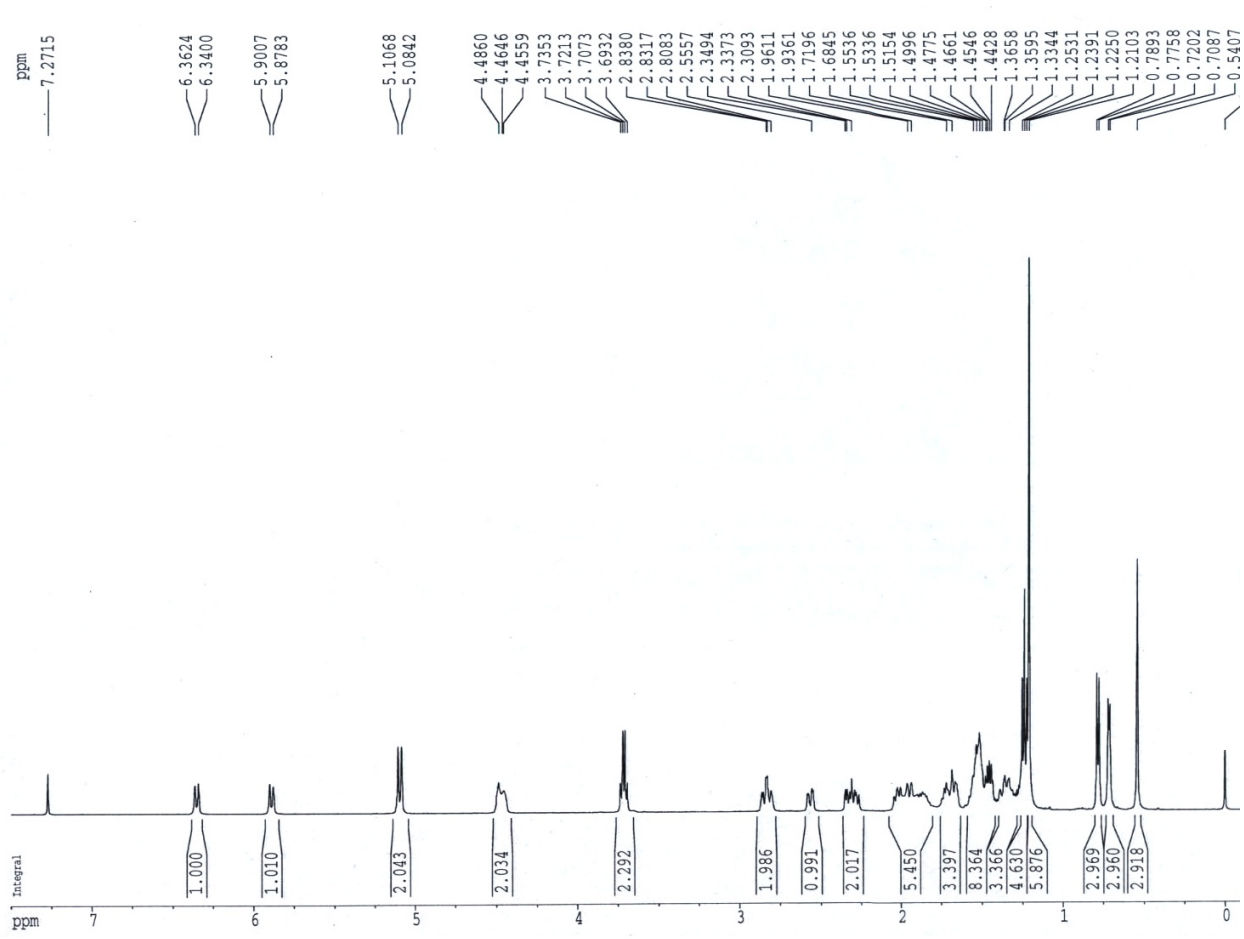


Figure 11. ^{1}H NMR spectrum of the vitamin D analog **4a**

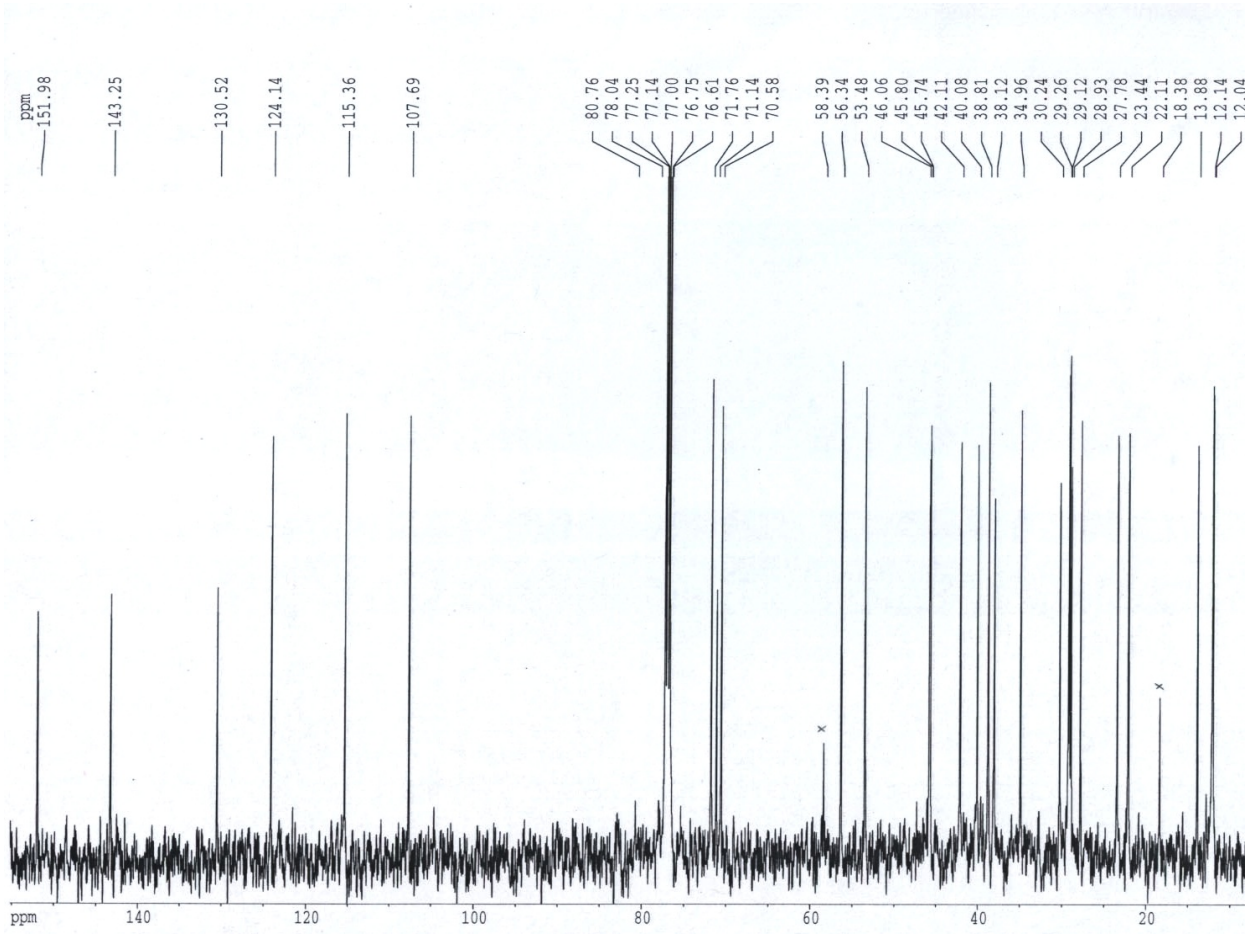


Figure 12. ^{13}C NMR spectrum of the vitamin D analog **4a**

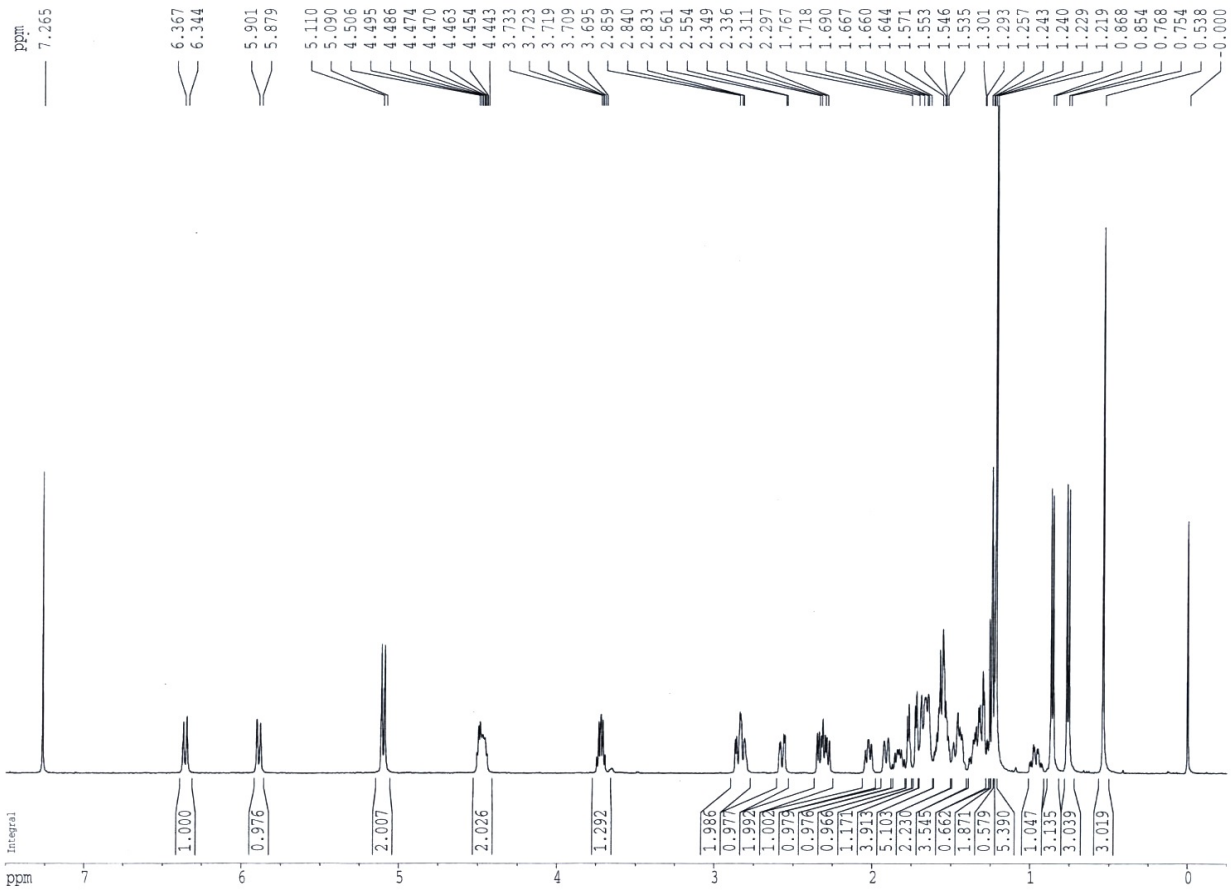


Figure 13. ^{1}H NMR spectrum of the vitamin D analog **4b**

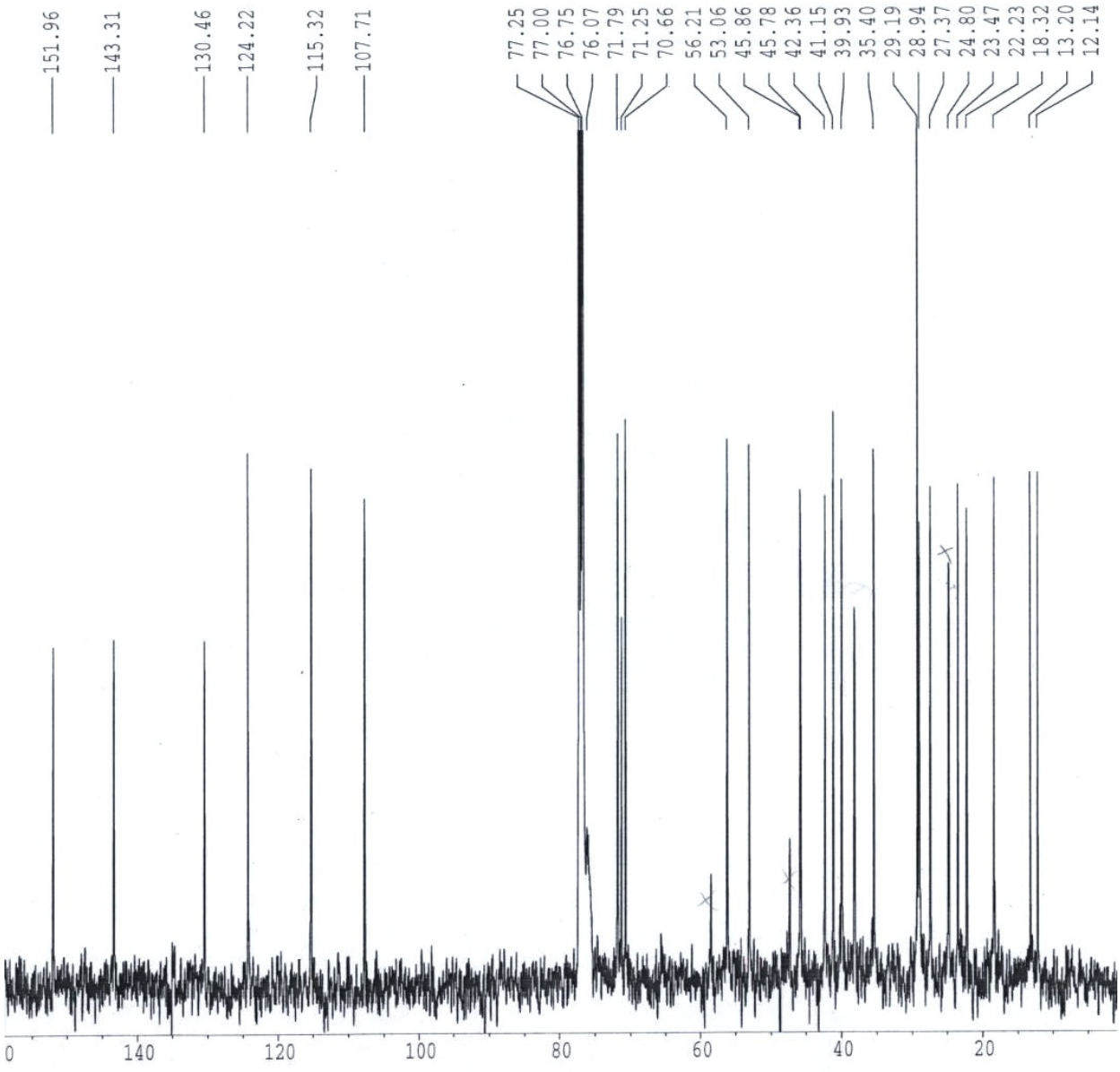


Figure 14. ^{13}C NMR spectrum of the vitamin D analog **4b**

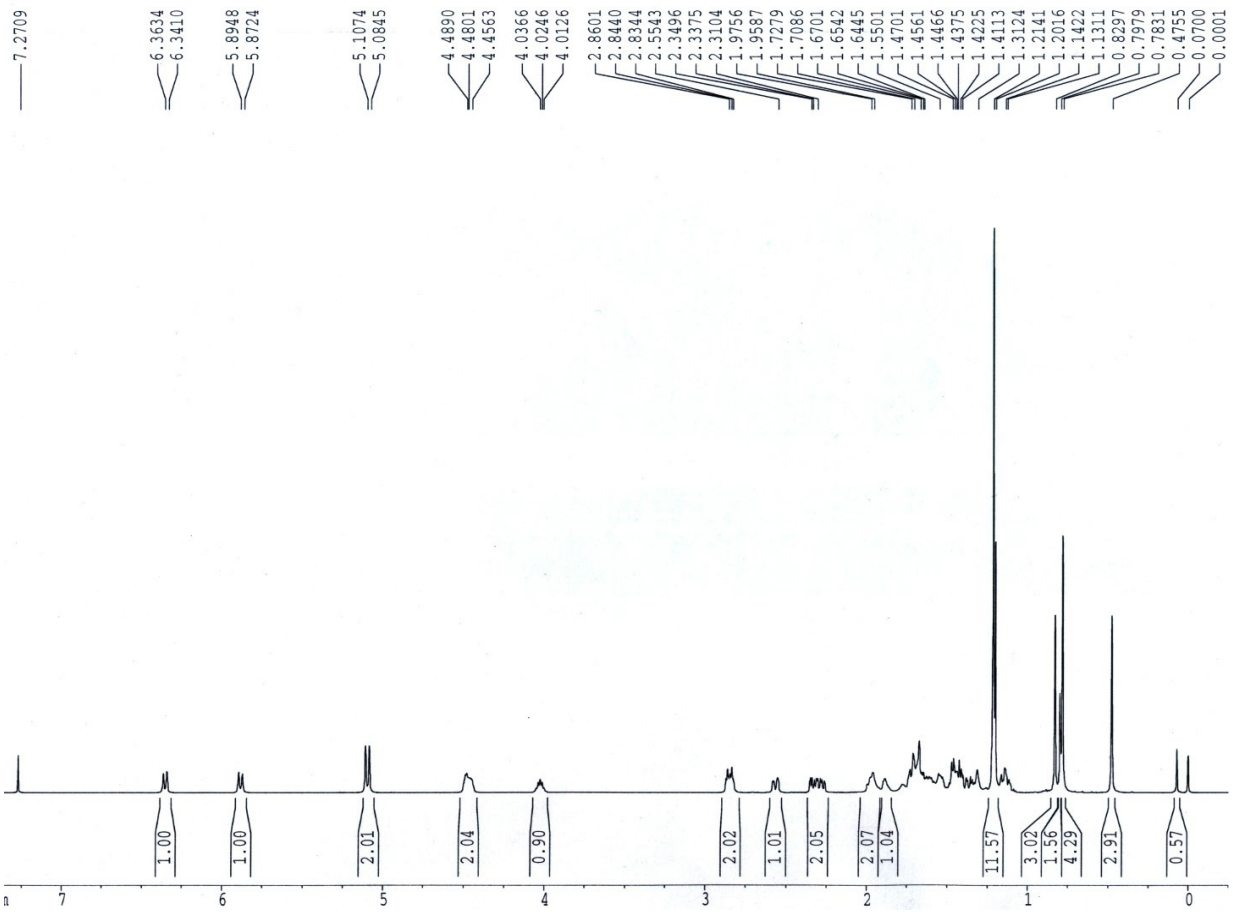


Figure 15. ^{1}H NMR spectrum of the vitamin D analog **5**

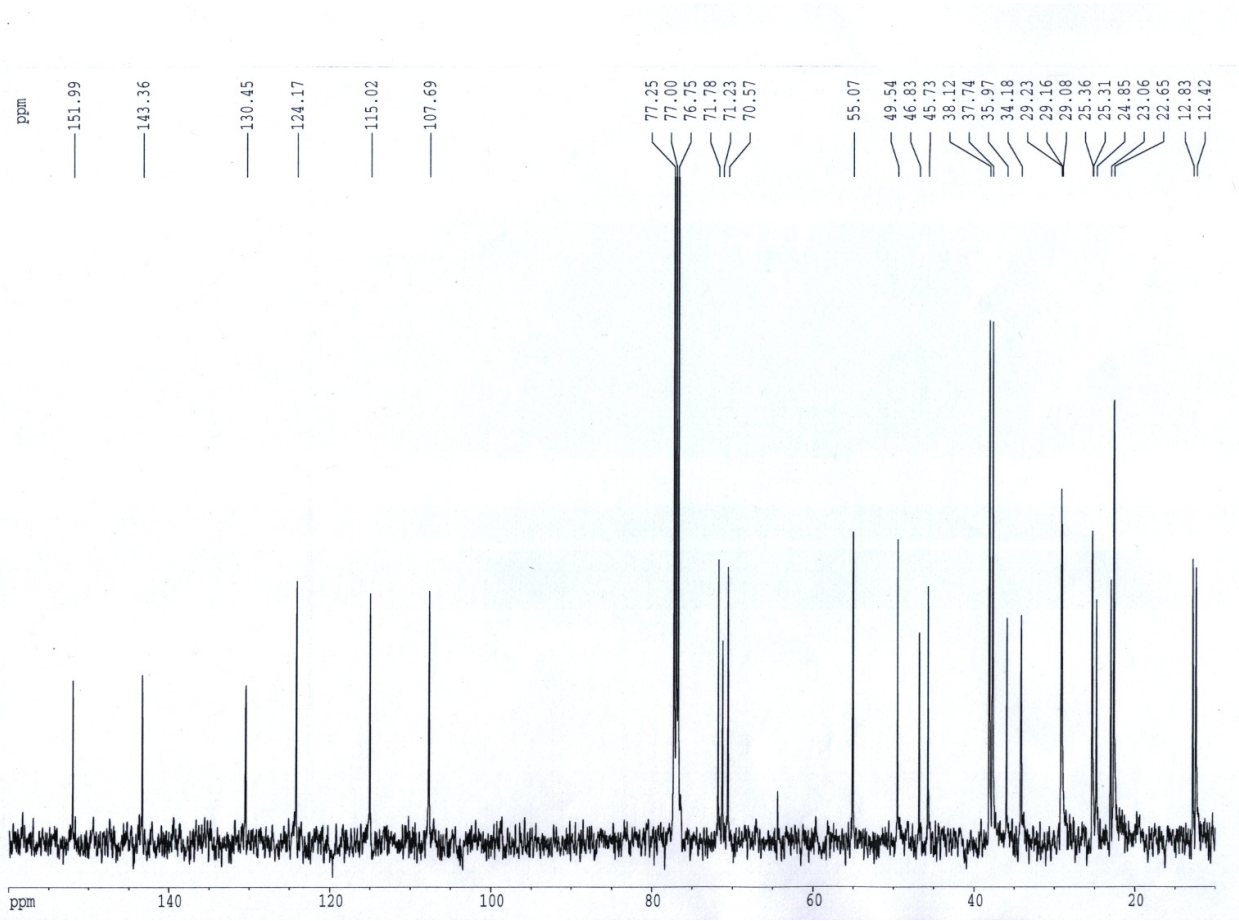


Figure 16. ^{13}C NMR spectrum of the vitamin D analog **5**

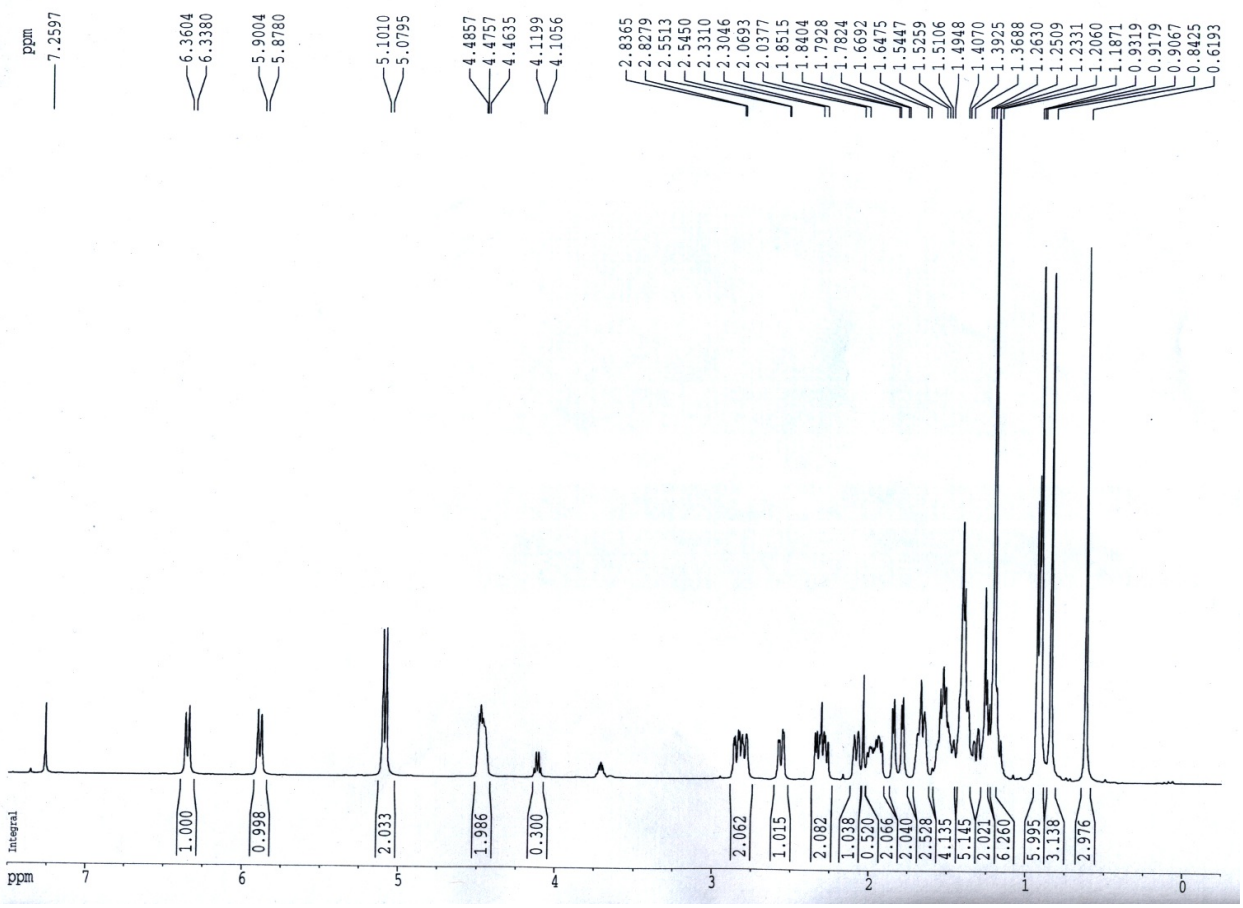


Figure 17. ^{1}H NMR spectrum of the vitamin D analog **6**

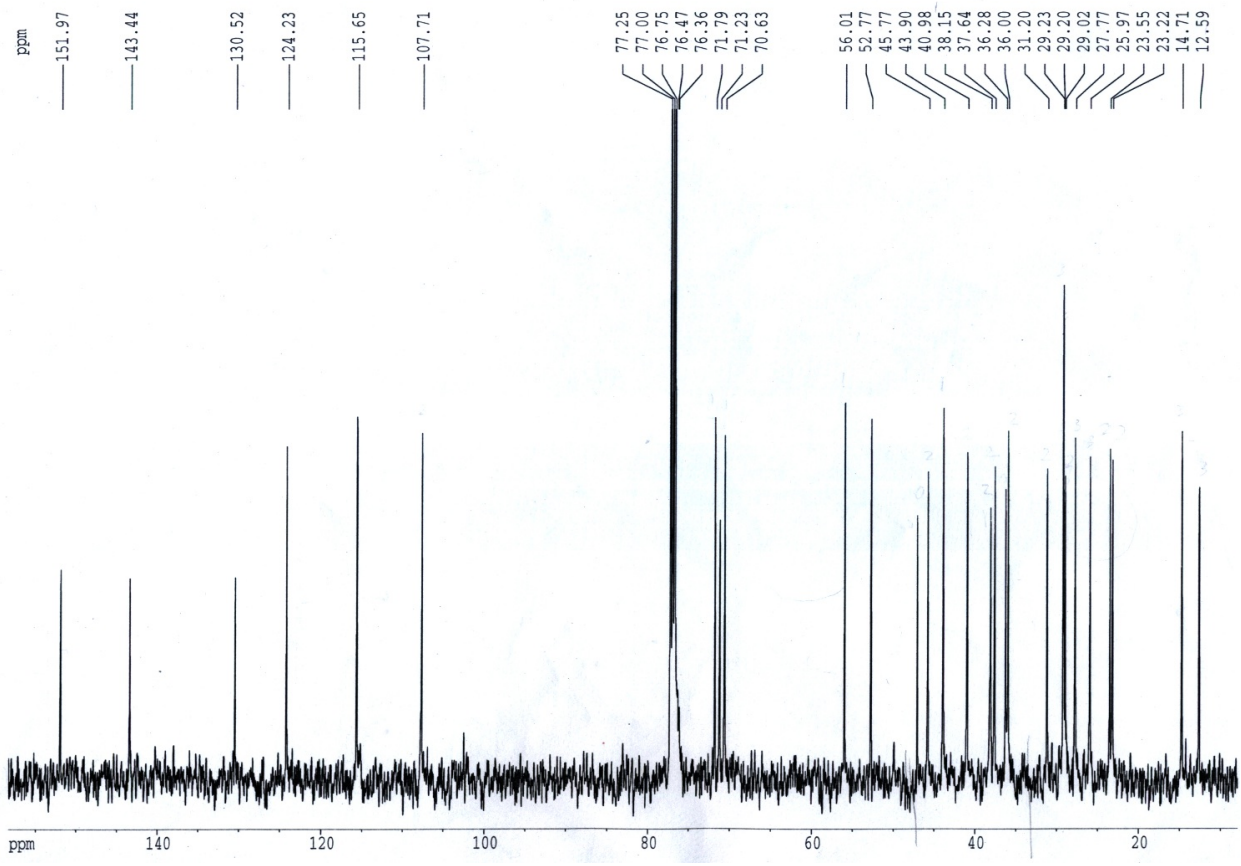
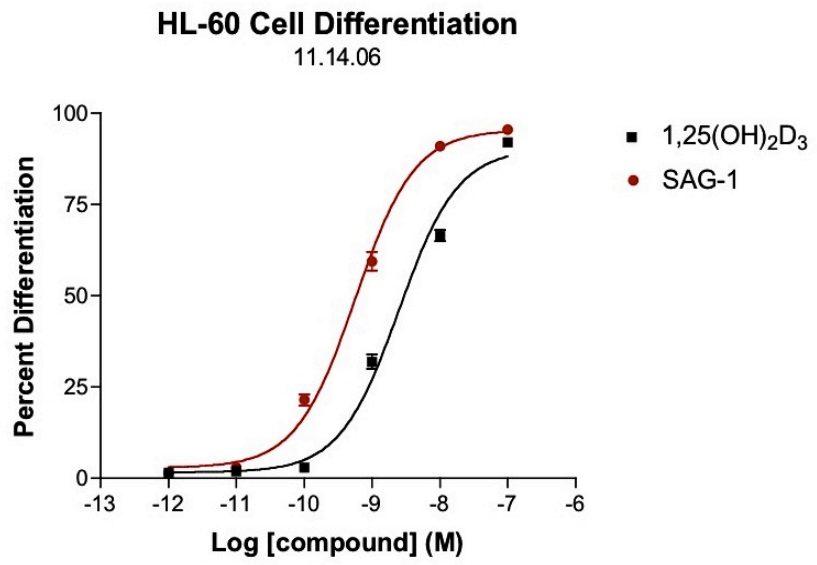
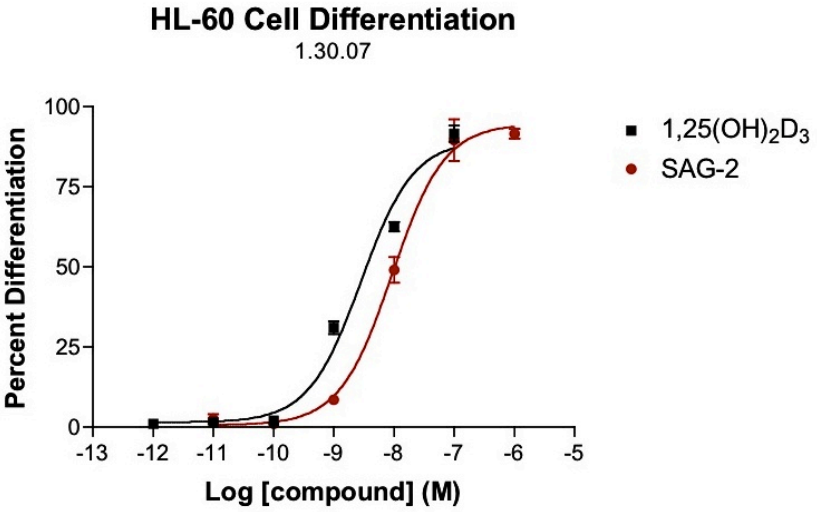


Figure 18. ^{13}C NMR spectrum of the vitamin D analog **6**



EC_{50}: $1,25(OH)_2D_3 = 2 \times 10^{-9}$ M

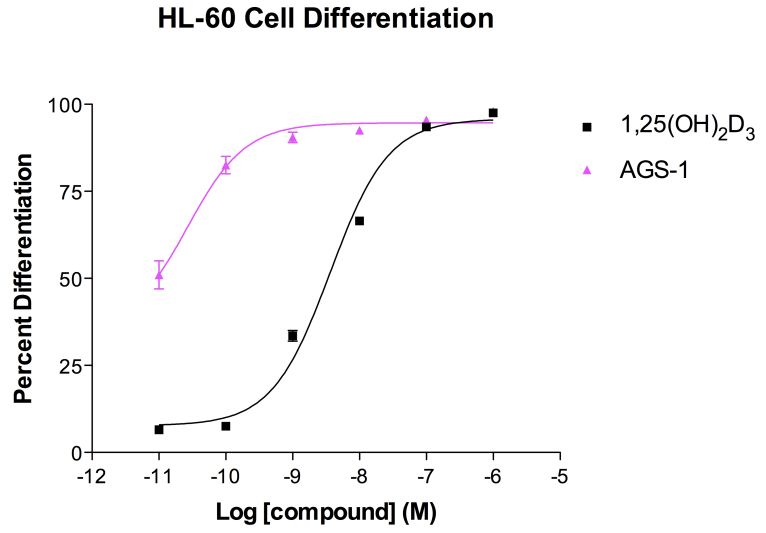
SAG-1= 6×10^{-10} M



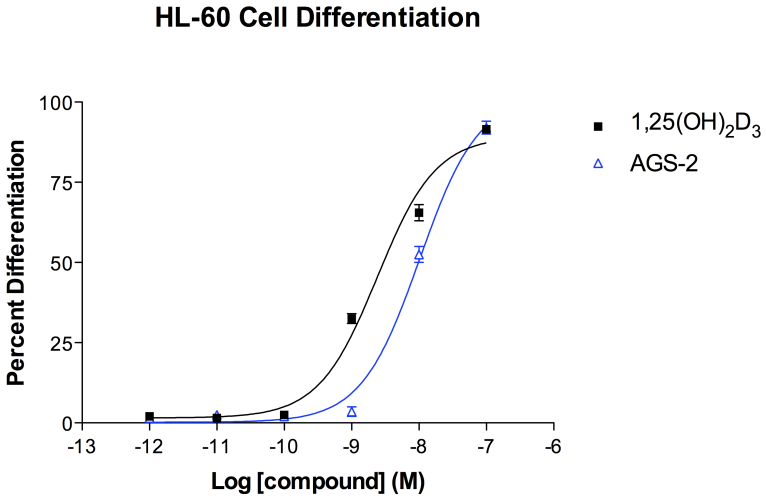
EC_{50}: $1,25(OH)_2D_3 = 3 \times 10^{-9}$ M

SAG-2= 6×10^{-9} M

Figure 19. Induction of differentiation of HL-60 promyelocytes to monocytes by 1α,25-$(OH)_2$ D_3 (**1**) and the synthesized vitamin D analogues **3a** (SAG-2) and **3b** (SAG-1)



EC_{50}: $1,25(OH)_2D_3 = 4 \times 10^{-9}$ M
AGS-1 = ~3×10^{-11} M



EC_{50}: $1,25(OH)_2D_3 = 3 \times 10^{-9}$ M
AGS-2 = ~1×10^{-8} M

Figure 20. Induction of differentiation of HL-60 promyelocytes to monocytes by 1α,25-$(OH)_2$ D_3 (**1**) and the synthesized vitamin D analog **4a** (AGS-1) and **4b** (AGS-2)

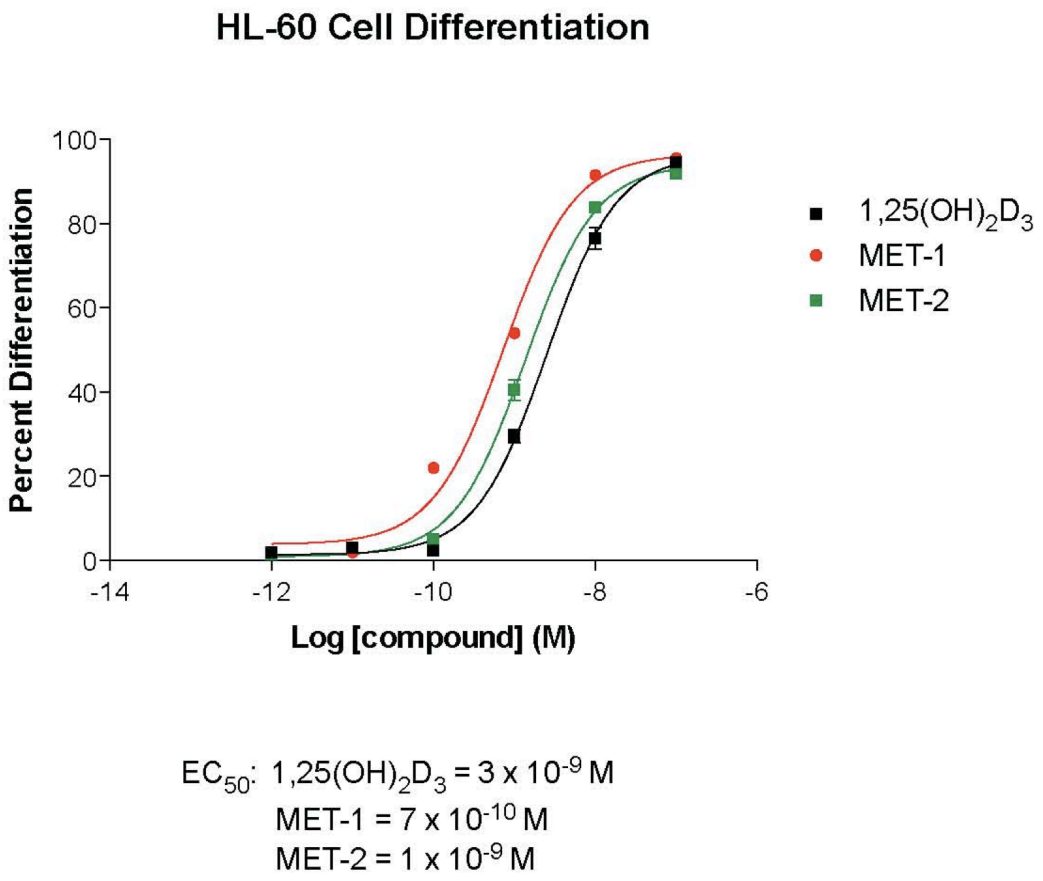


Figure 21. Induction of differentiation of HL-60 promyelocytes to monocytes by 1α,25-$(OH)_2$ D_3 (**1**) and the synthesized vitamin D analogues **5** (MET-2) and **6** (MET-1)