Supporting Information-I

A general approach to high-yielding asymmetric synthesis of chiral 3-alkyl-4-nitromethylchromans *via* cascade Barbas-Michael and acetalization reactions

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General Methods: The ^{1}H NMR and ^{13}C NMR spectra were recorded at 400 MHz and 100 MHz, respectively. The chemical shifts are reported in ppm downfield to TMS ($\delta = 0$) for ^{1}H NMR and relative to the central $CDCl_3$ resonance ($\delta = 77.0$) for ^{13}C NMR. *In the ^{13}C NMR spectra, the nature of the carbons (C, CH, CH_2 or CH_3) was determined by recording the DEPT-135 experiment, and is given in parentheses.* The coupling constants *J* are given in Hz. Column chromatography was performed using Acme's silica gel (particle size 0.063-0.200 mm). High-resolution mass spectra were recorded on micromass ESI-TOF MS. GCMS mass spectrometry was performed on Shimadzu GCMS-QP2010 mass spectrometer. IR spectra were recorded on JASCO FT/IR-5300. Elemental analyses were recorded on a Thermo Finnigan Flash EA 1112 analyzer. Mass spectra were recorded on either VG7070H mass spectrometer using EI technique or Shimadzu-LCMS-2010 A mass spectrometer. The X-ray diffraction measurements were carried out at 298 K on an automated Enraf-Nonious MACH 3 diffractometer using graphite monochromated, Mo-Kα ($\lambda = 0.71073$ Å) radiation with CAD4 software or the X-ray intensity data were measured at 298 K on a Bruker SMART APEX CCD area detector system equipped with a graphite monochromator and a Mo-Kα fine-focus sealed tube ($\lambda = 0.71073$ Å). For thin-layer chromatography (TLC), silica gel plates Merck 60 F254 were used and compounds were visualized by

irradiation with UV light and/or by treatment with a solution of *p*-anisaldehyde (23 mL), conc. H_2SO_4 (35 mL), acetic acid (10 mL), and ethanol (900 mL) followed by heating.

The enantiomeric excess (*ee*) of the *BMA* products was determined by chiral stationary phase HPLC using a Daicel Chiralcel OD-H, Chiralcel OJ-H, Chiralpak AD-H, Chiralpak AS-H or Lux 5u Amylose-2 columns and hexane/2-propanol as the eluent. Retention times and solvent ratios are indicated in the respective entries.

Materials: All solvents and commercially available chemicals were used as received.

General Experimental Procedures for the Cascade BMA Reactions:

Procedure A: ***General procedure for amine-catalyzed asymmetric cascade BMA reaction of aldehydes 1 with 2-(2-nitrovinyl)phenols 2:*** In an ordinary glass vial equipped with a magnetic stirring bar, to a mixture of D-DPPOTMS **3e** (0.1 mmol) and $PhCO_2H$ **4a** (0.1 mmol) in DCM (2.0 mL), was added propionaldehyde **1a** (5.0 mmol, 10 equiv.) or aldehydes **1b-f** (0.75 mmol, 1.5 equiv.) and of 2-(2-nitrovinyl)phenols **2a-j** (0.5 mmol). After stirring the reaction mixture at 25 °C as shown in Tables 1-2, the crude reaction mixture was worked up with aqueous NH_4Cl solution and the aqueous layer was extracted with ethyl acetate (3 x 10 mL). The combined organic layers were dried (Na_2SO_4), filtered and concentrated. Pure chiral products **5/6** were obtained by column chromatography (silica gel, mixture of hexane/ethyl acetate).

Procedure B: ***General procedure for amino acid-catalyzed cascade BMA reaction of aldehydes 1 with 2-(2-nitrovinyl)phenols 2:*** In an ordinary glass vial equipped with a magnetic stirring bar, to *DL*-proline **3a** (12 mg, 0.1 mmol) in DMSO (2.0 mL), was added propionaldehyde **1a** (5.0 mmol, 10 equiv.) or aldehydes **1b-f** (0.75 mmol, 1.5 equiv.) and of 2-(2-nitrovinyl)phenols **2a-j** (0.5 mmol). After stirring the reaction mixture at 25 °C for 2-9 h, the crude reaction mixture was worked up with aqueous NH_4Cl solution and the aqueous layer was extracted with ethyl acetate (3 x 10 mL). The combined organic layers were dried (Na_2SO_4), filtered and concentrated. Pure achiral products (±)-**5/6** were obtained by column chromatography (silica gel, mixture of hexane/ethyl acetate).

Procedure C: ***General procedure for the oxidation of cascade BMA products with PCC:*** In an oven dried round bottom flask, to the lactol **5/6** (0.3 mmol), added dry DCM (3.0 mL), NaOAc (0.9 mmol, 3 equiv.) and PCC (0.9 mmol, 3 equiv.). After stirring the reaction mixture at 0 °C for 0.5 h, it was brought to 25 °C and stirred for 1-2 h. The crude reaction mixture was passed through a pad of celite and

concentrated to dryness. Pure chiral products **7** were obtained by column chromatography (silica gel, mixture of hexane/ethyl acetate).

Procedure D: ***General procedure for the oxidation of cascade BMA products with IBX:*** In an oven dried round bottom flask, to the lactol **5/6** (0.3 mmol), added dry $CHCl_3$ (3.0 mL), and IBX (0.45 mmol, 1.5 equiv.). After stirring the reaction mixture at 65 °C for 15-24 h, it was brought to 25 °C and the crude reaction mixture was passed through a pad of celite and concentrated to dryness. Pure chiral products **7** were obtained by column chromatography (silica gel, mixture of hexane/ethyl acetate).

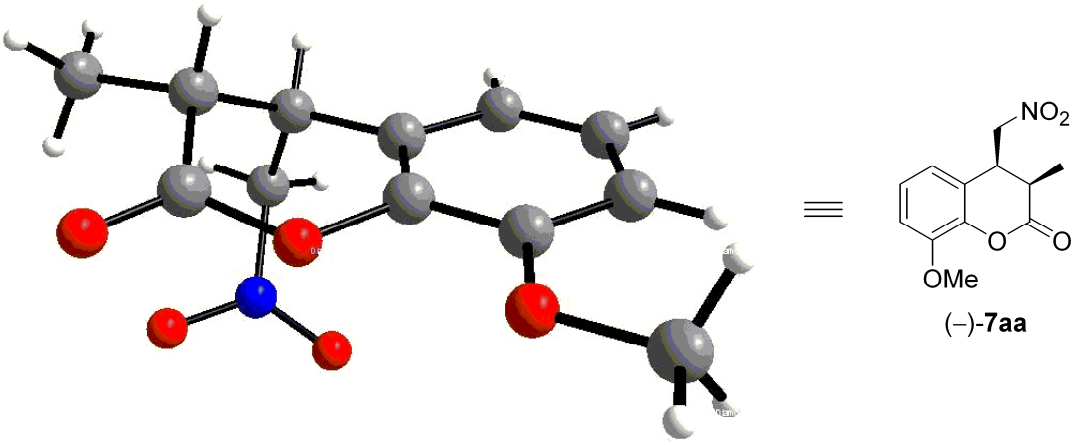
Procedure E: ***General procedure for the reduction of cascade BMA products:*** In an oven dried round bottom flask, to the lactol **5/6** (0.3 mmol), added dry MeOH (3.0 mL), and $NaBH_4$ (0.45 mmol, 1.5 equiv.). After stirring the reaction mixture at 0 °C for 0.5 h, it was brought to 25 °C and the crude reaction mixture was worked up with aqueous NH_4Cl solution and the aqueous layer was extracted with dichloromethane (3 x 10 mL). The combined organic layers were dried (Na_2SO_4), filtered and concentrated. Pure chiral product **9** was obtained by column chromatography (silica gel, mixture of hexane/ethyl acetate).

Procedure F: ***General procedure for the Brønsted acid-catalyzed acetalization of cascade BMA products:*** In an ordinary glass vial equipped with a magnetic stirring bar, to a cascade BMA products **5/6** (0.3 mmol) was dissolved in dry MeOH (**a**) (3.0 mL) and cooled to 0 °C, and added *p*-TSA (19 mg, 20 mol%). The mixture was stirred at the same temperature for 30 min and then brought to room temperature and stirred for 3-5 h. The crude reaction mixture was worked up with aqueous $NaHCO_3$ solution and the aqueous layer was extracted with dichloromethane (3 x 10 mL). The combined organic layers were dried (Na_2SO_4), filtered and concentrated. Pure chiral products **5** and **6** were separated by column chromatography (silica gel, mixture of hexane/ethyl acetate).

Procedure G: ***Brønsted acid-catalyzed hydrolysis of cascade BMA products:*** In an oven dried round bottom flask, to the lactol **5/6** (0.3 mmol), added dry toluene (3.0 mL), and *p*-TSA.H_2O (3.5 mg, 10 mol%). After heating reaction mixture to 110 °C for 1 h, it was brought to 25 °C and the crude reaction mixture was worked up with aqueous $NaHCO_3$ solution and the aqueous layer was extracted with dichloromethane (3 x 10 mL). The combined organic layers were dried (Na_2SO_4), filtered and concentrated. Pure chiral product **11** was obtained by column chromatography (silica gel, mixture of hexane/ethyl acetate).

Procedure H: ***Hydrogenation followed by protection of nitro products:*** In an oven dried round bottom flask, was taken activated (10%) Pd/C (7 mg, 10 mol-%), with compound (–)-**11aa** (0.3 mmol) dissolved in dry MeOH (3.0 mL) and stirred under H_2 atmosphere at 25 °C for 4 or 14 h. The reaction mixture was passed through a pad of celite and concentrated to dryness. The crude mixture was taken in a dry oven dried round bottom flask in dry DCM (3.0 mL) and added successively dry triethylamine (60 µL, 0.4 mmol) and di-*tert*-butyl carbonate (86 mg, 0.4 mmol) at 0 °C. The resulting mixture was stirred at 25 °C for 2 h and then worked up with aqueous NH_4Cl and the aqueous layer was extracted with ethyl acetate (3 x 10 mL). The combined organic layers were dried (Na_2SO_4), filtered and concentrated. Pure product (–)-**12aa** or (+)-**13aa** was obtained by column chromatography (silica gel, mixture of hexane/ethyl acetate).

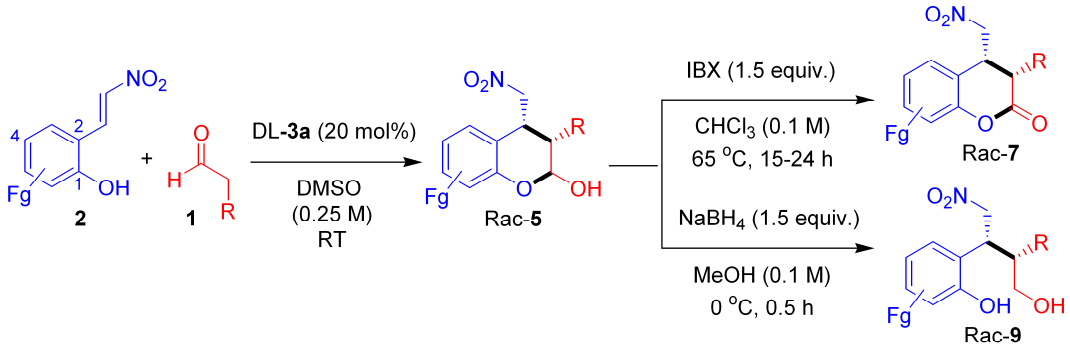
Procedure I: ***Synthesis of chiral chromane acetates via cascade W/OM reactions on BMA products:*** In an oven dried round bottomed flask, to the lactol **5aa** (253 mg, 1.0 mmol), added dry toluene (0.1 M) and methyl-(triphenylphosphorylidine)acetate (501mg, 1.5 mmol). This reaction mixture was refluxed at 110 °C for 4 h. After the reaction is completed, it is cooled to room temperature and pure products **14aa** was obtained by column chromatography using EtOAc/hexane and isolated as liquid.



(–)-**7aa**

Figure S1. X-Ray crystal structure of chiral 8-methoxy-3-methyl-4-nitromethyl-chroman-2-one (**7aa**).

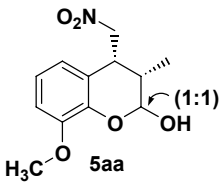
Table S1: Synthesis of achiral *BMA* products **5**, **7** and **9**[a]



Entry	Fg: **2**	R: **1**	Time (h)	Products **5/7/9**	Products yield (%)[b] **5**	**7/9**	*de* (%)[c] **7/9**
1	6-OMe (**2a**)	CH_3 (**1a**)	2	**5aa/7aa**	86	70	78
2	H (**2b**)	CH_3 (**1a**)	2	**5ab/9ab**	90	>95	>99
3	4-F (**2c**)	CH_3 (**1a**)	4	**5ac/9ac**	86	91	89
4	4-Cl (**2d**)	CH_3 (**1a**)	4	**5ad/7ad**	85	65	60
5	4-Cl (**2d**)	CH_3 (**1a**)	4	**5ad/9ad**	85	92	91
6	4-Br (**2e**)	CH_3 (**1a**)	4	**5ae/9ae**	82	>95	74
7	4,6-Cl_2 (**2f**)	CH_3 (**1a**)	4	**5af/7af**	80	65	90
8	4-OMe (**2g**)	CH_3 (**1a**)	4	**5ag/7ag**	96	70	95
9	5-OMe (**2h**)	CH_3 (**1a**)	4	**5ah/7ah**	85	61	97
10	4-Me (**2i**)	CH_3 (**1a**)	4	**5ai/7ai**	80	70	97
11	6-OH (**2j**)	CH_3 (**1a**)	4	**5aj/9aj**	80	>95	>99
12	6-OMe (**2a**)	CH_2CH_3 (**1b**)	6	**5ba/7ba**	82	72	88
13	6-OMe (**2a**)	CH_2Ph (**1c**)	6	**5ca/7ca**	80	70	81
14[d]	6-OMe (**2a**)	OCH_2Ph (**1d**)	6	**5da/7da**	96	73	28
15	6-OMe (**2a**)	$CH_2CH_2CH_3$ (**1e**)	8	**5ea/7ea**	95	81	84
16	6-OMe (**2a**)	$CH_2CH_2CH_2CH_3$ (**1f**)	9	**5fa/7fa**	95	75	45

[a] Reactions were carried out in DMSO (0.25 M) with 10 equiv. of **1a** or 1.5 equiv. of **1b-f** relative to the **2a-j** (0.5 mmol) in the presence of 20-mol% of catalyst DL-**3a**. [b] Yield refers to the column purified product. [c] Ratio or *de* is based on HPLC analysis. [d] DL-DPPOTMS **3c** (20 mol%) used as catalyst in DCM (0.25 M).

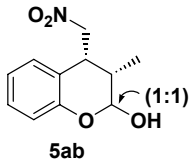
(3*S*, 4*R*)-8-Methoxy-3-methyl-4-nitromethylchroman-2-ol (5aa): Prepared by following the procedure



5aa

A and purified by column chromatography using EtOAc/hexane and isolated as liquid. **$[\alpha]_D^{25}$ = +20.06° (*c* = 0.28 g/100 mL, $CHCl_3$);** IR (Neat): ν_{max} 3659 (O-*H*), 2974, 1551 (NO_2), 1490, 1379, 1222, 1130, 976, 757, 658 and 632 cm^{-1}; ^1H NMR ($CDCl_3$, 1:1 ratio of isomers) δ 6.93-6.82 (4H, m), 6.64 (2H, br d, *J* = 6.0 Hz), 5.59 (1H, s), 5.50 (1H, s), 4.98-4.91 (2H, m), 4.74 (1H, dd, *J* = 13.2, 8.0 Hz), 4.60 (1H, dd, *J* = 12.8, 9.2 Hz), 4.23-4.16 (2H, m), 4.16-4.13 (1H, m), 3.86 (6H, s, OC*H*$_3$), 3.75-3.72 (1H, m), 2.45-2.42 (1H, m), 2.24-2.21 (1H, m), 1.25 (3H, d, *J* = 7.2 Hz), 0.98 (3H, d, *J* = 7.2 Hz); ^{13}C NMR ($CDCl_3$, DEPT-135, 1:1 ratio of isomers) δ 148.3 (2 x C), 140.1 (C), 140.0 (C), 122.8 (2 x C), 121.2 (CH), 121.0 (CH), 120.5 (CH), 117.9 (CH), 110.6 (CH), 110.5 (CH), 95.5 (CH), 94.8 (CH), 78.1 (CH_2), 76.2 (CH_2), 55.8 (2 x CH_3), 36.4 (CH), 33.4 (CH), 32.6 (CH), 32.2 (CH), 12.8 (CH_3), 11.1 (CH_3); LRMS m/z 254.20 ($M + H^+$), calcd for $C_{12}H_{15}NO_5$ 253.095; HRMS m/z 252.0889 (M – H), calcd for $C_{12}H_{15}NO_5$-H^+ 252.0872; Anal. calcd for $C_{12}H_{15}NO_5$ (253.095): C, 56.91; H, 5.97; N, 5.53. Found: C, 56.88; H, 6.02; N, 5.46%.

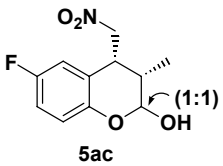
(3*S*, 4*R*)-3-Methyl-4-nitromethylchroman-2-ol (5ab): Prepared by following the procedure **A** and



5ab

purified by column chromatography using EtOAc/hexane and isolated as liquid. **$[\alpha]_D^{25}$ = +39.28° (*c* = 0.31 g/100 mL, $CHCl_3$);** IR (Neat): ν_{max} 3625 (O-*H*), 2973, 1551 (NO_2), 1453, 1379, 1222, 1027, 757, 674 and 648 cm^{-1}; ^1H NMR ($CDCl_3$, 1:1 ratio of isomers) δ 7.23-7.18 (2H, m), 7.01 (2H, d, *J* = 7.6 Hz), 6.97-6.89 (2H, m), 6.86 (2H, t, *J* = 7.2 Hz), 5.46 (1H, br s), 5.30 (1H, br s), 4.95-4.90 (2H, m), 4.74 (1H, dd, *J* = 13.2, 8.4 Hz), 4.59 (1H, dd, *J* = 12.4, 8.8 Hz), 4.14-4.12 (1H, m), 3.75-3.70 (1H, m), 3.62 (1H, d, *J* = 2.8 Hz), 3.50 (1H, br s), 2.44-2.40 (1H, m), 2.23-2.18 (1H, m), 1.22 (3H, d, *J* = 7.2 Hz), 0.97 (3H, d, *J* = 6.8 Hz); ^{13}C NMR ($CDCl_3$, DEPT-135, 1:1 ratio of isomers) δ 150.7 (C), 150.5 (C), 129.1 (CH), 128.8 (CH), 128.7 (CH), 126.2 (CH), 121.7 (C), 121.6 (CH), 121.5 (CH), 119.7 (C), 117.3 (CH), 117.3 (CH), 95.3 (CH), 94.6 (CH), 78.1 (CH_2), 76.1 (CH_2), 36.3 (CH), 33.4 (CH), 32.8 (CH), 32.3 (CH), 12.4 (CH_3), 11.0 (CH_3); LRMS m/z 223.80 ($M + H^+$), calcd for $C_{11}H_{13}NO_4$ 223.084; Anal. calcd for $C_{11}H_{13}NO_4$ (223.084): C, 59.19; H, 5.87; N, 6.27. Found: C, 59.25; H, 5.81; N, 6.21%.

(3*S*, 4*R*)-6-Fluoro-3-methyl-4-nitromethylchroman-2-ol (5ac): Prepared by following the procedure **A**

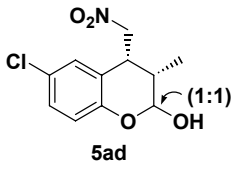


5ac

and purified by column chromatography using EtOAc/hexane and isolated as liquid. **$[\alpha]_D^{25}$ = +43.46° (*c* = 0.15 g/100 mL, $CHCl_3$);** IR (Neat): ν_{max} 3626 (O-*H*), 2975, 1551 (NO_2), 1493, 1379, 1197, 982, 818, 663 and 616 cm^{-1}; ^1H NMR ($CDCl_3$, 1:1 ratio of isomers) δ 6.94-6.88 (2H, m), 6.85-6.79 (2H, m), 6.76-6.72 (2H, m), 5.45 (1H, s), 5.36 (1H, s), 4.92 (1H, dd, *J* = 13.6, 4.8 Hz), 4.88 (1H, dd, *J* = 10.8, 4.8 Hz), 4.73 (1H, dd, *J* = 13.6, 8.4 Hz), 4.60 (1H, dd, *J* = 12.4, 8.4 Hz), 4.11-4.08 (1H, m), 3.72-3.68 (1H, m), 3.39 (1H, t, *J* = 6.8

Hz), 3.27 (1H, br s), 2.42-2.39 (1H, m), 2.22-2.19 (1H, m), 1.22 (3H, d, *J* = 7.2 Hz), 0.96 (3H, d, *J* = 7.2 Hz); ^{13}C NMR ($CDCl_3$, DEPT-135, 1:1 ratio of isomers) δ 157.4 (C, d, *J* = 238 Hz), 157.2 (C, d, *J* = 238.6 Hz), 146.7 (C), 146.6 (C), 122.8 (C, d, *J* = 6.9 Hz), 120.9 (C, d, *J* = 6.6 Hz), 118.8 (CH, d, *J* = 7.9 Hz), 118.5 (CH, d, *J* = 22.8 Hz), 116.07 (CH, d, *J* = 23.0 Hz), 115.6 (CH, d, *J* = 23.0 Hz), 114.8 (CH, d, *J* = 23.3 Hz), 112.7 (CH, d, *J* = 23.9 Hz), 95.4 (CH), 94.6 (CH), 77.8 (CH_2), 75.8 (CH_2), 36.3 (CH), 33.2 (CH), 32.8 (CH), 32.1 (CH), 12.5 (CH_3), 11.0 (CH_3); LRMS m/z 242.05 ($M + H^+$), calcd for $C_{11}H_{12}FNO_4$ 241.08; Anal. calcd for $C_{11}H_{12}FNO_4$ (241.08): C, 54.77; H, 5.01; N, 5.81. Found: C, 54.85; H, 4.97; N, 5.88%.

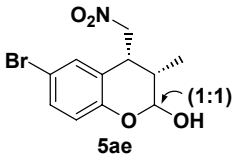
(3*S*, 4*R*)-6-Chloro-3-methyl-4-nitromethylchroman-2-ol (5ad): Prepared by following the procedure **A**



5ad

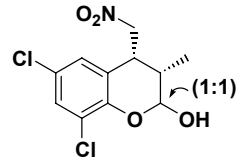
and purified by column chromatography using EtOAc/hexane and isolated as liquid. **$[\alpha]_D^{25}$ = +21.46° (*c* = 0.28 g/100 mL, $CHCl_3$);** IR (Neat): ν_{max} 3620 (O-*H*), 2975, 1551 (NO_2), 1494, 1380, 1198, 980, 817 and 664 cm^{-1}; ^{1}H NMR ($CDCl_3$, 1:1 ratio of isomers) δ 7.17-7.11 (2H, m), 7.00 (1H, s), 6.98 (1H, s), 6.82-6.77 (2H, m), 5.45 (1H, br s), 5.36 (1H, d, *J* = 2.8 Hz), 4.95-4.87 (2H, m), 4.70 (1H, dd, *J* = 13.6, 8.0 Hz), 4.59 (1H, dd, *J* = 12.4, 8.8 Hz), 4.09-4.05 (1H, m), 3.71-3.67 (1H, m), 2.40-2.35 (1H, m), 2.21-2.18 (1H, m), 1.21 (3H, d, *J* = 7.2 Hz), 0.95 (3H, d, *J* = 7.2 Hz); ^{13}C NMR ($CDCl_3$, DEPT-135, 1:1 ratio of isomers) δ 149.3 (C), 148.7 (C), 129.1 (CH), 128.8 (CH), 128.3 (CH), 126.4 (C), 126.1 (C), 126.0 (CH), 123.3 (C), 121.3 (C), 118.7 (2 x CH), 95.3 (CH), 94.7 (CH), 77.7 (CH_2), 75.7 (CH_2), 36.0 (CH), 33.2 (CH), 32.6 (CH), 32.0 (CH), 12.3 (CH_3), 10.9 (CH_3); LRMS m/z 256.20 ($M - H^+$), calcd for $C_{11}H_{12}ClNO_4$ 257.045; Anal. calcd for $C_{11}H_{12}ClNO_4$ (257.045): C, 51.27; H, 4.69; N, 5.44. Found: C, 51.35; H, 4.72; N, 5.39%.

(3*S*, 4*R*)-6-Bromo-3-methyl-4-nitromethylchroman-2-ol (*cis*-5ae): Prepared by following the procedure **A** and purified by column chromatography using EtOAc/hexane and isolated as liquid. **$[\alpha]_D^{25}$ = +17.36° (*c* = 0.28 g/100 mL, $CHCl_3$);** IR (Neat): ν_{max} 3595 (O-*H*), 2974, 1551 (NO_2), 1379, 1222, 976, 757, 658 and 632 cm^{-1}; ^{1}H NMR ($CDCl_3$, 1:1 ratio of isomers, major compound) δ 7.30-7.25 (2H, m), 7.14 (1H, br s), 7.11 (1H, br s), 6.75 (1H, d, *J* = 8.0 Hz), 6.74 (1H, d, *J* = 8.0 Hz), 5.45 (1H, s), 5.35 (1H, d, *J* = 2.8 Hz), 4.95-4.87 (2H, m), 4.71-4.66 (1H, m), 4.64-4.55 (1H, m), 4.09-4.04 (1H, m), 3.76 (1H, br s), 3.71-3.66 (1H, m), 3.62 (1H, br s), 2.39-2.36 (1H, m), 2.20-2.16 (1H, m), 1.20 (3H, d, *J* = 7.2 Hz), 0.94 (3H, d, *J* = 7.2 Hz); ^{13}C NMR ($CDCl_3$, DEPT-135, 1:1 ratio of isomers, major compound) δ 150.0 (C), 149.9 (C), 132.1 (CH), 131.8 (CH), 131.3 (CH), 129.0 (CH), 124.0 (C), 121.9 (C), 119.3 (2 x CH), 113.7 (C), 113.4 (C), 95.3 (CH), 94.7 (CH), 77.7 (CH_2), 75.7 (CH_2), 36.0 (CH), 33.2 (CH), 32.6 (CH), 32.0 (CH), 12.4 (CH_3), 11.0 (CH_3); LRMS m/z 300 (M), calcd for $C_{11}H_{12}BrNO_4$ 300.995; Anal. calcd for $C_{11}H_{12}BrNO_4$ (300.995): C, 43.73; H, 4.00; N, 4.64. Found: C, 43.85; H, 4.09; N, 4.61%.



5ae

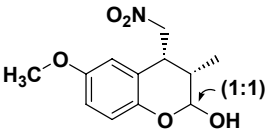
(3*S*, 4*R*)-6,8-Dichloro-3-methyl-4-nitromethylchroman-2-ol (5af): Prepared by following the procedure



5af

A and purified by column chromatography using EtOAc/hexane and isolated as solid. **$[\alpha]_D^{25}$ = +11.24° (*c* = 0.57 g/100 mL, $CHCl_3$);** IR (Neat): ν_{max} 3620, 2975, 1551 (NO_2), 1494, 1380, 1198, 980, 664 and 640 cm^{-1}; ^1H NMR ($CDCl_3$, 1:1 ratio of isomers) δ 7.36-7.31 (2H, m), 6.96-6.93 (2H, m), 5.61 (1H, t, *J* = 2.8 Hz), 5.52 (1H, t, *J* = 2.8 Hz), 4.97-4.87 (2H, m), 4.73-4.59 (2H, m), 4.14-4.09 (1H, m), 3.76 (2H, d, *J* = 3.2 Hz), 3.74-3.71 (1H, m), 2.46-2.41 (1H, m), 2.29-2.22 (1H, m), 1.26 (3H, d, *J* = 7.2 Hz), 0.98 (3H, d, *J* = 7.2 Hz); ^{13}C NMR ($CDCl_3$, DEPT-135, 1:1 ratio of isomers) δ 145.7 (C), 145.5 (C), 129.5 (CH), 129.2 (CH), 127.1 (CH), 126.2 (C), 126.0 (C), 124.8 (CH), 123.2 (C), 123.1 (C), 122.9 (C), 121.7 (C), 95.9 (CH), 95.1 (CH), 77.6 (CH_2), 75.6 (CH_2), 37.8 (CH), 36.2 (CH), 33.2 (CH), 32.1 (CH), 12.5 (CH_3), 11.0 (CH_3); LRMS m/z 290 ($M - H^+$), calcd for $C_{11}H_{11}Cl_2NO_4$ 291.0065; Anal. calcd for $C_{11}H_{11}Cl_2NO_4$ (291.0065): C, 45.23; H, 3.80; N, 4.79. Found: C, 45.31; H, 3.75; N, 4.85%.

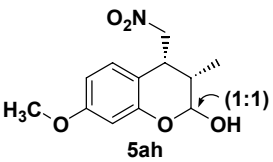
(3*S*, 4*R*)-6-Methoxy-3-methyl-4-nitromethylchroman-2-ol (5ag): Prepared following the procedure **A**



5ag

and purified by column chromatography using EtOAc/hexane and isolated as solid. **$[\alpha]_D^{25}$ = +23.8° (*c* = 0.33 g/100 mL, $CHCl_3$);** IR (Neat): ν_{max} 3589, 2973, 1550 (NO_2), 1490, 1379, 1222, 1131, 977, 757 and 635 cm^{-1}; ^1H NMR ($CDCl_3$, 1:1 ratio of isomers) δ 6.80-6.78 (4H, m), 6.57-6.55 (2H, m), 5.42 (1H, br s), 5.33 (1H, br s), 4.96-4.87 (2H, m), 4.75 (1H, dd, *J* = 13.2, 8.0 Hz), 4.61 (1H, dd, *J* = 12.8, 8.8 Hz), 4.10-4.05 (1H, m), 3.76 (3H, s, OC*H*$_3$), 3.74 (3H, s, OC*H*$_3$), 3.72-3.67 (1H, m), 2.42-2.39 (1H, m), 2.21-2.17 (1H, m), 1.22 (3H, d, *J* = 7.2 Hz), 0.97 (3H, d, *J* = 6.8 Hz); ^{13}C NMR ($CDCl_3$, DEPT-135, 1:1 ratio of isomers) δ 154.2 (C), 153.9 (C), 144.6 (C), 144.4 (C), 122.3 (C), 120.5 (C), 118.0 (CH), 117.9 (CH), 115.5 (CH), 114.2 (CH), 112.9 (CH), 111.7 (CH), 95.3 (CH), 94.6 (CH), 78.1 (CH_2), 76.2 (CH_2), 55.7 (2 x CH_3), 36.7 (CH), 33.5 (CH), 33.2 (CH), 32.5 (CH), 12.5 (CH_3), 11.2 (CH_3); LRMS m/z 252 ($M - H^+$), calcd for $C_{12}H_{15}NO_5$ 253.0950; HRMS m/z 276.0851 (M + Na), calcd for $C_{12}H_{15}NO_5Na$ 276.0848; Anal. calcd for $C_{12}H_{15}NO_5$ (253.0950): C, 56.91; H, 5.97; N, 5.33. Found: C, 56.85; H, 5.91; N, 5.58%.

(3*S*, 4*R*)-7-Methoxy-3-methyl-4-nitromethylchroman-2-ol (5ah): Prepared following the procedure **A**

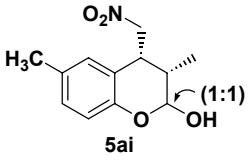


5ah

and purified by column chromatography using EtOAc/hexane and isolated as liquid. **$[\alpha]_D^{25}$ = +42.18° (*c* = 0.43 g/100 mL, $CHCl_3$);** IR (Neat): ν_{max} 3625 (O-*H*), 2973, 1551 (NO_2), 1453, 1379, 1222, 1027, 757, 674 and 617 cm^{-1}; ^1H NMR ($CDCl_3$, 1:1 ratio of isomers) δ 6.91 (2H, d, *J* = 8.8 Hz), 6.55-6.50 (2H, m), 6.45 (1H, d, *J* = 2.4 Hz), 6.42 (1H, d, *J* = 2.4 Hz), 5.46 (1H, br s), 5.36 (1H, d, *J* = 2.8 Hz), 4.89 (2H, td, *J* = 11.2, 6.0 Hz), 4.75 (1H, dd, *J* = 13.2, 8.4 Hz), 4.59 (1H, dd, *J* = 12.4, 8.8 Hz), 4.07-4.03 (1H, m), 3.79 (3H, s, OC*H*$_3$), 3.78 (3H, s, OC*H*$_3$), 3.70-3.66 (1H, m), 3.44-3.35 (2H, m), 2.43-2.40 (1H, m), 2.23-

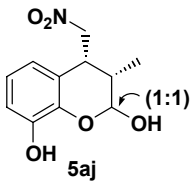
2.20 (1H, m), 1.23 (3H, d, *J* = 7.2 Hz), 0.99 (3H, d, *J* = 7.2 Hz); ^{13}C NMR ($CDCl_3$, DEPT-135, 1:1 ratio of isomers) δ 160.3 (C), 160.1 (C), 151.8 (C), 151.5 (C), 129.3 (CH), 126.9 (CH), 114.0 (C), 111.9 (C), 108.1 (CH), 108.0 (CH), 102.5 (CH), 102.3 (CH), 95.5 (CH), 94.7 (CH), 78.3 (CH_2), 76.3 (CH_2), 55.3 (2 x O*C*H$_3$), 35.9 (CH), 33.6 (CH), 32.53 (CH), 32.47 (CH), 12.5 (CH_3), 11.1 (CH_3); LRMS m/z 251.90 (M - H$^+$), calcd for $C_{12}H_{15}NO_5$ 253.0954; Anal. calcd for $C_{12}H_{15}NO_5$ (253.0954): C, 56.91; H, 5.97; N, 5.53. Found: C, 56.85; H, 5.92; N, 5.49%.

(3*S*, 4*R*)-3,6-Dimethyl-4-nitromethylchroman-2-ol (5ai): Prepared following the procedure **A** and purified by column chromatography using EtOAc/hexane and isolated as liquid. **$[\alpha]_D^{25}$ = +20.56° (*c* = 0.28 g/100 mL, $CHCl_3$);** IR (Neat): ν_{max} 3620 (O-*H*), 2975, 1551 (NO_2), 1494, 1380, 1198, 980, 817, 664 and 615 cm^{-1}; ^{1}H NMR ($CDCl_3$, 1:1 ratio of isomers) δ 7.04-7.01 (2H, m), 6.83 (2H, br s), 6.79 (1H, d, *J* = 6.4 Hz), 6.77 (1H, d, *J* = 6.4 Hz), 5.46 (1H, br s), 5.36 (1H, br s), 4.98-4.93 (2H, m), 4.75 (1H, dd, *J* = 13.2, 7.6 Hz), 4.62 (1H, dd, *J* = 12.4, 8.8 Hz), 4.12-4.07 (1H, m), 3.73-3.69 (1H, m), 3.40-3.23 (2H, m), 2.45-2.38 (1H, m), 2.29 (3H, s, ArC*H*$_3$), 2.27 (3H, s, ArC*H*$_3$), 2.24-2.18 (1H, m), 1.24 (3H, d, *J* = 7.2 Hz), 0.99 (3H, d, *J* = 7.2 Hz); ^{13}C NMR ($CDCl_3$, DEPT-135, 1:1 ratio of isomers) δ 148.4 (C), 148.3 (C), 131.0 (C), 130.9 (C), 129.8 (CH), 129.5 (CH), 128.9 (CH), 126.5 (CH), 121.4 (C), 119.4 (C), 117.2 (CH), 117.1 (CH), 95.3 (CH), 94.7 (CH), 78.2 (CH_2), 76.2 (CH_2), 36.3 (CH), 33.5 (CH), 32.8 (CH), 32.4 (CH), 20.7 (CH_3), 20.5 (CH_3), 12.5 (CH_3), 11.1 (CH_3); LRMS m/z 238.55 (M + H$^+$), calcd for $C_{12}H_{15}NO_4$ 237.100; Anal. calcd for $C_{12}H_{15}NO_4$ (237.100): C, 60.75; H, 6.37; N, 5.90. Found: C, 60.81; H, 6.32; N, 5.86%.



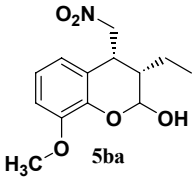
5ai

(3*S*, 4*R*)-3-Methyl-4-nitromethylchroman-2,8-diol (5aj): Prepared following the procedure **A** and purified by column chromatography using EtOAc/hexane and isolated as liquid. **$[\alpha]_D^{25}$ = +33.2° (*c* = 0.14 g/100 mL, $CHCl_3$);** IR (Neat): ν_{max} 3625 (O-*H*), 2973, 1551 (NO_2), 1453, 1379, 1222, 1027, 979, 757, 674 and 617 cm^{-1}; ^{1}H NMR ($CDCl_3$, 1:1 ratio of isomers) δ 6.86-6.76 (4H, m), 6.55-6.53 (2H, m), 6.09 (2H, br s), 5.48 (1H, d, *J* = 2.0 Hz), 5.38 (1H, d, *J* = 3.2 Hz), 4.88 (2H, ddd, *J* = 12.8, 6.4, 3.6 Hz), 4.73 (1H, dd, *J* = 13.2, 8.0 Hz), 4.58 (1H, dd, *J* = 12.8, 8.8 Hz), 4.07-4.02 (1H, m), 3.74-3.69 (1H, m), 2.40-2.35 (1H, m), 2.20-2.18 (1H, m), 1.19 (3H, d, *J* = 7.2 Hz), 0.94 (3H, d, *J* = 6.8 Hz); ^{13}C NMR ($CDCl_3$, DEPT-135, 1:1 ratio of isomers) δ 144.8 (2 x C), 138.2 (2 x C), 122.1 (C), 121.6 (CH), 121.4 (CH), 120.2 (C), 119.5 (CH), 117.3 (CH), 114.4 (2 x CH), 95.6 (CH), 94.9 (CH), 77.8 (CH_2), 75.9 (CH_2), 36.2 (CH), 33.6 (CH), 32.9 (CH), 32.7 (CH), 12.1 (CH_3), 11.1 (CH_3); LRMS m/z 240.15 (M + H$^+$), calcd for $C_{11}H_{13}NO_5$ 239.0794; Anal. calcd for $C_{11}H_{13}NO_5$ (239.0794): C, 55.23; H, 5.48; N, 5.86. Found: C, 55.16; H, 5.45; N, 5.92%.



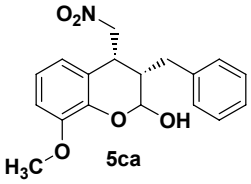
5aj

(3*S*, 4*R*)-3-Ethyl-8-methoxy-4-nitromethylchroman-2-ol (5ba): Prepared following the procedure **A** and



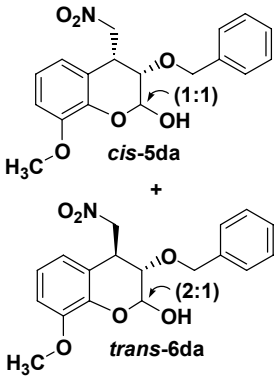
purified by column chromatography using EtOAc/hexane and isolated as solid. Mp 105 °C; **$[\alpha]_D^{25}$ = +39.13° (*c* = 0.30 g/100 mL, $CHCl_3$);** IR (Neat): ν_{max} 3626, 2975, 1551 (NO_2), 1493, 1379, 1197, 1083, 982, 818, 663 and 616 cm^{-1}; ^1H NMR ($CDCl_3$) δ 6.90-6.79 (2H, m), 6.62-6.59 (1H, m), 5.10 (1H, br s), 4.87-4.76 (2H, m), 3.82 (3H, s, OC*H*$_3$), 3.78-3.74 (1H, m), 2.16-2.14 (1H, m), 1.76-1.59 (2H, m), 1.09 (3H, t, *J* = 7.6 Hz); ^{13}C NMR ($CDCl_3$, DEPT-135) δ 147.9 (C), 139.8 (C), 123.0 (C), 120.7 (CH), 120.6 (CH), 110.4 (CH), 93.4 (CH), 78.1 (CH_2), 55.4 (CH_3), 40.3 (CH), 34.4 (CH), 20.7 (CH_2), 11.2 (CH_3); LRMS m/z 268.30 (M + H^+), calcd for $C_{13}H_{17}NO_5$ 267.1107; Anal. calcd for $C_{13}H_{17}NO_5$ (267.1107): C, 58.42; H, 6.41; N, 5.24. Found: C, 58.31; H, 6.44; N, 5.28%.

(3*S*, 4*R*)-3-Benzyl-8-methoxy-4-nitromethylchroman-2-ol (5ca): Prepared following the procedure **A**



and purified by column chromatography using EtOAc/hexane and isolated as solid. Mp 95 °C; **$[\alpha]_D^{25}$ = +14.07° (*c* = 0.23 g/100 mL, $CHCl_3$);** IR (Neat): ν_{max} 3462 (O-*H*), 2973, 1551 (NO_2), 1494, 1379, 1198, 981, 817 and 634 cm^{-1}; ^1H NMR ($CDCl_3$) δ 7.34-7.13 (5H, m), 6.89-6.75 (2H, m), 6.63 (1H, t, *J* = 8.0 Hz), 5.55 (1H, s), 5.17-4.97 (2H, m), 4.91-4.86 (1H, m), 4.24-4.21 (1H, m), 3.80 (3H, s), 3.75-3.73 (1H, m), 3.01-2.91 (1H, m); ^{13}C NMR ($CDCl_3$, DEPT-135) δ 147.9 (C), 139.7 (C), 137.9 (C), 128.6 (5 x CH), 126.6 (CH), 122.9 (C), 121.0 (CH), 110.6 (CH), 92.9 (CH), 78.1 (CH_2), 55.5 (CH_3), 40.5 (CH), 34.7 (CH), 34.0 (CH_2); LRMS m/z 330.55 (M + H^+), calcd for $C_{18}H_{19}NO_5$ 329.126; HRMS m/z 352.1168 (M + Na), calcd for $C_{18}H_{19}NO_5Na$ 352.1161; Anal. calcd for $C_{18}H_{19}NO_5$ (329.126): C, 65.64; H, 5.81; N, 4.25. Found: C, 65.58; H, 5.81; N, 4.29%.

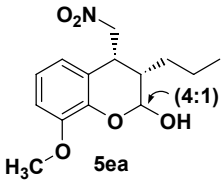
(3*S*, 4*R*)-3-Benzyl-8-methoxy-4-nitromethylchroman-2-ol (5da): Prepared following the procedure **A**



and purified by column chromatography using EtOAc/hexane and isolated as liquid. **$[\alpha]_D^{25}$ = +17.37° (*c* = 0.48 g/100 mL, $CHCl_3$);** IR (Neat): ν_{max} 3462 (O-*H*), 2958, 1548 (NO_2), 1482, 1380, 1264, 1085, 982, 733 and 634 cm^{-1}; ^1H NMR ($CDCl_3$, 2:1 ratio of isomers) δ 7.38-7.33 (10H, m), 6.95-6.88 (2H, m), 6.82-6.66 (4H, m), 5.74-5.71 (2H, m), 4.85-4.57 (8H, m), 4.16-4.12 (2H, m), 3.89-3.87 (2H, m), 3.80 (6H, s, OC*H*$_3$); ^{13}C NMR ($CDCl_3$, DEPT-135, 2:1 ratio of isomers) δ 148.6 (C), 148.4 (C), 148.3 (2 x C), 140.5 (C), 140.3 (C), 140.1 (C), 139.6 (C), 137.4 (C), 137.3 (2 x C), 137.1 (C), 128.7-127.99 (20 x CH), 121.9 (2 x CH), 121.7 (CH), 121.6 (CH), 121.4 (2 x CH), 121.1 (CH), 120.9 (CH), 120.2 (2 x C),119.3 (2 x C), 118.6 (2 x CH), 118.6 (CH), 111.0 (CH), 110.7 (2 x CH), 92.6 (CH), 91.1 (CH), 90.7 (CH), 89.6 (CH), 77.4 (CH_2), 77.2 (CH_2), 75.1 (CH_2), 74.9 (CH_2), 73.5 (CH), 72.7 (CH), 72.67 (CH_2), 72.64 (CH),

72.38 (CH_2), 71.96 (CH_2), 71.92 (CH), 71.5 (CH_2), 55.74 (3 x CH_3), 55.70 (CH_3), 36.4 (CH), 36.1 (CH), 35.7 (CH), 34.4 (CH); LRMS m/z 344.00 ($M - H^+$), calcd for $C_{18}H_{19}NO_6$ 345.11; HRMS m/z 368.1103 (M + Na), calcd for $C_{18}H_{19}NO_6Na$ 368.1110; Anal. calcd for $C_{18}H_{19}NO_6$ (345.11): C, 62.60; H, 5.55; N, 4.06. Found: C, 62.48; H, 5.49; N, 4.12%.

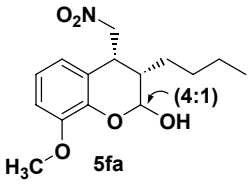
(3*S*, 4*R*)-8-Methoxy-4-nitromethyl-3-propylchroman-2-ol (5ea): Prepared following the procedure **A**



5ea

and purified by column chromatography using EtOAc/hexane and isolated as liquid. **$[\alpha]_D^{25}$ = +19.9° (*c* = 0.58 g/100 mL, $CHCl_3$);** IR (Neat): ν_{max} 3459 (OH), 2965, 1549 (NO_2), 1484, 1379, 1264, 1205, 983, 733 and 634 cm^{-1}; ^{1}H NMR ($CDCl_3$, 4:1 ratio of isomers, major isomer) δ 6.85-6.80 (2H, m), 6.62 (1H, d, *J* = 7.2 Hz), 5.66 (1H, s), 4.87-4.76 (2H, m), 4.47 (1H, br s), 4.15-4.09 (1H, m), 3.85 (3H, s), 3.76-3.72 (1H, m), 2.29-2.27 (1H, m), 1.67-1.58 (2H, m), 1.56-1.47 (2H, m), 1.00 (3H, t, *J* = 7.2 Hz); ^{13}C NMR ($CDCl_3$, DEPT-135, 4:1 ratio of isomers, major isomer) δ 148.2 (C), 139.8 (C), 123.0 (C), 120.9 (CH), 120.7 (CH), 110.6 (CH), 93.7 (CH), 78.3 (CH_2), 55.7 (CH_3), 38.3 (CH), 34.8 (CH), 29.9 (CH_2), 20.4 (CH_2), 14.1 (CH_3); LRMS m/z 282.20 ($M + H^+$), calcd for $C_{14}H_{19}NO_5$ 281.1263; Anal. calcd for $C_{14}H_{19}NO_5$ (281.1263): C, 59.78; H, 6.81; N, 4.98. Found: C, 59.68; H, 6.85; N, 4.91%.

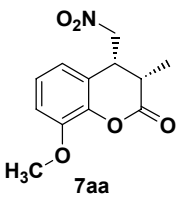
(3*S*, 4*R*)-3-Butyl-8-methoxy-4-nitromethylchroman-2-ol (5fa): Prepared following the procedure **A**



5fa

and purified by column chromatography using EtOAc/hexane and isolated as liquid. **$[\alpha]_D^{25}$ = +18.05° (*c* = 0.23 g/100 mL, $CHCl_3$);** IR (Neat): ν_{max} 3459 (O-*H*), 2965, 1549 (NO_2), 1484, 1379, 1264, 1085, 983, 733 and 634 cm^{-1}; ^{1}H NMR ($CDCl_3$, 4:1 ratio of isomers, major isomer) δ 7.01-6.78 (2H, m), 6.64-6.62 (1H, m), 5.68 (1H, s), 4.89-4.80 (1H, m), 4.72 (1H, dd, *J* = 10.4, 4.4 Hz), 4.65 (1H, dd, *J* = 10.0, 6.0 Hz), 3.85 (3H, s, OC*H*$_3$), 3.76 (1H, m), 2.23 (1H, m), 1.80-1.20 (6H, m), 0.96 (3H, t, *J* = 6.0 Hz); ^{13}C NMR ($CDCl_3$, DEPT-135, 4:1 ratio of isomers, major isomer) δ 148.0 (C), 139.8 (C), 123.2 (C), 120.7 (CH), 120.6 (CH), 110.5 (CH), 93.7 (CH), 78.2 (CH_2), 55.5 (CH_3), 38.5 (CH), 34.7 (CH), 28.8 (CH_2), 27.4 (CH_2), 22.6 (CH_2), 13.8 (CH_3); LRMS m/z 296.20 ($M + H^+$), calcd for $C_{15}H_{21}NO_5$ 295.142; Anal. calcd for $C_{15}H_{21}NO_5$ (295.142): C, 61.00; H, 7.17; N, 4.74. Found: C, 60.15; H, 7.12; N, 4.71%.

(3*S*, 4*R*)-8-Methoxy-3-methyl-4-nitromethylchroman-2-one (7aa): Prepared following the procedure **D**

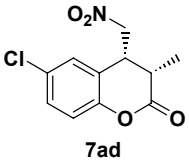


7aa

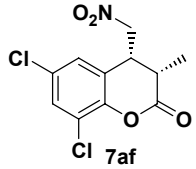
and purified by column chromatography using EtOAc/hexane and isolated as white solid. Mp 99 °C; The enantiomeric excess (ee) was determined by chiral stationary phase HPLC using a Daicel Chiralcel OJ-H column (hexane/2-propanol = 60:40, flow rate 1.0 mL/min, λ = 254 nm), t_R = 34.20 min (major), t_R = 50.21 min (minor). **$[\alpha]_D^{25}$ = +97.4° (*c* = 0.2 g/100 mL, $CHCl_3$, 99% *ee*);** IR (Neat): ν_{max} 2973, 1760 (C=O), 1552 (NO_2), 1455, 1379, 1273, 1025, 839, 756, 663 and 635 cm^{-1}; ^{1}H NMR ($CDCl_3$) δ 7.08 (1H, t, *J* = 8.0 Hz),

6.95 (1H, d, *J* = 7.2 Hz), 6.74 (1H, d, *J* = 7.2 Hz), 4.65 (1H, dd, *J* = 12.4, 3.2 Hz), 4.34 (1H, dd, *J* = 12.4, 9.6 Hz), 3.90 (3H, s, OC*H*$_3$), 3.82 (1H, quintet, *J* = 5.2 Hz), 3.13 (1H, quintet, *J* = 6.8 Hz), 1.42 (3H, d, *J* = 7.2 Hz); ^{13}C NMR ($CDCl_3$, DEPT-135) δ 168.7 (C, O-C=O), 147.9 (C), 140.2 (C), 125.1 (C), 123.6 (CH), 119.2 (CH), 112.7 (CH), 75.5 (CH_2), 56.1 (CH_3), 39.7 (CH), 36.6 (CH), 12.2 (CH_3); LRMS m/z 252.05 (M + H$^+$), calcd for $C_{12}H_{13}NO_5$ 251.0794; HRMS m/z 252.0873 (M + H$^+$), calcd for $C_{12}H_{13}NO_5H^+$ 252.0872; Anal. calcd for $C_{12}H_{13}NO_5$ (251.0794): C, 57.37; H, 5.22; N, 5.58. Found: C, 57.45; H, 5.18; N, 5.62%.

(3*S*, 4*R*)-6-Chloro-3-methyl-4-nitromethylchroman-2-one (7ad): Prepared following the procedure **D** and purified by column chromatography using EtOAc/hexane and isolated as white solid. Mp 133 °C; The enantiomeric excess (ee) was determined by chiral stationary phase HPLC using a Daicel Chiralcel OJ-H column (hexane/2-propanol = 75:25, flow rate 1.0 mL/min, λ = 254 nm), t_R = 30.46 min (minor), t_R = 36.24 min (major). **$[\alpha]_D^{25}$ = +20.0° (*c* = 0.1 g/100 mL, $CHCl_3$, >99% *ee*);** IR (Neat): ν_{max} 2975, 1763 (C=O), 1552 (NO_2), 1455, 1380, 1274, 1155, 1025, 824, 661 and 635 cm^{-1}; ^{1}H NMR ($CDCl_3$) δ 7.31 (1H, d, *J* = 8.4 Hz), 7.18 (1H, s), 7.04 (1H, d, *J* = 8.4 Hz), 4.66 (1H, dd, *J* = 13.2, 5.2 Hz), 4.35 (1H, dd, *J* = 12.4, 9.6 Hz), 3.82-3.77 (1H, m), 3.10 (1H, quintet, *J* = 6.8 Hz), 1.40 (3H, d, *J* = 6.8 Hz); ^{13}C NMR ($CDCl_3$, DEPT-135) δ 168.6 (C), 149.5 (C), 130.2 (CH), 130.1 (C), 127.9 (CH), 124.1 (C), 118.8 (CH), 79.9 (CH_2), 39.0 (CH), 36.4 (CH), 12.0 (CH_3); LRMS m/z 256.00 (M + H$^+$), calcd for $C_{11}H_{10}ClNO_4$ 255.0298; HRMS m/z 254.0180 (M – H$^+$), calcd for $C_{11}H_{10}ClNO_4$–H$^+$ 254.0220; Anal. calcd for $C_{11}H_{10}ClNO_4$ (255.0298): C, 51.68; H, 3.94; N, 5.48. Found: C, 51.75; H, 3.91; N, 5.42%.



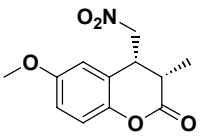
7ad



7af

(3*S*, 4*R*)-6,8-Dichloro-3-methyl-4-nitromethylchroman-2-one (7af): Prepared following the procedure **D** and purified by column chromatography using EtOAc/hexane and isolated as white solid. Mp 178 °C; The enantiomeric excess (ee) was determined by chiral stationary phase HPLC using a Daicel Chiralcel OJ-H column (hexane/2-propanol = 90:10, flow rate 1.0 mL/min, λ = 254 nm), t_R = 55.73 min (minor), t_R = 67.06 min (major). **$[\alpha]_D^{25}$ = +87.78° (*c* = 0.11 g/100 mL, $CHCl_3$, >99% *ee*);** IR (Neat): ν_{max} 2976, 1760 (C=O), 1552 (NO_2), 1450, 1380, 1274, 1154, 1025, 827, 662, 640 and 616 cm^{-1}; ^{1}H NMR ($CDCl_3$) δ 7.44 (1H, s), 7.10 (1H, s), 4.67 (1H, dd, *J* = 12.8, 4.8 Hz), 4.35 (1H, dd, *J* = 13.2, 10.0 Hz), 3.86-3.80 (1H, m), 3.12 (1H, quintet, *J* = 6.8 Hz), 1.44 (3H, d, *J* = 7.2 Hz); ^{13}C NMR ($CDCl_3$, DEPT-135) δ 167.4 (C, O-C=O), 145.9 (C), 130.7 (CH), 130.1 (C), 126.4 (CH), 125.4 (C), 123.5 (C), 74.7 (CH_2), 39.4 (CH), 36.4 (CH), 12.0 (CH_3); LRMS m/z 289.95 (M + H$^+$), calcd for $C_{11}H_9Cl_2NO_4$ 288.9909; HRMS m/z 287.9822 (M – H$^+$), calcd for $C_{11}H_9Cl_2NO_4$-H$^+$ 287.9831; Anal. calcd for $C_{11}H_9Cl_2NO_4$ (288.9909): C, 45.54; H, 3.13; N, 4.83. Found: C, 45.61; H, 3.18; N, 4.79%.

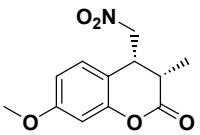
(3*S*, 4*R*)-6-Methoxy-3-methyl-4-nitromethylchroman-2-one (7ag): Prepared following the procedure **D**



7ag

and purified by column chromatography using EtOAc/hexane and isolated as white solid. Mp 80 °C; The enantiomeric excess (ee) was determined by chiral stationary phase HPLC using a Daicel Chiralcel OJ-H column (hexane/2-propanol = 85:15, flow rate 1.0 mL/min, λ = 254 nm), t_R = 48.54 min (minor), t_R = 57.97 min (major). **$[\alpha]_D^{25}$ = +44.88° (*c* = 0.11 g/100 mL, $CHCl_3$, 99.7% *ee*);** IR (Neat): ν_{max} 2973, 1758 (C=O), 1552 (NO_2), 1455, 1379, 1273, 1025, 839, 756, 663 and 635 cm^{-1}; ^1H NMR ($CDCl_3$) δ 7.03 (1H, d, *J* = 9.2 Hz), 6.86 (1H, dd, *J* = 9.2, 3.2 Hz), 6.68 (1H, d, *J* = 3.2 Hz), 4.65 (1H, dd, *J* = 12.8, 5.2 Hz), 4.34 (1H, dd, *J* = 12.8, 10.0 Hz), 3.81-3.76 (1H, m), 3.78 (3H, s, OCH_3), 3.13-3.06 (1H, m), 1.40 (3H, d, *J* = 7.2 Hz); ^{13}C NMR ($CDCl_3$, DEPT-135) δ 169.5 (C, O-C=O), 156.5 (C), 144.8 (C), 123.4 (C), 118.3 (CH), 115.3 (CH), 112.9 (CH), 75.4 (CH_2), 55.8 (CH_3), 39.6 (CH), 36.7 (CH), 12.2 (CH_3); LRMS m/z 252.00 ($M + H^+$), calcd for $C_{12}H_{13}NO_5$ 251.0794; HRMS m/z 252.0870 ($M + H^+$), calcd for $C_{12}H_{13}NO_5H^+$ 252.0872; Anal. calcd for $C_{12}H_{13}NO_5$ (251.0794): C, 57.37; H, 5.22; N, 5.58. Found: C, 57.45; H, 5.26; N, 5.51%.

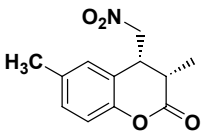
(3*S*, 4*R*)-7-Methoxy-3-methyl-4-nitromethylchroman-2-one (7ah): Prepared following the procedure



7ah

D and purified by column chromatography using EtOAc/hexane and isolated as white solid. Mp 80 °C; The enantiomeric excess (ee) was determined by chiral stationary phase HPLC using a Daicel Chiralcel OJ-H column (hexane/2-propanol = 80:20, flow rate 1.0 mL/min, λ = 254 nm), t_R = 43.47 min (major), t_R = 53.07 min (minor). **$[\alpha]_D^{25}$ = +115.16° (*c* = 0.14 g/100 mL, $CHCl_3$, 99% *ee*);** IR (Neat): ν_{max} 2973, 1763 (C=O), 1552 (NO_2), 1455, 1380, 1274, 1117, 1024, 824, 757, 633, 610 and 606 cm^{-1}; ^1H NMR ($CDCl_3$) δ 7.05 (1H, d, *J* = 8.4 Hz), 6.65 (1H, d, *J* = 8.4 Hz), 6.62 (1H, s), 4.63 (1H, dd, *J* = 12.4, 4.8 Hz), 4.29 (1H, dd, *J* = 12.4, 10.0 Hz), 3.78 (3H, s, OCH_3), 3.77 (1H, m), 3.11 (1H, quintet, *J* = 6.8 Hz), 1.39 (3H, d, *J* = 7.2 Hz); ^{13}C NMR ($CDCl_3$, DEPT-135) δ 169.3 (C, O-C=O), 160.9 (C), 151.9 (C), 128.6 (CH), 114.2 (C), 110.9 (CH), 102.9 (CH), 75.8 (CH_2), 55.5 (CH_3), 38.8 (CH), 36.9 (CH), 12.2 (CH_3); LRMS m/z 252.15 ($M + H^+$), calcd for $C_{12}H_{13}NO_5$ 251.0794; HRMS m/z 252.0870 ($M + H^+$), calcd for $C_{12}H_{13}NO_5H^+$ 252.0872; Anal. calcd for $C_{12}H_{13}NO_5$ (251.0794): C, 57.37; H, 5.22; N, 5.58. Found: C, 57.48; H, 5.16; N, 5.67%.

(3*S*, 4*R*)-3,6-Dimethyl-4-nitromethylchroman-2-one (7ai): Prepared following the procedure **D** and

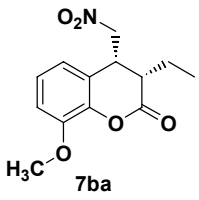


7ai

purified by column chromatography using EtOAc/hexane and isolated as white solid. Mp 110 °C; The enantiomeric excess (ee) was determined by chiral stationary phase HPLC using a Daicel Chiralpak AS-H column (hexane/2-propanol = 851:5, flow rate 1.0 mL/min, λ = 254 nm), t_R = 16.83 min (major), t_R = 18.51 min (minor). **$[\alpha]_D^{25}$ = +63.27° (*c* = 0.15 g/100 mL, $CHCl_3$, 99.6% *ee*);** IR (Neat): ν_{max} 2974, 1763 (C=O), 1552 (NO_2), 1455,

1379, 1025, 825, 784, 662 and 636 cm^{-1}; ^1H NMR ($CDCl_3$) δ 7.13 (1H, d, *J* = 8.0 Hz), 6.98 (1H, d, *J* = 8.4 Hz), 6.95 (1H, s), 4.64 (1H, dd, *J* = 12.4, 4.8 Hz), 4.33 (1H, dd, *J* = 12.4, 9.6 Hz), 3.79-3.74 (1H, m), 3.09 (1H, quintet, *J* = 6.4 Hz), 2.30 (3H, s, ArC*H*$_3$), 1.39 (3H, d, *J* = 7.2 Hz); ^{13}C NMR ($CDCl_3$, DEPT-135) δ 169.5 (C, O-C=O), 148.8 (C), 134.7 (C), 130.6 (CH), 128.2 (CH), 122.2 (C), 117.1 (CH), 75.5 (CH_2), 39.3 (CH), 36.8 (CH), 20.7 (CH_3), 12.1 (CH_3); LRMS m/z 236.05 (M + H^+), calcd for $C_{12}H_{13}NO_4$ 235.0845; HRMS m/z 234.0764 (M – H^+), calcd for $C_{12}H_{13}NO_4$-H^+ 234.0767; Anal. calcd for $C_{12}H_{13}NO_4$ (235.0845): C, 61.27; H, 5.57; N, 5.95. Found: C, 61.32; H, 5.53; N, 5.89%.

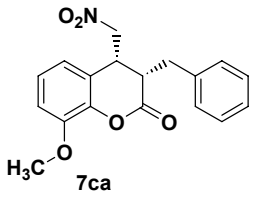
(3*S*, 4*R*)-3-Ethyl-8-methoxy-4-nitromethylchroman-2-one (*cis*-7ba): Prepared following the procedure



7ba

D and purified by column chromatography using EtOAc/hexane and isolated as oily liquid. The enantiomeric excess (ee) was determined by chiral stationary phase HPLC using a Lux 5u Amylose-2 column (hexane/2-propanol = 75:25, flow rate 1.0 mL/min, λ = 254 nm), t_R = 17.43 min (major), t_R = 22.23 min (minor) [for *cis*-**7ba**]; t_R = 13.28 min (major), t_R = 14.86 min (minor) [for *trans*-**7ba**]. **$[\alpha]_D^{25}$ = +36.59° (*c* = 0.41 g/100 mL, $CHCl_3$, >99.9% *ee*);** IR (Neat): ν_{max} 2976, 1760 (C=O), 1552 (NO_2), 1450, 1380, 1274, 1154, 1025, 827, 662, 640 and 616 cm^{-1}; ^1H NMR ($CDCl_3$) δ 7.06 (1H, t, *J* = 8.0 Hz), 6.94 (1H, d, *J* = 8.4 Hz), 6.73 (1H, d, *J* = 8.0 Hz), 4.58 (1H, dd, *J* = 12.4, 4.8 Hz), 4.30 (1H, dd, *J* = 12.0, 10.8 Hz), 3.92-3.91 (1H, m), 3.89 (3H, s, OC*H*$_3$), 2.85-2.77 (1H, m), 2.16-2.07 (1H, m), 1.59-1.50 (1H, m), 1.13 (3H, t, *J* = 7.6 Hz); ^{13}C NMR ($CDCl_3$, DEPT-135) δ 168.2 (C, O-C=O), 147.8 (C), 140.0 (C), 125.0 (CH), 123.7 (C), 119.2 (CH), 112.6 (CH), 75.4 (CH_2), 55.0 (CH_3), 43.2 (CH), 37.6 (CH), 19.9 (CH_2), 11.9 (CH_3); LRMS m/z 266.20 (M + H^+), calcd for $C_{13}H_{15}NO_5$ 265.0950; HRMS m/z 264.0870 (M – H^+), calcd for $C_{13}H_{15}NO_5$-H^+ 264.0872; Anal. calcd for $C_{13}H_{15}NO_5$ (265.0950): C, 58.86; H, 5.70; N, 5.28. Found: C, 58.79; H, 5.75; N, 5.22%.

(3*S*, 4*R*)-3-Benzyl-8-methoxy-4-nitromethylchroman-2-one (7ca): Prepared following the procedure **D**

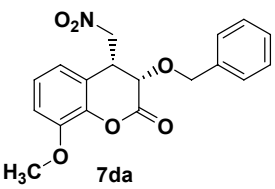


7ca

and purified by column chromatography using EtOAc/hexane and isolated as solid. Mp 128 °C; The enantiomeric excess (ee) was determined by chiral stationary phase HPLC using a Daicel Chiralpak AS-H column (hexane/2-propanol = 80:20, flow rate 1.0 mL/min, λ = 254 nm), t_R = 24.94 min (minor), t_R = 34.75 min (major). **$[\alpha]_D^{25}$ = +16.55° (*c* = 0.28 g/100 mL, $CHCl_3$, 99.3% *ee*);** IR (Neat): ν_{max} 3112, 2975, 1763 (C=O), 1552 (NO_2), 1455, 1380, 1211, 1117, 1025, 824, 663 and 631 cm^{-1}; ^1H NMR ($CDCl_3$) δ 7.37 (2H, br t, *J* = 7.6 Hz), 7.30 (1H, br d, *J* = 7.6 Hz), 7.28 (2H, br d, *J* = 7.6 Hz), 7.02 (1H, t, *J* = 7.6 Hz), 6.92 (1H, dd, *J* = 8.4, 1.2 Hz), 6.61 (1H, dd, *J* = 7.6, 1.2 Hz), 4.74 (1H, dd, *J* = 12.0, 4.4 Hz), 4.37 (1H, dd, *J* = 12.4, 10.8 Hz), 3.87 (3H, s), 3.55-3.50 (1H, m), 3.52 (1H, dd, *J*= 14.8, 5.6 Hz), 3.29-3.24 (1H, m), 2.77 (1H, dd, *J* = 14.8, 9.6 Hz); ^{13}C NMR ($CDCl_3$, DEPT-135) δ 168.0 (C, O-

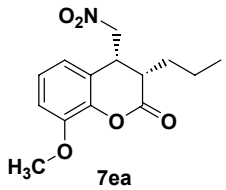
C=O), 147.9 (C), 140.1 (C), 137.1 (C), 129.1 (2 x CH), 128.7 (2 x CH), 127.3 (CH), 125.1 (CH), 123.8 (C), 119.4 (CH), 112.7 (CH), 75.3 (CH_2), 56.1 (CH_3), 43.4 (CH), 36.9 (CH), 32.4 (CH_2); LRMS m/z 328.25 ($M + H^+$), calcd for $C_{18}H_{17}NO_5$ 327.1107; HRMS m/z 326.1022 ($M - H^+$), calcd for $C_{18}H_{17}NO_5$-H^+ 326.1029; Anal. calcd for $C_{18}H_{17}NO_5$ (325.1107): C, 66.05; H, 5.23; N, 4.28. Found: C, 66.15; H, 5.17; N, 4.32%.

(3*S*, 4*R*)-3-Benzyloxy-8-methoxy-4-nitromethylchroman-2-one (*cis*-7da): Prepared following the procedure **D** and purified by column chromatography using EtOAc/hexane and isolated as oily liquid. The enantiomeric excess (ee) was determined by chiral stationary phase HPLC using a Daicel Chiralcel OJ-H column (hexane/2-propanol = 80:20, flow rate 1.0 mL/min, λ = 254 nm), t_R = 49.12 min (major), t_R = 65.82 min (minor) [for *cis*-**7da**]; t_R = 57.41 min (minor), t_R = 105.14 min (major) [for *trans*-**7da**]. **$[\alpha]_D^{25}$ = +14.13° (*c* = 0.07 g/100 mL, $CHCl_3$, 87% *ee*);** IR (Neat): ν_{max} 3112, 2975, 1763 (C=O), 1552 (NO_2), 1455, 1380, 1274, 1153, 1025, 824, 663 and 631 cm^{-1}; ^1H NMR ($CDCl_3$) δ 7.38-7.32 (5H, m), 7.06 (1H, t, *J* = 7.6 Hz), 6.92 (1H, d, *J* = 8.0 Hz), 6.72 (1H, d, *J* = 7.6 Hz), 5.07-5.04 (1H, m), 4.89 (1H, dd, *J* = 12.8, 4.8 Hz), 4.75 (1H, d, *J* = 9.6 Hz), 4.44-4.39 (1H, m), 4.05 (1H, m), 3.95-3.85 (1H, m), 3.87 (3H, s); ^{13}C NMR ($CDCl_3$, DEPT-135) δ 165.7 (C), 147.6 (C), 139.2 (C), 136.2 (C), 128.6 (2 x CH), 128.4 (CH), 128.1 (2 x CH), 125.4 (CH), 121.0 (C), 119.8 (CH), 112.8 (CH), 74.9 (CH_2), 73.2 (CH_2), 71.4 (CH), 56.0 (CH_3), 39.9 (CH); LRMS m/z 344.15 ($M + H^+$), calcd for $C_{18}H_{17}NO_6$ 343.1056; Anal. calcd for $C_{18}H_{17}NO_6$ (343.1056): C, 62.97; H, 4.99; N, 4.08. Found: C, 62.85; H, 5.03; N, 4.12%.



7da

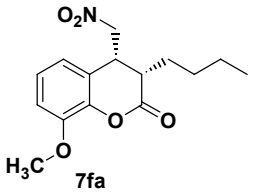
(3*S*, 4*R*)-8-Methoxy-4-nitromethyl-3-propylchroman-2-one (7ea): Prepared following the procedure **D** and purified by column chromatography using EtOAc/hexane and isolated as solid. Mp 76-78 °C; The enantiomeric excess (ee) was determined by chiral stationary phase HPLC using a Daicel Chiralcel OJ-H column (hexane/2-propanol = 92:8, flow rate 1.0 mL/min, λ = 254 nm), t_R = 42.45 min (minor), t_R = 58.37 min (major). **$[\alpha]_D^{25}$ = +27.56° (*c* = 0.14 g/100 mL, $CHCl_3$, 99% *ee*);** IR (Neat): ν_{max} 2973, 1762, 1552 (NO_2), 1455, 1379, 1273, 1025, 839, 756, 663 and 635 cm^{-1}; ^1H NMR ($CDCl_3$) δ 7.06 (1H, t, *J* = 8.0 Hz), 6.93 (1H, d, *J* = 8.4 Hz), 6.72 (1H, d, *J* = 7.2 Hz), 4.59 (1H, dd, *J* = 12.4, 4.8 Hz), 4.30 (1H, t, *J* = 11.2 Hz), 3.89 (3H, s), 3.86-3.83 (1H, m), 2.94-2.86 (1H, m), 2.00 (1H, m), 1.66-1.43 (3H, m), 0.99 (3H, t, *J* = 6.8 Hz); ^{13}C NMR ($CDCl_3$, DEPT-135) δ 168.3 (C, O-C=O), 147.8 (C), 140.0 (C), 125.0 (CH), 123.8 (C), 119.2 (CH), 112.6 (CH), 75.4 (CH_2), 56.0 (CH_3), 41.2 (CH), 37.9 (CH), 28.7 (CH_2), 20.5 (CH_2), 13.8 (CH_3); LRMS m/z 279.90 ($M + H^+$), calcd for $C_{14}H_{17}NO_5$ 279.1107; HRMS m/z 280.1179 ($M + H^+$), calcd for



7ea

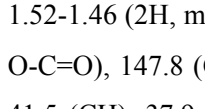
$C_{14}H_{17}NO_5H^+$ 280.1185; Anal. calcd for $C_{14}H_{17}NO_5$ (279.1107): C, 60.21; H, 6.14; N, 5.02. Found: C, 60.28; H, 6.09; N, 5.11%.

(3*S*, 4*R*)-3-Butyl-8-methoxy-4-nitromethylchroman-2-one (7fa): Prepared following the procedure **D** and purified by column chromatography using EtOAc/hexane and isolated as oily liquid. The enantiomeric excess (ee) was determined by chiral stationary phase HPLC using a Daicel Chiralcel OJ-H column (hexane/2-propanol = 70:30, flow rate 1.0 mL/min, λ = 254 nm), t_R = 14.47 min (minor), t_R = 18.73 min (major). **$[\alpha]_D^{25}$ = +12.14° (*c* = 0.15 g/100 mL, $CHCl_3$, 90% *ee*);** IR (Neat): ν_{max} 2976, 1763 (C=O), 1552 (NO_2), 1456, 1379, 1273, 1024, 840, 823, 754, and 625 cm^{-1}; ^1H NMR ($CDCl_3$) δ 7.07 (1H, t, *J* = 8.0 Hz), 6.94 (1H, d, *J* = 7.6 Hz), 6.72 (1H, d, *J* = 7.6 Hz), 4.69 (1H, dd, *J* = 12.4, 4.8 Hz), 4.30 (1H, t, *J* = 10.8 Hz), 3.90 (3H, s), 3.90-3.80 (1H, m), 2.90 (1H, quintet, *J*= 6.4 Hz), 2.06-2.04 (1H, m), 1.52-1.46 (2H, m), 1.42-1.38 (3H, m), 0.95 (3H, t, *J* = 7.2 Hz); ^{13}C NMR ($CDCl_3$, DEPT-135) δ 168.3 (C, O-C=O), 147.8 (C), 140.1 (C), 125.0 (CH), 123.8 (C) 119.3 (CH), 112.7 (CH), 75.5 (CH_2), 56.1 (CH_3), 41.5 (CH), 37.9 (CH), 29.4 (CH_2), 26.3 (CH_2), 22.4 (CH_2), 13.8 (CH_3); LRMS m/z 294.00 (M + H^+), calcd for $C_{15}H_{19}NO_5$ 293.1263; HRMS m/z 294.1340 (M + H^+), calcd for $C_{15}H_{19}NO_5H^+$ 294.1341; Anal. calcd for $C_{15}H_{19}NO_5$ (293.1263): C, 61.42; H, 6.53; N, 4.78. Found: C, 61.48; H, 6.57; N, 4.71%.



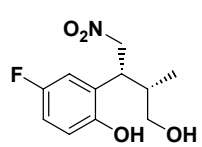
7fa

(1*R*, 2*S*)-2-(3-Hydroxy-2-methyl-1-nitromethylpropyl)phenol (9ab): Prepared following the procedure **E** and purified by column chromatography using EtOAc/hexane and isolated as solid. Mp 68 °C; The enantiomeric excess (ee) was determined by chiral stationary phase HPLC using a Daicel Chiralpak AS-H column (hexane/2-propanol = 80:20, flow rate 1.0 mL/min, λ = 254 nm), t_R = 7.53 min (minor), t_R = 9.57 min (major). **$[\alpha]_D^{25}$ = +21.4° (*c* = 0.28 g/100 mL, EtOH, 89% *ee*);** IR (Neat): ν_{max} 3373 (O-*H*), 2975, 1552 (NO_2), 1455, 1379, 1252, 1025, 841, 826, 755 and 634 cm^{-1}; ^1H NMR ($CDCl_3$) δ 7.13 (1H, t, *J* = 7.2 Hz), 6.99 (1H, d, *J* = 7.2 Hz), 6.87 (1H, t, *J* = 7.2 Hz), 6.86 (1H, d, *J* = 8.0 Hz), 4.86-4.76 (2H, m), 4.29-4.24 (1H, m), 3.50 (1H, dd, *J* = 11.2, 4.0 Hz), 3.11 (1H, t, *J* = 10.8 Hz), 2.24 (1H, br s, OH), 2.17-2.15 (1H, m), 0.77 (3H, d, *J* = 6.8 Hz); ^{13}C NMR ($CDCl_3$, DEPT-135) δ 154.8 (C), 128.8 (CH), 128.6 (CH), 122.2 (C), 120.4 (CH), 116.4 (CH), 77.9 (CH_2), 65.3 (CH_2), 37.1 (CH), 36.7 (CH), 11.5 (CH_3); LRMS m/z 226.20 (M + H^+), calcd for $C_{11}H_{15}NO_4$ 225.1001; HRMS m/z 224.0926 (M – H^+), calcd for $C_{11}H_{15}NO_4$–H^+ 224.0926; Anal. calcd for $C_{11}H_{15}NO_4$ (225.1001): C, 58.66; H, 6.71; N, 6.22. Found: C, 58.55; H, 6.76; N, 6.18%.



9ab

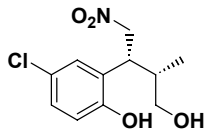
(1*R*, 2*S*)-4-Fluoro-2-(3-hydroxy-2-methyl-1-nitromethylpropyl)phenol (9ac): Prepared following the procedure **E** and purified by column chromatography using EtOAc/hexane and isolated as solid. Mp 103 °C; The enantiomeric excess (ee) was determined by chiral



9ac

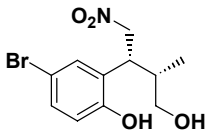
stationary phase HPLC using a Daicel Chiralpak AS-H column (hexane/2-propanol = 90:10, flow rate 1.0 mL/min, λ = 254 nm), t_R = 16.24 min (minor), t_R = 24.02 min (major). **$[\alpha]_D^{25}$ = +12.6° (*c* = 0.3 g/100 mL, $CHCl_3$, 89% *ee*);** IR (Neat): ν_{max} 3379 (O-*H*), 2974, 1553 (NO_2), 1450, 1379, 1273, 1025, 840, 821, 708, 637 and 602 cm^{-1}; ^{1}H NMR (CD_3OD) δ 6.86 (1H, dd, *J* = 10.4, 3.2 Hz), 6.82 (1H, dd, *J* = 8.4, 3.2 Hz), 6.77 (1H, dd, *J* = 8.4, 4.8 Hz), 5.05-4.94 (2H, m), 4.64 (1H, br s), 3.80-3.74 (1H, m), 3.53 (2H, d, *J* = 5.6 Hz), 2.22-2.12 (1H, m), 0.83 (3H, d, *J* = 6.8 Hz); ^{13}C NMR (CD_3OD, DEPT-135) δ 156.2 (C, d, *J* = 234.1 Hz), 151.6 (C), 126.2 (C, d, *J* = 6.5 Hz), 116.0 (CH), 115.8 (CH, d, *J* = 17.7 Hz), 113.8 (CH, d, *J* = 22.7 Hz), 77.1 (CH_2), 64.8 (CH_2), 42.0 (CH), 36.9 (CH), 13.8 (CH_3); LRMS m/z 243.90 (M + H^+), calcd for $C_{11}H_{14}FNO_4$ 243.0907; HRMS m/z 242.0833 (M – H^+), calcd for $C_{11}H_{14}FNO_4$–H^+ 242.0829; Anal. calcd for $C_{11}H_{14}FNO_4$ (243.0907): C, 54.32; H, 5.80; N, 5.76. Found: C, 54.42; H, 5.86; N, 5.71%.

(1*R*, 2*S*)-4-Chloro-2-(3-hydroxy-2-methyl-1-nitromethylpropyl)phenol (9ad): Prepared following the procedure **E** and purified by column chromatography using EtOAc/hexane and isolated as solid. Mp 135 °C; The enantiomeric excess (ee) was determined by chiral stationary phase HPLC using a Daicel Chiralpak AS-H column (hexane/2-propanol = 90:10, flow rate 0.8 mL/min, λ = 254 nm), t_R = 21.43 min (minor), t_R = 33.11 min (major). **$[\alpha]_D^{25}$ = +13.73° (*c* = 0.31 g/100 mL, EtOH, 96.8% *ee*);** IR (Neat): ν_{max} 3377 (O-*H*), 2975, 1553 (NO_2), 1449, 1379, 1274, 1023, 840, 820, 732, and 658 cm^{-1}; ^{1}H NMR ($CDCl_3$ + CD_3OD) δ 7.07 (1H, d, *J* = 8.4 Hz), 7.00 (1H, s), 6.78 (1H, d, *J* = 8.8 Hz), 4.95-4.82 (2H, m), 4.00-3.94 (1H, m), 3.52 (1H, dd, *J* = 11.2, 4.4 Hz), 3.30 (1H, dd, *J* = 11.2, 8.0 Hz), 2.20-2.13 (1H, m), 0.80 (3H, d, *J* = 6.8 Hz); ^{13}C NMR ($CDCl_3$ + CD_3OD, DEPT-135) δ 153.7 (C), 128.8 (CH), 127.9 (CH), 125.1 (C), 124.2 (C), 116.9 (CH), 77.3 (CH_2), 64.9 (CH_2), 39.4 (CH), 36.7 (CH), 12.8 (CH_3); LRMS m/z 260.20 (M + H^+), calcd for $C_{11}H_{14}ClNO_4$ 259.0611; HRMS m/z 258.0530 (M – H^+), calcd for $C_{11}H_{14}ClNO_4$–H^+ 258.0533; Anal. calcd for $C_{11}H_{14}ClNO_4$ (259.0611): C, 50.88; H, 5.43; N, 5.39. Found: C, 50.75; H, 5.49; N, 5.34%.



9ad

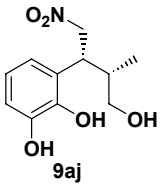
(1*R*, 2*S*)-4-Bromo-2-(3-hydroxy-2-methyl-1-nitromethylpropyl)phenol (9ae): Prepared following the procedure **E** and purified by column chromatography using EtOAc/hexane and isolated as solid. Mp 160 °C; The enantiomeric excess (ee) was determined by chiral stationary phase HPLC using a Daicel Chiralpak AS-H column (hexane/2-propanol = 88:12, flow rate 1.0 mL/min, λ = 254 nm), t_R = 12.86 min (minor), t_R = 18.96 min (major). **$[\alpha]_D^{25}$ = +12.7° (*c* = 0.3 g/100 mL, EtOH, 89.5% *ee*);** IR (Neat): ν_{max} 3367 (O-*H*), 2972, 1553 (NO_2), 1449, 1379, 1274, 1025, 820, 657 and 632 cm^{-1}; ^{1}H NMR (CD_3OD) δ 7.22 (1H, s), 7.20 (1H, d, *J* = 4.0 Hz), 6.73 (1H, d, *J* = 8.0 Hz), 5.55-4.94 (2H, m), 3.72-3.68 (1H, m), 3.54 (2H, d, *J* = 4.0 Hz), 2.21-



9ae

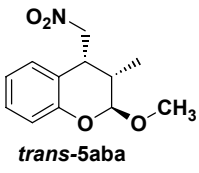
2.14 (1H, m), 0.82 (3H, d, J = 8.0 Hz); ^{13}C NMR (CD_3OD, DEPT-135) δ 154.9 (C), 132.4 (CH), 130.6 (CH), 127.4 (C), 117.0 (CH), 110.7 (C), 77.0 (CH_2), 64.7 (CH_2), 42.4 (CH), 36.8 (CH), 14.1 (CH_3); LRMS m/z 302.50 (M – H^+), calcd for $C_{11}H_{14}BrNO_4$ 303.0106; HRMS m/z 302.0028 (M – H^+), calcd for $C_{11}H_{14}BrNO_4$–H^+ 302.0028; Anal. calcd for $C_{11}H_{14}BrNO_4$ (303.0106): C, 43.44; H, 4.64; N, 4.61. Found: C, 43.51; H, 4.68; N, 4.65%.

(1*R*, 2*S*)-3-(3-Hydroxy-2-methyl-1-nitromethylpropyl)benzene-1,2-diol (9aj): Prepared following the procedure **E** and purified by column chromatography using EtOAc/hexane and isolated as solid. The enantiomeric excess (ee) was determined by chiral stationary phase HPLC using a Daicel Chiralpak AS-H column (hexane/2-propanol = 92:08, flow rate 1.0 mL/min, λ = 254 nm), t_R = 46.98 min (minor), t_R = 51.19 min (major). **$[\alpha]_D^{25}$ = –17.6° (*c* = 0.11 g/100 mL, $CHCl_3$, >99% *ee*);** IR (Neat): ν_{max} 3589 (O-*H*), 2973, 1550 (NO_2), 1490, 1379, 1222, 1131, 1042, 977, 757 and 635 cm^{-1}; ^{1}H NMR ($CDCl_3$) δ 6.79-6.71 (2H, m), 6.51 (1H, dd, J = 6.4, 1.2 Hz), 4.78 (2H, d, J = 7.6 Hz), 4.22 (1H, m), 3.54 (1H, dd, J = 11.2, 4.0 Hz), 3.06 (1H, t, J = 10.4 Hz), 2.14 (1H, m), 0.77 (3H, d, J = 6.8 Hz); ^{13}C NMR ($CDCl_3$, DEPT-135) δ 145.5 (C), 142.7 (C), 122.4 (C), 120.9 (CH), 119.5 (CH), 114.2 (CH), 77.6 (CH_2), 65.5 (CH_2), 36.5 (CH), 36.2 (CH), 10.9 (CH_3); LRMS m/z 242.05 (M + H^+), calcd for $C_{11}H_{15}NO_5$ 241.0950; HRMS m/z 240.0870 (M – H^+), calcd for $C_{11}H_{15}NO_5$–H^+ 240.0872; Anal. calcd for $C_{11}H_{15}NO_5$ (241.0950): C, 54.77; H, 6.27; N, 5.81. Found: C, 54.61; H, 6.32; N, 5.75%.



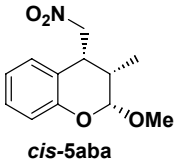
9aj

(2*S*, 3*S*, 4*R*)-2-Methoxy-3-methyl-4-nitromethylchroman (*trans*-5aba): Prepared following the procedure **F** and purified by column chromatography using EtOAc/hexane and isolated as solid. Mp 80 °C; The enantiomeric excess (ee) was determined by chiral stationary phase HPLC using a Daicel Chiralcel OD-H column (hexane/2-propanol = 98:2, flow rate 0.5 mL/min, λ = 254 nm), t_R = 15.12 min (minor), t_R = 18.80 min (major). **$[\alpha]_D^{25}$ = –23.60° (*c* = 0.44 g/100 mL, $CHCl_3$, 98% *ee*);** IR (Neat): ν_{max} 2974, 1551 (NO_2), 1494, 1380, 1198, 982, 913, 818 and 635 cm^{-1}; ^{1}H NMR ($CDCl_3$) δ 7.20 (1H, t, J = 7.2 Hz), 7.00 (1H, d, J = 6.8 Hz), 6.91 (1H, t, J = 6.8 Hz), 6.89 (1H, d, J = 8.0 Hz), 4.95 (1H, br s), 4.87 (1H, dd, J = 13.2, 5.2 Hz), 4.62 (1H, dd, J = 13.2, 7.6 Hz), 3.07-3.68 (1H, m), 3.48 (3H, s), 2.47-1.44 (1H, m), 1.20 (3H, d, J = 7.2 Hz); ^{13}C NMR ($CDCl_3$, DEPT-135) δ 150.6 (C), 129.0 (CH), 128.8 (CH), 122.2 (C), 121.3 (CH), 117.5 (CH), 101.2 (CH), 78.2 (CH_2), 56.2 (CH_3), 36.5 (CH), 33.3 (CH), 12.7 (CH_3); LRMS m/z 236.60 (M - H^+), calcd for $C_{12}H_{15}NO_4$ 237.1001; Anal. calcd for $C_{12}H_{15}NO_4$ (237.1001): C, 60.75; H, 6.37; N, 5.90. Found: C, 60.85; H, 6.32; N, 5.85%.



trans-5aba

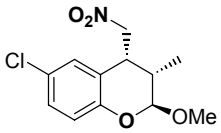
(2*R*, 3*S*, 4*R*)-2-Methoxy-3-methyl-4-nitromethylchroman (*cis*-5aba): Prepared following the



cis-5aba

procedure **F** and purified by column chromatography using EtOAc/hexane and isolated as oily liquid. The enantiomeric excess (ee) was determined by chiral stationary phase HPLC using a Daicel Chiralcel OD-H column (hexane/2-propanol = 98:02, flow rate 1.0 mL/min, λ = 254 nm), t_R = 20.56 min (minor), t_R = 24.70 min (major). **$[\alpha]_D^{25}$ = +86.90° (*c* = 0.14 g/100 mL, $CHCl_3$, >99% *ee*);** IR (Neat): ν_{max} 2974, 1551 (NO_2), 1494, 1380, 1198, 982, 913, 818 and 635 cm^{-1}; ^1H NMR ($CDCl_3$) δ 7.23-7.19 (1H, m), 7.00-6.90 (3H, m), 4.95 (1H, dd, *J* = 12.4, 6.4 Hz), 4.88 (1H, br s), 4.57 (1H, dd, *J* = 12.8, 9.2 Hz), 4.08-4.06 (1H, m), 3.49 (3H, s), 2.21-2.20 (1H, m), 0.97 (3H, d, *J* = 6.8 Hz); ^{13}C NMR ($CDCl_3$, DEPT-135) δ 150.9 (C), 128.8 (CH), 126.0 (CH), 121.6 (CH), 120.0 (C), 117.6 (CH), 101.9 (CH), 76.1 (CH_2), 55.8 (CH_3), 33.0 (CH), 31.8 (CH), 10.9 (CH_3); LRMS m/z 236.50 ($M - H^+$), calcd for $C_{12}H_{15}NO_4$ 237.1001; Anal. calcd for $C_{12}H_{15}NO_4$ (237.1001): C, 60.75; H, 6.37; N, 5.90. Found: C, 60.80; H, 6.35; N, 5.88%.

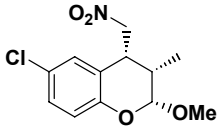
(2*S*, 3*S*, 4*R*)-6-Chloro-2-methoxy-3-methyl-4-nitromethylchroman (*trans*-5ada): Prepared following



trans-5ada

the procedure **F** and purified by column chromatography using EtOAc/hexane and isolated as oily liquid. The enantiomeric excess (ee) was determined by chiral stationary phase HPLC using a Daicel Chiralcel OD-H column (hexane/2-propanol = 98:02, flow rate 0.5 mL/min, λ = 254 nm), t_R = 18.46 min (minor), t_R = 23.32 min (major). **$[\alpha]_D^{25}$ = –45.4° (*c* = 0.28 g/100 mL, $CHCl_3$, 80.71% *ee*);** IR (Neat): ν_{max} 2973, 1551 (NO_2), 1494, 1429, 1379, 1198, 982, 913, 817 and 634 cm^{-1}; ^1H NMR ($CDCl_3$) δ 7.15 (1H, d, *J* = 8.8 Hz), 7.01 (1H, s), 6.83 (1H, d, *J* = 8.8 Hz), 4.92 (1H, br s), 4.89 (1H, dd, *J* = 13.6, 4.4 Hz), 4.59 (1H, dd, *J* = 13.6, 7.6 Hz), 3.67-3.65 (1H, m), 3.47 (3H, s), 2.41 (1H, m), 1.19 (3H, d, *J* = 7.2 Hz); ^{13}C NMR ($CDCl_3$, DEPT-135) δ 149.3 (C), 129.2 (CH), 128.4 (CH), 126.2 (C), 123.9 (C), 118.9 (CH), 101.3 (CH), 77.9 (CH_2), 56.3 (CH_3), 36.2 (CH), 33.2 (CH), 12.6 (CH_3); LRMS m/z 272.30 ($M + H^+$), calcd for $C_{12}H_{14}ClNO_4$ 271.0611; HRMS m/z 270.0533 ($M – H^+$), calcd for $C_{12}H_{14}ClNO_4$-H 270.0533; Anal. calcd for $C_{12}H_{14}ClNO_4$ (271.0611): C, 53.05; H, 5.19; N, 5.16. Found: C, 53.12; H, 5.23; N, 5.13%.

(2*R*, 3*S*, 4*R*)-6-Chloro-2-methoxy-3-methyl-4-nitromethylchroman (*cis*-5ada): Prepared following the

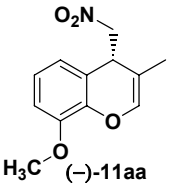


cis-5ada

procedure **F** and purified by column chromatography using EtOAc/hexane and isolated as oily liquid. The enantiomeric excess (ee) was determined by chiral stationary phase HPLC using a Daicel Chiralcel OD-H column (hexane/2-propanol = 99:1, flow rate 0.5 mL/min, λ = 254 nm), t_R = 36.79 min (major), t_R = 43.02 min (minor). **$[\alpha]_D^{25}$ = +28.08° (*c* = 0.1 g/100 mL, $CHCl_3$, 88.92% *ee*);** IR (Neat): ν_{max} 2973, 1551 (NO_2), 1494, 1429, 1379, 1198, 982, 913, 817 and 634 cm^{-1}; ^1H NMR ($CDCl_3$) δ 7.18-7.15 (1H, m), 6.98 (1H, s), 6.85 (1H, d, *J* = 8.4 Hz), 4.93-4.87 (2H, m), 4.57 (1H, dd, *J* = 12.4, 9.2 Hz), 4.07-4.02 (1H, m), 3.48 (3H, s), 2.20-2.19 (1H, m), 0.94 (3H, d, *J* = 7.2 Hz); ^{13}C NMR ($CDCl_3$, DEPT-135) δ 149.5 (C), 128.8 (CH), 126.4 (C), 126.0 (CH), 121.7 (C), 118.9 (CH), 101.9 (CH), 75.7 (CH_2), 55.8 (CH_3), 32.9 (CH), 31.5 (CH),

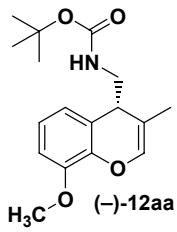
10.8 (CH_3); LRMS m/z 272.30 ($M + H^+$), calcd for $C_{12}H_{14}NO_4$ 271.0611; Anal. calcd for $C_{12}H_{14}NO_4$ (271.0611): C, 53.05; H, 5.19; N, 5.16. Found: C, 53.15; H, 5.22; N, 5.09%.

(*4R*)-8-Methoxy-3-methyl-4-nitromethyl-4H-chromene (11aa): Prepared following the procedure **G**

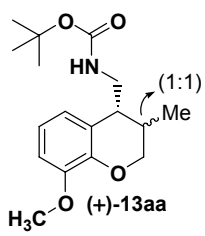


and purified by column chromatography using EtOAc/hexane and isolated as white solid. The enantiomeric excess (ee) was determined by chiral stationary phase HPLC using a Daicel Chiralcel OJ-H column (hexane/2-propanol = 90:10, flow rate 1.0 mL/min, λ = 254 nm), t_R = 45.41 min (minor), t_R = 61.92 min (major). **$[\alpha]_D^{25}$ = –62.74 (*c* = 0.28 g/100 mL, $CHCl_3$, 99% *ee*);** IR (Neat): ν_{max} 1619 (C=C), 1584, 1544, 1484, 1266, 1213, 1125, 1102, 774, 733, 646 and 622 cm^{-1}; ^1H NMR ($CDCl_3$) δ 7.01 (1H, t, *J* = 8.0 Hz), 6.84 (1H, d, *J* = 8.4 Hz), 6.69 (1H, d, *J* = 8.0 Hz), 6.65 (1H, s), 4.56 (1H, dd, *J* = 12.0, 4.8 Hz), 4.44 (1H, dd, *J* = 11.6, 7.2 Hz), 4.14 (1H, t, *J* = 6.8 Hz), 3.89 (3H, s), 1.79 (3H, s); ^{13}C NMR ($CDCl_3$, DEPT-135) δ 147.9 (C), 140.9 (C), 138.7 (CH), 123.6 (CH), 119.8 (C), 119.5 (CH), 110.7 (CH), 107.6 (C), 79.6 (CH_2), 56.0 (CH_3), 38.8 (CH), 16.0 (CH_3); LRMS m/z 235.90 ($M + H^+$), calcd for $C_{12}H_{13}NO_4$ 235.0845; Anal. calcd for $C_{12}H_{13}NO_4$ (235.0845): C, 61.27; H, 5.57; N, 5.95. Found: C, 61.33; H, 5.52; N, 6.07%.

***tert*-Butyl (*4R*)-(8-Methoxy-3-methyl-4H-chromen-4-ylmethyl)carbamate (12aa):** Prepared following



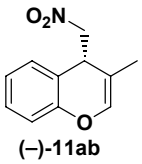
the procedure **H** and purified by column chromatography using EtOAc/hexane and isolated as liquid. The enantiomeric excess (ee) was determined by chiral stationary phase HPLC using a Daicel Chiralpak AD-H column (hexane/2-propanol = 97:03, flow rate 1.0 mL/min, λ = 254 nm), t_R = 13.85 min (major), t_R = 16.0 min (minor). **$[\alpha]_D^{25}$ = –20.06° (*c* = 0.1 g/100 mL, $CHCl_3$, 80.9% *ee*);** IR (Neat): ν_{max} 2975, 1710 (C=O), 1485, 1266, 1171, 780, 737, and 622 cm^{-1}; ^1H NMR ($CDCl_3$) δ 6.98 (1H, t, *J* = 8.0 Hz), 6.77 (1H, d, *J* = 8.0 Hz), 6.73 (1H, d, *J* = 7.6 Hz), 6.60 (1H, s), 4.45 (1H, br s), 3.88 (3H, s), 3.47-3.46 (1H, m), 3.41-3.39 (2H, m), 1.74 (3H, s), 1.37 (9H, s); ^{13}C NMR ($CDCl_3$, DEPT-135) δ 156.0 (C), 147.6 (C), 141.3 (C), 137.3 (CH), 123.0 (CH), 121.9 (C), 120.2 (CH), 109.7 (CH), 109.5 (C), 79.2 (C), 55.9 (CH_3), 44.1 (CH_2), 39.2 (CH), 28.2 (3 x CH_3), 16.1 (CH_3); LRMS m/z 303.95 ($M - H^+$), calcd for $C_{17}H_{23}NO_4$ 305.1627; Anal. calcd for $C_{17}H_{23}NO_4$ (305.1627): C, 66.86; H, 7.59; N, 4.59. Found: C, 66.79; H, 7.65; N, 4.51%.



***tert*-Butyl-(3*S*, *4R*)-(8-Methoxy-3-methyl-chroman-4-ylmethyl)carbamate (*cis*-13aa) and *tert*-Butyl-(3*R*, *4R*)-(8-Methoxy-3-methyl-chroman-4-ylmethyl)carbamate (*trans*-13aa):** Prepared following the procedure **H** and purified by column chromatography using EtOAc/hexane and isolated as liquid. The enantiomeric excess (ee) of *cis*-**13aa** and *trans*-**13aa** was determined by chiral stationary phase HPLC using a Daicel Chiralcel OD-H column (hexane/2-propanol = 95:5, flow rate 1.0 mL/min, λ = 254 nm), t_R = 17.66 min (major), t_R = 27.78

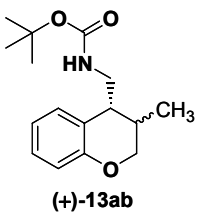
min (minor); t_R = 23.82 min (major), t_R = 30.35 min (minor). **$[\alpha]_D^{25}$ = +59.33° (*c* = 0.14 g/100 mL, $CHCl_3$, 93% *ee*);** IR (Neat): ν_{max} 2962, 1712 (C=O), 1484, 1263, 830, 681, and 634 cm^{-1}; ^1H NMR ($CDCl_3$, 1:1 ratio of isomers) δ 6.86-6.80 (2H,m), 6.76-6.70 (4H, m), 4.58 (2H, br s), 4.21-4.18 (2H, m), 3.86 (6H, s), 3.49-3.67 (4H, m), 2.98 (1H, br s), 2.62 (1H, br s), 2.30 (1H, br s), 2.04 (1H, br s), 1.44 (9H, s), 1.43 (9H, s), 1.08 (3H, d, *J* = 5.6 Hz), 1.06 (3H, d, *J* = 6.4 Hz); ^{13}C NMR ($CDCl_3$, DEPT-135, 1:1 ratio of isomers) δ 156.1 (C), 155.7 (C), 148.3 (2 x C), 144.2 (C), 143.4 (C), 123.8 (C), 122.6 (C), 121.3 (CH), 121.1 (CH), 120.1 (CH), 119.6 (CH), 109.6 (CH), 109.3 (CH), 82.0 (C), 79.4 (C), 69.2 (CH_2), 68.6 (CH_2), 55.8 (2 x CH_3), 44.6 (CH_2), 41.6 (CH_2), 41.5 (CH), 38.3 (CH), 29.0 (CH), 28.4 (3 x CH_3), 28.33 (3 x CH_3), 28.2 (CH), 16.8 (CH_3), 12.9 (CH_3); LRMS m/z 306.30 (M - H^+), calcd for $C_{17}H_{25}NO_4$ 307.1784; Anal. calcd for $C_{17}H_{25}NO_4$ (307.1784): C, 66.43; H, 8.20; N, 4.56. Found: C, 66.25; H, 8.16; N, 4.61%.

(4*R*)-3-Methyl-4-nitromethyl-4*H*-chromene (11ab): Prepared following the procedure **G** and purified by column chromatography using EtOAc/hexane and isolated as solid. Mp: 78 °C. The enantiomeric excess (*ee*) was determined by chiral stationary phase HPLC using a Daicel Chiralcel OJ-H column (hexane/2-propanol = 90:10, flow rate 1.0 mL/min, λ = 254 nm), t_R = 14.54 min (minor), t_R = 15.62 min (major). **$[\alpha]_D^{25}$ = –114.94° (*c* = 0.143 g/100 mL, $CHCl_3$, 94% *ee*);** IR (Neat): ν_{max} 1619 (C=C), 1544, 1484, 1266, 1234, 1213, 1125, 774, 733, 646 and 622 cm^{-1}; ^1H NMR ($CDCl_3$) δ 7.27-7.21 (1H, m), 7.11-7.04 (2H, m), 6.97 (1H, d, *J* = 8.0 Hz), 6.56 (1H, br s), 4.57 (1H, dd, *J* = 11.6, 4.8 Hz), 4.46 (1H, dd, *J* = 11.6, 7.2 Hz), 4.13 (1H, br t, *J* = 6.4 Hz), 1.78 (3H, s); ^{13}C NMR ($CDCl_3$, DEPT-135) δ 151.2 (C), 138.7 (CH), 128.7 (CH), 128.1 (CH), 123.8 (CH), 119.0 (C), 116.6 (CH), 107.4 (C), 79.6 (CH_2), 38.8 (CH), 16.0 (CH_3); LRMS m/z 206.00 (M + H^+), calcd for $C_{11}H_{11}NO_3$ 205.0739; Anal. calcd for $C_{11}H_{11}NO_3$ (205.0739): C, 64.38; H, 5.40; N, 6.83 . Found: C, 64.29; H, 5.45; N, 6.79%.



(–)-11ab

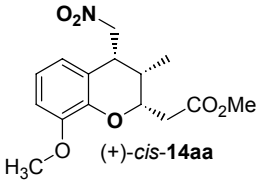
***tert*-Butyl-(3*S*, *4R*)-(3-methyl-chroman-4-ylmethyl)carbamate (*cis*-13ab) and *tert*-Butyl-(3*R*, *4R*)-(3-methyl-chroman-4-ylmethyl)carbamate (*trans*-13ab):** Prepared following the procedure **H** and purified by column chromatography using EtOAc/hexane and isolated as liquid. **$[\alpha]_D^{25}$ = +45.17° (*c* = 0.071 g/100 mL, $CHCl_3$, 94% *ee*);** IR (Neat): ν_{max} 3477, 1708 (C=O), 1358, 1259, 1062, 979, 755, and 644 cm^{-1}; ^1H NMR ($CDCl_3$, 1.6:1 ratio of isomers) δ 7.15-7.10 (4H, m), 6.89 (2H, t, *J* = 7.2 Hz), 6.83 (1H, d, *J* = 8.0 Hz), 6.82 (1H, d, *J* = 7.6 Hz), 4.63 (2H, br s), 4.15 (1H, d, *J* = 10.8 Hz), 4.10 (1H, dd, *J* = 10.8, 3.2 Hz), 3.95 (1H, t, *J* = 10.4 Hz), 3.87 (1H, dd, *J* = 10.8, 5.2 Hz), 3.47-3.40 (2H, m), 3.37-3.32 (2H, m), 2.98 (1H, br s), 2.62 (1H, br s), 2.31 (1H, br s), 2.04 (1H, br s), 1.46 (9H, s, 3 x CH_3), 1.44 (9H, s, 3 x CH_3), 1.08 (3H, d, *J* = 6.8 Hz, CHCH_3), 1.07 (3H, d, *J* = 6.8 Hz, CHCH_3); ^{13}C NMR ($CDCl_3$, DEPT-135, 1.6:1 ratio of isomers) δ 156.1 (C), 155.8 (C), 154.7 (C), 154.0 (C), 129.7 (CH), 129.3 (CH), 128.0 (CH), 127.7



(+)-13ab

(CH), 123.2 (C), 121.9 (C), 120.6 (CH), 120.1 (CH), 116.9 (CH), 116.7 (CH), 79.4 (2 x C), 68.9 (CH_2), 68.1 (CH_2), 44.7 (2 x CH_2), 41.6 (2 x CH), 38.4 (CH), 29.2 (CH), 28.3 (6 x CH_3), 16.8 (CH_3), 12.9 (CH_3); LRMS m/z 278.00 ($M + H^+$), calcd for $C_{16}H_{23}NO_3$ 277.1678; Anal. calcd for $C_{16}H_{23}NO_3$ (277.1678): C, 69.29; H, 8.36; N, 5.05. Found: C, 69.15; H, 8.29; N, 5.12%.

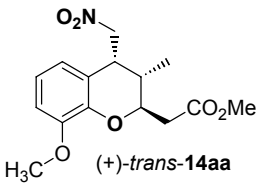
Methyl (2*R*, 3*S*, *4R*)-(8-methoxy-3-methyl-4-nitromethyl-chroman-2-yl)acetate (*cis*-14aa): Prepared



(+)-*cis*-**14aa**

by following the procedure **I** and purified by column chromatography using EtOAc/hexane and isolated as liquid. **$[\alpha]_D^{25}$ = +51.01° (*c* = 0.385 g/100 mL, $CHCl_3$);** IR (Neat): ν_{max} 2953, 1738, 1554 (NO_2), 1437, 1379, 1265, 1059, 951, 825, 783 and 700 cm^{-1}; ^1H NMR ($CDCl_3$) δ 6.88 (1H, t, *J* = 8.0 Hz), 6.78 (1H, d, *J* = 7.2 Hz), 6.73 (1H, d, *J* = 8.0 Hz), 4.64 (2H, d, *J* = 7.6 Hz), 4.47 (1H, t, *J* = 6.8 Hz), 3.83 (3H, s, OCH_3), 3.74 (3H, s, OCH_3), 3.43 (1H, t, *J* = 7.6 Hz), 3.02 (1H, dd, *J* = 15.6, 6.8 Hz), 2.70 (1H, dd, *J* = 16.0, 6.8 Hz), 2.02 (1H, q, *J* = 6.8 Hz), 0.99 (3H, d, *J* = 6.8 Hz); ^{13}C NMR ($CDCl_3$, DEPT-135) δ 170.6 (C), 148.3 (C), 144.0 (C), 121.6 (CH), 121.0 (CH), 118.5 (C), 110.8 (CH), 80.5 (CH_2), 70.5 (CH), 56.0 (CH_3, OCH_3), 51.9 (CH_3, OCH_3), 41.2 (CH), 37.2 (CH_2), 30.2 (CH), 12.2 (CH_3); LRMS m/z 308.00 ($M - H^+$), calcd for $C_{15}H_{19}NO_6$ 309.12; Anal. alcd for $C_{15}H_{19}NO_6$ (309.12): C, 58.25; H, 6.19; N, 4.53. Found: C, 58.32; H, 6.23; N, 4.46%.

Methyl (2*S*, 3*S*, *4R*)-(8-methoxy-3-methyl-4-nitromethyl-chroman-2-yl)acetate (*trans*-14aa):



(+)-*trans*-**14aa**

Prepared by following the procedure **I** and purified by column chromatography using EtOAc/hexane and isolated as liquid. **$[\alpha]_D^{25}$ = +28.94° (*c* = 0.471 g/100 mL, $CHCl_3$);** IR (Neat): ν_{max} 2953, 2596, 1732, 1554 (NO_2), 1483, 1265, 1084, 906, 733 and 692 cm^{-1}; ^1H NMR ($CDCl_3$, 2:1 ratio of isomers, major isomer) δ 6.95-6.72 (3H, m), 4.63 (2H, d, *J* = 6.8 Hz), 4.47 (1H, q, *J* = 6.4 Hz), 3.81 (3H, s, OCH_3), 3.72 (3H, s, OCH_3), 3.80-3.72 (1H, m), 2.80-2.71 (2H, m), 2.21-2.18 (1H, m), 1.07 (3H, d, *J* = 7.2 Hz, CHCH_3); ^{13}C NMR ($CDCl_3$, DEPT-135, 2:1 ratio of isomers, major isomer) δ 170.7 (C), 148.6 (C), 142.3 (C), 120.6 (CH), 119.4 (CH), 116.6 (C), 111.2 (CH), 79.4 (CH_2), 74.6 (CH), 56.0 (CH_3, OCH_3), 51.9 (CH_3, OCH_3), 38.3 (CH), 36.4 (CH_2), 32.4 (CH), 12.1 (CH_3); LRMS m/z 308.00 ($M - H^+$), calcd for $C_{15}H_{19}NO_6$ 309.12; Anal. alcd for $C_{15}H_{19}NO_6$ (309.12): C, 58.25; H, 6.19; N, 4.53. Found: C, 58.19; H, 6.17; N, 4.58%.

Datablock: dbr15a (Compound (–)-7aa):

Bond precision: C-C = 0.0054 A Wavelength=1.54184

Cell: a=5.6366(2) b=12.6433(7) c=16.9777(7)

alpha=90 beta=90 gamma=90

Temperature: 293 K

	Calculated	Reported
Volume	1209.92(9)	1209.92(9)
Space group	P 21 21 21	P 21 21 21
Hall group	P 2ac 2ab	?
Moiety formula	C12 H13 N O5	?
Sum formula	C12 H13 N O5	C12 H11 N O5
Mr	251.23	249.22
Dx,g cm-3	1.379	1.368
Z	4	4
Mu (mm-1)	0.919	0.919
F000	528.0	520.0
F000'	529.90	
h,k,lmax	6,14,19	6,14,19
Nref	1121[1870]	1782
Tmin,Tmax	0.727,0.773	0.538,1.000
Tmin'	0.659	

Correction method= MULTI-SCAN

Data completeness= 1.59/0.95 Theta(max)= 61.220

R(reflections)= 0.0920(1669) wR2(reflections)= 0.2354(1782)

S = 1.118 Npar= 165

Datablock dbr15a (Compound (–)-7aa) - ellipsoid plot