Synthesis and Biological Evaluation of Colchicine B-Ring Analogues Tethered with Halogenated Benzyl Moieties.

Laura Cosentino, Mariano Redondo-Horcajo, Ying Zhao, Ana Rita Santos, Kaniz F. Chowdury, Victoria Vinader, Qasem M. A. Abdallah, Hamdy Abdel-Rahman, Jérémie Fournier Dit Chabert, Steven D. Shnyder, Paul M. Loadman, Wei-shuo Fang, José Fernando Díaz, Isabel Barasoain, Philip A. Burns, Klaus Pors.

Supporting Information

Synthesis: Materials and Methods

All chemicals were obtained from Aldrich (Poole, Dorset) and Lancaster (Morecambe, Lancashire). Anhydrous THF was from Aldrich. All other solvents were supplied by VWR. Silica for column chromatography: particle size 35-70 µm and thin layer chromatography plates (on aluminium) were supplied by VWR. Analytical thin-layer chromatography (TLC) was performed on plates precoated with silica gel 60 F254 (Merck). Visualisation of the plates was carried out using UV light (254 nm). Melting points were determined with a Stuart scientific SMP3 melting point apparatus. ^{1}H and ^{13}C NMR spectra were measured on a Bruker Advance AM 400 (400 MHz) spectrometer. NMR spectra were processed using a Bruker XWIN NMR 3.5 program. Low resolution mass spectra (LRMS) were generated using a Micromass Quattro Ultima mass spectrometer. High resolution accurate mass measurements were obtained from EPSRC National Mass Spectrometry Service Centre, University of Wales, Swansea. HPLC analysis was performed on Agilent Technologies 1200 HPLC system with diode array detection, using C18 reversed phase columns (Agilent Eclipse XDB - analytical: 4.6 x 100 mm; preparative: 21.2 x 150 mm). The purity of all compounds was ≥95%.

Benzyl-*N*-aminocolchicine

To a stirring solution of *N*-deacetylcolchicine (150 mg, 0.419 mmol) in anhydrous THF (6 mL) under argon atmosphere were added benzyl bromide (0.107 g, 0.629 mmol) and NEt_3 (116 µL, 0.839 mmol). The resulting solution was heated at 65°C for 16 h. The reaction mixture was then poured in saturated $NaHCO_3$ (20 mL) and extracted with CH_2Cl_2 (3 x 25 mL). The combined organic extracts were dried over $MgSO_4$ and the solvent was removed under vacuum. The crude oil was subjected to column chromatography on silica gel (Pet. Ether/EtOAc 1:1 → EtOAc) to give the title compound as a yellow oil (0.146 g, 70%). δ_H (400 MHz, $CDCl_3$): 1.65-1.72 (m, 1H, H6), 2.14-2.23 (m, 1H, H6'), 2.32-2.41 (m, 1H, H5), 2.44 (dd, 1H, *J* 6.8 and 13.4 Hz, H5'), 3.39 (d, 1H, *J* 13.0 Hz, H14), 3.44 (dd, 1H, *J* 6.8 and 11.3 Hz, H7), 3.52 (s, 3H, OCH_3), 3.71 (d, 1H, *J* 13.0 Hz, H14'), 3.88 (s, 3H, OCH_3), 3.89 (s, 3H, OCH_3), 3.99 (s, 3H, OCH_3), 6.50 (s, 1H, HAr), 6.79 (d, 1H, *J* 10.8 Hz, HAr), 7.13-7.18 (m, 1H, HAr), 7.20-7.22 (m, 5H, HAr), 7.90 (s, 1H, HAr.) ^{13}C (101 MHz, $CDCl_3$): 30.3 (C5), 38.8 (C6), 51.8 (C14), 56.0 (CH_3), 56.3 (CH_3), 60.0 (C7), 60.8 (CH_3), 61.2 (CH_3), 107.1 (CHAr), 111.8 (CHAr), 125.5 (CAr), 127.0 (CHAr), 128.1 (CHAr), 128.3 (CHAr), 132.4 (CHAr), 134.6 (CHAr), 135.2 (CAr), 137.0 (CAr), 139.8 (CAr), 141.1 (CAr), 150.7 (CAr), 151.0 (CAr), 153.2 (CAr), 163.9 (CAr), 179.8 (CO). m/z (AP+) 448 $[M+H]^+$ (100%). HMRS calc. for $C_{27}H_{30}O_5N_1$ 448.2118, found 448.2116 $[M+H]^+$.

4-Bromobenzyl-*N*-aminocolchicine

The method follows that of Benzyl-*N*-aminocolchicine. Reagents and solvent used: *N*-deacetylcolchicine (50 mg, 0.140 mmol), anhydrous THF (3 mL), 4-bromobenzyl bromide (52.4 mg, 0.210 mmol) and NEt_3 (39 µL, 0.280 mmol). The crude oil was subjected to column chromatography on silica gel (Pet. Ether/EtOAc 1:1 → EtOAc) to give the title compound as a straw-coloured solid (52 mg, 71%). δ_H (400 MHz, $CDCl_3$): 1.70-1.77 (m, 1H, H6), 2.18-2.26 (m, 1H, H6'), 2.32-2.40 (m, 1H, H5), 2.45 (dd, 1H, *J* 6.3 and 13.0 Hz, H5'), 3.40-3.44 (m, 1H, H7), 3.43 (d, 1H, *J* 13.5 Hz, H14), 3.54 (s, 3H, OCH_3), 3.68 (d, 1H, *J* 13.5 Hz, H14'), 3.88 (s, 3H, OCH_3), 3.89 (s, 3H, OCH_3), 3.98 (s, 3H, OCH_3), 6.50 (s, 1H, HAr), 6.80 (d, 1H, *J* 10.8 Hz, HAr), 7.11 (d, 2H, *J* 8.4 Hz, HAr), 7.21 (d, 1H, *J* 10.8 Hz, HAr), 7.32 (d, 2H, *J* 8.4 Hz, HAr), 7.85 (s, 1H, HAr). ^{13}C (101 MHz, $CDCl_3$): 30.2 (C5), 38.4 (C6), 50.9 (C14), 56.0 (OCH_3), 56.3 (OCH_3), 59.9 (C7), 60.9 (OCH_3), 61.2 (OCH_3), 107.1 (CHAr), 111.9 (CHAr), 120.9 (CAr), 125.3 (CAr), 130.0 (CHAr), 131.4 (CHAr), 132.3 (CHAr), 134.9 (CHAr), 135.0 (CAr), 136.9 (CAr), 138.1 (CAr), 141.2 (CAr), 150.4 (CAr), 150.7 (CAr), 153.3 (CAr), 163.9 (CAr), 179.7 (C=O). m/z (ES+) 526 (100% $C_{27}H_{29}{}^{79}BrNO_5$), 528 (98% $C_{27}H_{29}{}^{81}BrNO_5$) $[M+H]^+$. HMRS calc. for $C_{27}H_{29}O_5N_1Br_1$ 526.1224, found 526.1220 $[M+H]^+$.

3-Fluorobenzyl-*N*-aminocolchicine

The method follows that of Benzyl-*N*-aminocolchicine. Reagents and solvent used: *N*-deacetylcolchicine (35 mg, 0.098 mmol), anhydrous THF (3 mL), 3-fluorobenzyl bromide (27.8 mg, 0.147 mmol) and NEt_3 (27 µL, 0.196 mmol). The crude oil was subjected to column chromatography on silica gel (Pet. Ether/EtOAc 1:1 → EtOAc) to give the title compound as a straw-coloured solid (28 mg, 64%). δ_H (400 MHz, $CDCl_3$): 1.65-1.72 (m, 1H, H6), 2.15-2.24 (m, 1H, H6'), 2.32-2.41 (m, 1H, H5), 2.45 (dd, 1H, *J* 6.2 and 13.3 Hz, H5'), 3.38-3.42 (m, 1H, H7), 3.40 (d, 1H, *J* 13.6 Hz, H14), 3.52 (s, 3H, OCH_3), 3.71 (d, 1H, *J* 13.6 Hz, H14'), 3.88 (s, 3H, OCH_3), 3.88 (s, 3H, OCH_3), 3.99 (s, 3H, OCH_3), 6.50 (s, 1H, HAr), 6.79 (d, 1H, *J* 10.7 Hz, HAr), 6.84 (dt, 2H, *J* 2.0 and 8.4 Hz, HAr), 6.93 (dd, 1H, *J* 2.0 and 9.8 Hz, HAr), 6.98 (d, 1H, *J* 7.6 Hz, HAr), 7.16 (m, 1H, HAr), 7.21 (d, 1 H, *J* 10.7 Hz, HAr), 7.83 (s, 1H, HAr). ^{13}C (101 MHz, $CDCl_3$): 30.3 (C5), 38.8 (C6), 51.1 (C14), 56.0 (OCH_3), 56.3 (OCH_3), 59.8 (C7), 60.8 (OCH_3), 61.2 (OCH_3), 107.1 (CHAr), 111.8 (CHAr), 113.8 (d, *J* 21.1 Hz, CHAr), 114.8 (d, *J* 21.3 Hz, CHAr), 123.5 (d, *J* 2.8 Hz, CHAr), 125.4 (CAr), 129.8 (d, *J* 8.2 Hz, CHAr), 132.2 (CHAr), 134.8 (CHAr), 135.1 (CAr), 136.9 (CAr), 141.2 (CAr), 142.4 (d, *J* 6.9 Hz, CAr), 150.7 (CAr), 150.8 (CAr), 153.2 (CAr), 161.6 (CAr), 163.9 (CAr), 164.0 (CAr), 179.8 (C=O). m/z (AP+) 466 $[M+H]^+$ (100%). HMRS calc. for $C_{27}H_{29}O_5N_1F_1$ 466.2024, found 466.2020 $[M+H]^+$.

4-Chlorobenzyl-*N*-aminocolchicine

The method follows that of Benzyl-*N*-aminocolchicine. Reagents and solvent used: *N*-deacetylcolchicine (35 mg, 0.098 mmol), anhydrous THF (3 mL), 4-chlorobenzyl bromide (30.2 mg, 0.147 mmol) and NEt_3 (27 µL, 0.196 mmol). The crude oil was subjected to column chromatography on silica gel (Pet.

Ether/EtOAc 1:1 → EtOAc) to give the title compound as a yellow'ish coloured solid (19 mg, 40%). δ_H (400 MHz, $CDCl_3$): 1.66-1.73 (m, 1H, H6), 2.15-2.24 (m, 1H, H6'), 2.34-2.42 (m, 1H, H5), 2.46 (dd, 1H, *J* 6.2 and 13.3 Hz, H5'), 3.39 (d, 1H, *J* 13.3 Hz, H14), 3.42 (dd, 1H, *J* 5.8 and 11.3 Hz, H7), 3.55 (s, 3H, OCH_3), 3.68 (d, 1H, *J* 13.3 Hz, H14'), 3.90 (s, 3H, OCH_3), 3.91 (s, 3H, OCH_3), 4.00 (s, 3H, OCH_3), 6.52 (s, 1H, HAr), 6.81 (d, 1H, *J* 10.8 Hz, HAr), 7.15-7.21 (m, 4H, HAr), 7.23 (d, 1H, *J* 10.8 Hz, HAr), 7.86 (s, 1H, HAr). ^{13}C (101 MHz, $CDCl_3$): 30.3 (C5), 38.8 (C6), 51.0 (C14), 56.0 (OCH_3), 56.3 (OCH_3), 60.0 (C7), 60.8 (OCH_3), 61.3 (OCH_3), 107.1 (CHAr), 111.8 (CHAr), 125.5 (CAr), 128.4 (CHAr), 129.5 (CHAr), 132.3 (CHAr), 132.7 (CAr), 134.7 (CHAr), 135.1 (CAr), 137.0 (CAr), 138.2 (CAr), 141.2 (CAr), 150.7 (CAr), 150.8 (CAr), 153.3 (CAr), 163.9 (CAr), 179.8 (C=O). m/z 428 (100% $C_{27}H_{29}{}^{35}ClNO_5$), 484 (32% $C_{27}H_{29}{}^{37}ClNO_5$) $[M+H]^+$. HMRS calc. for $C_{27}H_{29}O_5N_1Cl_1$ 482.1729, found 482.1722 $[M+H]^+$.

4-Iodobenzyl-*N*-aminocolchicine

The method follows that of Benzyl-*N*-aminocolchicine. Reagents and solvent used: *N*-deacetylcolchicine (35 mg, 0.098 mmol), anhydrous THF (3 mL), 4-iodobenzyl bromide (43.7 mg, 0.147 mmol) and NEt_3 (27 µL, 0.196 mmol). The crude oil was subjected to column chromatography on silica gel (Pet. Ether/EtOAc 1:1 → EtOAc) to give the title compound as a straw-coloured solid (25 mg, 45%). δ_H (400 MHz, $CDCl_3$): 1.61-1.68 (m, 1H, H6), 2.10-2.19 (m, 1H, H6'), 2.27-2.35 (m, 1H, H5), 2.41 (dd, 1H, *J* 6.2 and 13.3 Hz, H5'), 3.32 (d, 1H, *J* 13.3 Hz, H14), 3.36 (dd, 1H, *J* 5.4 and 10.0 Hz, H7), 3.49 (s, 3H, OCH_3), 3.59 (d, 1H, *J* 13.3 Hz, H14'), 3.84 (s, 3H, OCH_3), 3.84 (s, 3H, OCH_3), 3.93 (s, 3H, OCH_3), 6.47 (s, 1H, HAr), 6.76 (d, 1 H, *J* 10.7 Hz, HAr), 6.93 (d, 2 H, *J* 8.2 Hz, HAr), 7.17 (d, 1 H, *J* 10.7 Hz, HAr), 7.47 (d, 2 H, *J* 8.2 Hz, HAr), 7.80 (s, 1H, HAr). ^{13}C (101 MHz, $CDCl_3$): 30.3 (C5), 38.7 (C6), 51.1 (C14), 56.1 (OCH_3), 56.3 (OCH_3), 59.9 (C7), 60.9 (OCH_3), 61.3 (OCH_3), 92.3 (CAr), 107.2 (CHAr), 111.9 (CHAr), 125.4 (CAr), 130.2 (CHAr), 132.3 (CHAr), 134.8 (CHAr), 135.0 (CAr), 137.0 (CAr), 137.3 (CHAr), 139.3 (CAr), 141.2 (CAr), 150.6 (CAr), 150.7 (CAr), 153.3 (CAr), 163.9 (CAr), 179.7 (C=O). m/z (AP+) 574 $[M+H]^+$ (100%). HMRS calc. for $C_{27}H_{29}O_5N_1I_1$ 574.1085, found 574.1081 $[M+H]^+$.

2,3-Di-fluorobenzyl-*N*-aminocolchicine

The method follows that of Benzyl-*N*-aminocolchicine. Reagents and solvent used: *N*-deacetylcolchicine (50 mg, 0.140 mmol), anhydrous THF (3 mL), 2,3-di-fluorobenzyl bromide (43.5 mg, 0.210 mmol) and NEt_3 (39 µL, 0.280 mmol). The crude oil was subjected to column chromatography on silica gel (Pet. Ether/EtOAc 1:1 → EtOAc) to give the title compound as a straw-coloured solid (39 mg, 58%). δ_H (400 MHz, $CDCl_3$): 1.61-1.68 (m, 1H, H6), 2.08-2.17 (m, 1H, H6'), 2.26-2.34 (m, 1H, H5), 2.38 (dd, 1H, *J* 6.2 and 13.4 Hz, H5'), 3.35 (dd, 1H, *J* 6.3 and 10.8 Hz, H7), 3.52 (d, 1H, *J* 13.6 Hz, H14), 3.53 (s, 3H, OCH_3), 3.65 (d, 1H, *J* 13.6 Hz, H14'), 3.81 (s, 3H, OCH_3), 3.82 (s, 3H, OCH_3), 3.92 (s, 3H, OCH_3), 6.43 (s, 1H, HAr), 6.74 (d, 1 H, *J* 10.7 Hz, HAr), 6.84-6.93 (m, 2 H, HAr), 6.97-7.00 (m, 1 H, HAr), 7.15 (d, 1 H, *J* 10.7 Hz, HAr), 7.82 (s, 1H, HAr). ^{13}C (101 MHz, $CDCl_3$): 29.2 (C5), 37.5 (C6), 43.4 (C14), 55.0

(OCH_3), 55.2 (OCH_3), 58.7 (C7), 59.8 (OCH_3), 60.1 (OCH_3), 106.2 (CHAr), 110.8 (CHAr), 114.8 (d, *J* 17.1 Hz, CHAr), 122.9 (dd, *J* 4.6 and 6.7 Hz, CHAr), 124.0 (t, *J* 3.1 Hz, CHAr), 124.3 (CAr), 128.0 (d, *J* 11.7 Hz, CAr), 131.3 (CHAr), 133.7 (CHAr), 133.9 (CAr), 135.9 (CAr), 140.2 (CAr), 146.5 (d, *J* 12.6 Hz, CAr), 148.0 (d, *J* 13.0 Hz, CAr), 149.0 (d, *J* 12.7 Hz, CAr), 149.4 (CAr), 149.7 (CAr), 150.5 (d, *J* 12.9 Hz, CAr), 152.3 (CAr), 162.9 (CAr), 178.6 (CO). m/z (ES+) 484 $[M+H]^+$ (100%). HMRS calc. for $C_{27}H_{28}O_5N_1F_2$ 484.1930, found 484.1933 $[M+H]^+$.

3,4-Di-fluorobenzyl-*N*-aminocolchicine

The method follows that of Benzyl-*N*-aminocolchicine. Reagents and solvent used: *N*-deacetylcolchicine (50 mg, 0.140 mmol), anhydrous THF (3 mL), 3,4-di-fluorobenzyl bromide (43.5 mg, 0.210 mmol) and NEt_3 (39 µL, 0.280 mmol). The crude oil was subjected to column chromatography on silica gel (Pet. Ether/EtOAc 1:1 → EtOAc) to give the title compound as a yellow'ish coloured solid (44 mg, 65%). δ_H (400 MHz, $CDCl_3$): 1.61-1.74 (m, 1H, H6), 2.17-2.26 (m, 1H, H6'), 2.34-2.42 (m, 1H, H5), 2.47 (dd, 1H, *J* 6.1 and 13.6 Hz, H5'), 3.37-3.42 (m, 2H, H7 and H14), 3.57 (s, 3H, OCH_3), 3.68 (d, 1H, *J* 13.5 Hz, H14'), 3.90 (s, 3H, OCH_3), 3.90 (s, 3H, OCH_3), 4.00 (s, 3H, OCH_3), 6.52 (s, 1H, HAr), 6.81 (d, 1 H, *J* 10.7 Hz, HAr), 6.93-7.10 (m, 3 H, HAr), 7.23 (d, 2 H, *J* 10.7 HAr), 7.80 (s, 1H, HAr). ^{13}C (101 MHz, $CDCl_3$): 30.2 (C5), 38.7 (C6), 50.6 (C14), 56.0 (OCH_3), 56.3 (OCH_3), 59.9 (C7), 60.8 (OCH_3), 61.2 (OCH_3), 107.1 (CHAr), 111.9 (CHAr), 116.9 (d, *J* 9.4 Hz, CHAr), 117.0 (d, *J* 9.4 Hz, CHAr) 123.9 (dd, *J* 3.5 and 6.0 Hz, CHAr), 125.3 (CAr), 132.0 (CHAr), 134.9 (CHAr), 135.0 (CAr), 136.6 (brs CAr), 136.9 (CAr), 141.1 (CAr), 148.1 (d, *J* 12.6 Hz, CAr), 148.9 (d, *J* 12.7 Hz, CAr), 150.5 (d, *J* 12.3 Hz, CAr), 150.6 (Car,) 151.3 (d, *J* 12.5 Hz, CAr), 153.3 (CAr), 163.9 (CAr), 179.7 (CO). m/z (ES+) 484 $[M+H]^+$ (100%). HMRS calc. for $C_{27}H_{28}O_5N_1F_2$ 484.1930, found 484.1934 $[M+H]^+$.

3,5-Di-fluorobenzyl-*N*-aminocolchicine

The method follows that of Benzyl-*N*-aminocolchicine. Reagents and solvent used: *N*-deacetylcolchicine (50 mg, 0.140 mmol), anhydrous THF (3 mL), 3,5-di-fluorobenzyl bromide (43.5 mg, 0.210 mmol) and NEt_3 (39 µL, 0.280 mmol). The crude oil was subjected to column chromatography on silica gel (Pet. Ether/EtOAc 1:1 → EtOAc) to give the title compound as a straw-to-yellow'ish coloured solid (46 mg, 68%). δ_H (400 MHz, MeOD): 1.58-1.64 (m, 1H, H6), 2.13-2.17 (m, 2H, H6' and H5), 2.41 (d, 1H, *J* 7.3 Hz, H5'), 3.21-3.26 (m, 1H, H7), 3.37 (d, 1H, *J* 14.3 Hz, H14), 3.39 (s, 3H, OCH_3), 3.57 (d, 1H, *J* 14.3 Hz, H14'), 3.72 (s, 3H, OCH_3), 3.76 (s, 3H, OCH_3), 3.89 (s, 3H, OCH_3), 6.56 (s, 1H, HAr), 6.56-6.62 (m, 1H, HAr), 6.71-6.75 (m, 2H, HAr), 7.07 (d, 1H, *J* 10.9 Hz, HAr), 7.25 (d, 1 H, *J* 10.9 Hz, HAr), 7.84 (s, 1H, HAr). ^{13}C (101 MHz, MeOD): 31.0 (C5), 39.5 (C6), 51.6 (C14), 56.6 (OCH_3), 57.0 (OCH_3), 60.8 (C7), 61.5 (OCH_3), 61.6 (OCH_3), 102.9 (t, *J* 25.8 Hz, CHAr), 108.6 (CHAr), 111.9 (d, *J* 12.0 Hz, CHAr), 111.9 (d, *J* 25.1 Hz, CHAr), 115.0 (CHAr), 126.4 (CAr), 132.9 (CHAr), 136.7 (CAr), 137.6 (CHAr), 139.5 (CAr), 142.4 (CAr), 146.1 (t, *J* 8.6 Hz, CAr), 151.8 (CAr), 154.3 (CAr), 155.0 (CAr), 163.2 (d, *J* 12.8 Hz, CAr),

165.3 (CAr), 165.6 (d, *J* 12.8 Hz, CAr), 181.0 (C=O). m/z (ES+) 484 $[M+H]^+$ (100%). HMRS calc. for $C_{27}H_{28}O_5N_1F_2$ 484.1930, found 484.1933 $[M+H]^+$.

3,4,5-Tri-fluorobenzyl-*N*-aminocolchicine

The method follows that of Benzyl-*N*-aminocolchicine. Reagents and solvent used: *N*-deacetylcolchicine (50 mg, 0.140 mmol), anhydrous THF (3 mL), 3,4,5-tri-fluorobenzyl bromide (47.3 mg, 0.210 mmol) and NEt_3 (39 µL, 0.280 mmol). The crude oil was subjected to column chromatography on silica gel (Pet. Ether/EtOAc 1:1 → EtOAc) to give the title compound as a straw-coloured solid (42 mg, 60%). δ_H (400 MHz, $CDCl_3$): 1.66-1.73 (m, 1H, H6), 2.18-2.26 (m, 1H, H6'), 2.31-2.39 (m, 1H, H5), 2.45 (dd, 1H, *J* 6.2 and 13.3 Hz, H5'), 3.35-3.39 (m, 1H, H7), 3.36 (d, 1H, *J* 13.3 Hz, H14), 3.55 (s, 3H, OCH_3), 3.66 (d, 1H, *J* 13.3 Hz, H14'), 3.87 (s, 6H, OCH_3), 3.98 (s, 3H, OCH_3), 6.50 (s, 1H, HAr), 6.80 (d, 1 H, *J* 10.7 Hz, HAr), 6.86 (d, 1H, *J* 7.1 Hz, HAr), 6.88 (d, 1H, *J* 7.1 Hz, HAr), 7.21 (d, 1 H, *J* 10.7 Hz, HAr), 7.74 (s, 1H, HAr). ^{13}C (101 MHz, $CDCl_3$): 30.2 (C5), 38.6 (C6), 50.4 (C14), 56.0 (OCH_3), 56.3 (OCH_3), 59.9 (C7), 60.8 (OCH_3), 61.2 (OCH_3), 107.2 (CHAr), 111.7 (d, *J* 21.3 Hz, CHAr), 111.7 (d, *J* 10.3 Hz, CHAr), 111.9 (CHAr), 125.2 (CAr), 131.9 (CHAr), 134.9 (CAr), 135.0 (CHAr), 135.9-136.0 (m, CAr), 136.9 (CAr), 137.3 (t, *J* 15.4 Hz, CAr), 139.8 (t, *J* 15.4 Hz, CAr), 141.2 (CAr), 149.7 (dd, *J* 3.8 and 9.8 Hz, CAr), 150.4 (CAr), 150.6 (CAr), 152.2 (dd, *J* 3.8 and 9.8 Hz, CAr), 153.4 (CAr), 163.9 (CAr), 179.6 (C=O). m/z (ES+) 502 $[M+H]^+$ (100%). HMRS calc. for $C_{27}H_{28}O_5N_1F_3$ 502.1836, found 502.1840 $[M+H]^+$.

4-Nitrobenzyl-*N*-aminocolchicine

The method follows that of Benzyl-*N*-aminocolchicine. Reagents and solvent used: *N*-deacetylcolchicine (35 mg, 0.098 mmol), anhydrous THF (3 mL), 4-nitrobenzyl bromide (31.8 mg, 0.147 mmol) and NEt_3 (27 µL, 0.196 mmol). The crude oil was subjected to column chromatography on silica gel (Pet. Ether/EtOAc 1:1 → EtOAc) to give the titled compound as a yellow'ish solid (23 mg, 48%). δ_H (400 MHz, $CDCl_3$): 1.65-1.72 (m, 1H, H6), 2.14-2.24 (m, 1H, H6'), 2.28-2.36 (m, 1H, H5), 2.42 (dd, 1H, *J* 6.1 and 13.1 Hz, H5'), 3.42 (dd, 1H, *J* 6.2 and 10.9 Hz, H5'), 3.55 (s, 3H, OCH_3), 3.55 (d, 1H, *J* 14.2 Hz, H14), 3.79 (d, 1H, *J* 14.2 Hz, H14'), 3.86 (s, 3H, OCH_3), 3.87 (s, 3H, OCH_3), 3.97 (s, 3H, OCH_3), 6.50 (s, 1H, HAr), 6.80 (d, 1 H, *J* 10.7 Hz, HAr), 7.21 (d, 1H, *J* 10.7 Hz, HAr), 7.42 (d, 2 H, *J* 8.7 Hz, HAr), 7.82 (s, 1H, HAr), 8.05 (d, 2 H, *J* 8.7 Hz, HAr). ^{13}C (101 MHz, $CDCl_3$): 30.2 (CH_2), 38.6 (CH_2), 51.0 (CH_2), 56.0 (OCH_3), 56.3 (OCH_3), 60.3 (CH), 60.9 (OCH_3), 61.2 (OCH_3), 107.2 (CHAr), 112.0 (CHAr), 123.5 (CHAr), 125.2 (CAr), 128.8 (CHAr), 132.0 (CHAr), 134.9 (CAr), 135.0 (CHAr), 136.9 (CAr), 141.2 (CAr), 147.0 (CAr), 147.2 (CAr), 150.4 (CAr), 150.6 (CAr), 153.4 (CAr), 164.0 (CAr), 179.6 (C=O). m/z (ES+) 492 $[M]^+$ (100%). HMRS calc. for $C_{27}H_{29}O_7N_2$ 493.1969, found 493.1969 $[M+H]^+$.

4-Methoxybenzyl-*N*-aminocolchicine

The method follows that of Benzyl-*N*-aminocolchicine. Reagents and solvent used: *N*-deacetylcolchicine (50 mg, 0.140 mmol), anhydrous THF (3 mL), 4-methoxybenzyl bromide (42.2 mg, 0.210 mmol) and

NEt_3 (39 µL, 0.280 mmol). The crude oil was subjected to column chromatography on silica gel (Pet. Ether/EtOAc 1:1 → EtOAc) to give the title compound as a straw-coloured solid (46 mg, 69%). δ_H (400 MHz, $CDCl_3$): 1.61-1.72 (m, 1H, H6), 2.14-2.23 (m, 1H, H6'), 2.33-2.41 (m, 1H, H5), 2.45 (dd, 1H, *J* 6.1 and 13.4 Hz, H5'), 3.33 (d, 1H, *J* 12.6 Hz, H14), 3.43 (dd, 1H, *J* 6.3 and 10.9 Hz, H7), 3.55 (s, 3H, OCH_3), 3.63 (d, 1H, *J* 12.6 Hz, H14'), 3.75 (s, 3H, OCH_3), 3.89 (s, 3H, OCH_3), 3.90 (s, 3H, OCH_3), 3.99 (s, 3H, OCH_3), 6.51 (s, 1H, HAr), 6.76 (d, 2H, *J* 8.6 Hz, HAr), 6.80 (d, 1H, *J* 10.8 Hz, HAr), 7.14 (d, 2H, *J* 8.6 Hz, HAr), 7.22 (d, 1H, *J* 10.8 Hz, HAr), 7.90 (s, 1H, HAr). ^{13}C (101 MHz, $CDCl_3$): 30.4 (C5), 38.8 (C6), 51.2 (C14), 55.2 (OCH_3), 56.0 (OCH_3), 56.3 (OCH_3), 60.0 (C7), 60.9 (OCH_3), 61.3 (OCH_3), 107.1 (CHAr), 111.8 (CHAr), 113.7 (CHAr), 125.6 (CAr), 129.3 (CHAr), 131.9 (CAr), 132.4 (CHAr), 134.6 (CHAr), 135.2 (CAr), 137.0 (CAr), 141.2 (CAr), 150.7 (CAr), 151.0 (CAr), 153.2 (CAr), 158.6 (CAr), 163.9 (CAr), 179.8 (C=O). m/z (AP+) 478 $[M+H]^+$ (100%). HMRS calc. for $C_{28}H_{32}O_6N_1$ 478.2224, found 478.2218 $[M+H]^+$.

Computational chemistry: Binding models of colchicinoids 1-11

The X-ray crystal structure of bovine α,β-tubulin complexed with *N*-deacetyl-*N*-(2-mercaptoacetyl)-colchicine was obtained from the protein database (PDB code 1SA0, 3.58Å) as previously described (Ravelli, R. B. et al. Insight into tubulin regulation from a complex with colchicine and a stathmin-like domain. *Nature* **2004**, 428, 198-202.). MOE software was employed to generate binding models for compounds 1-11, which were minimized in energy prior to calculating their binding affinities. All the colchicine models revealed how the benzyl fragment occupied the chemical space available in the binding domain as demonstrated in Figures S1-S11 below.

Figure S1 Benzyl-*N*-aminocolchicine docked into the colchicine binding domain

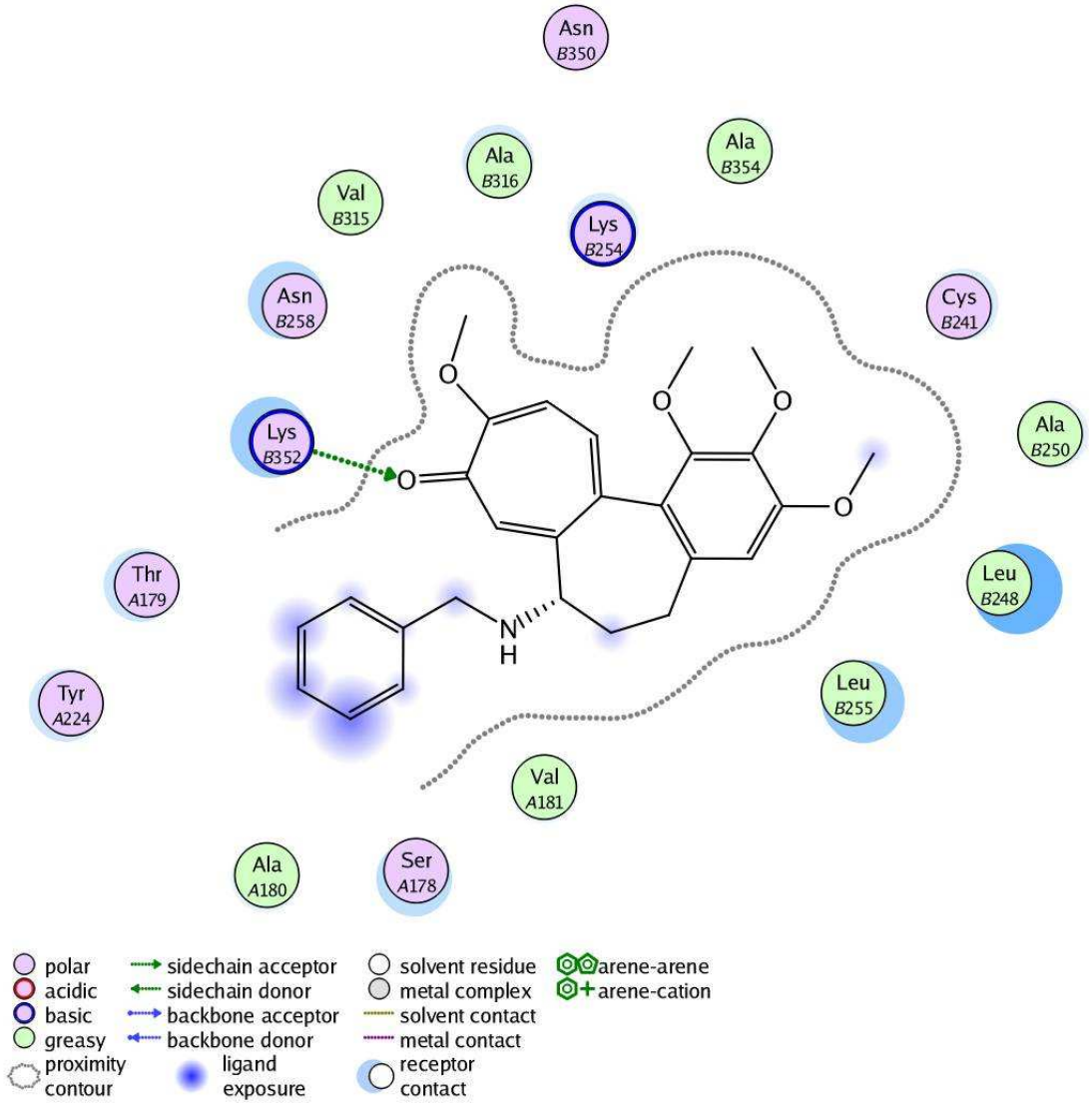


Figure S2 4-Bromobenzyl-*N*-aminocolchicine docked into the colchicine binding domain

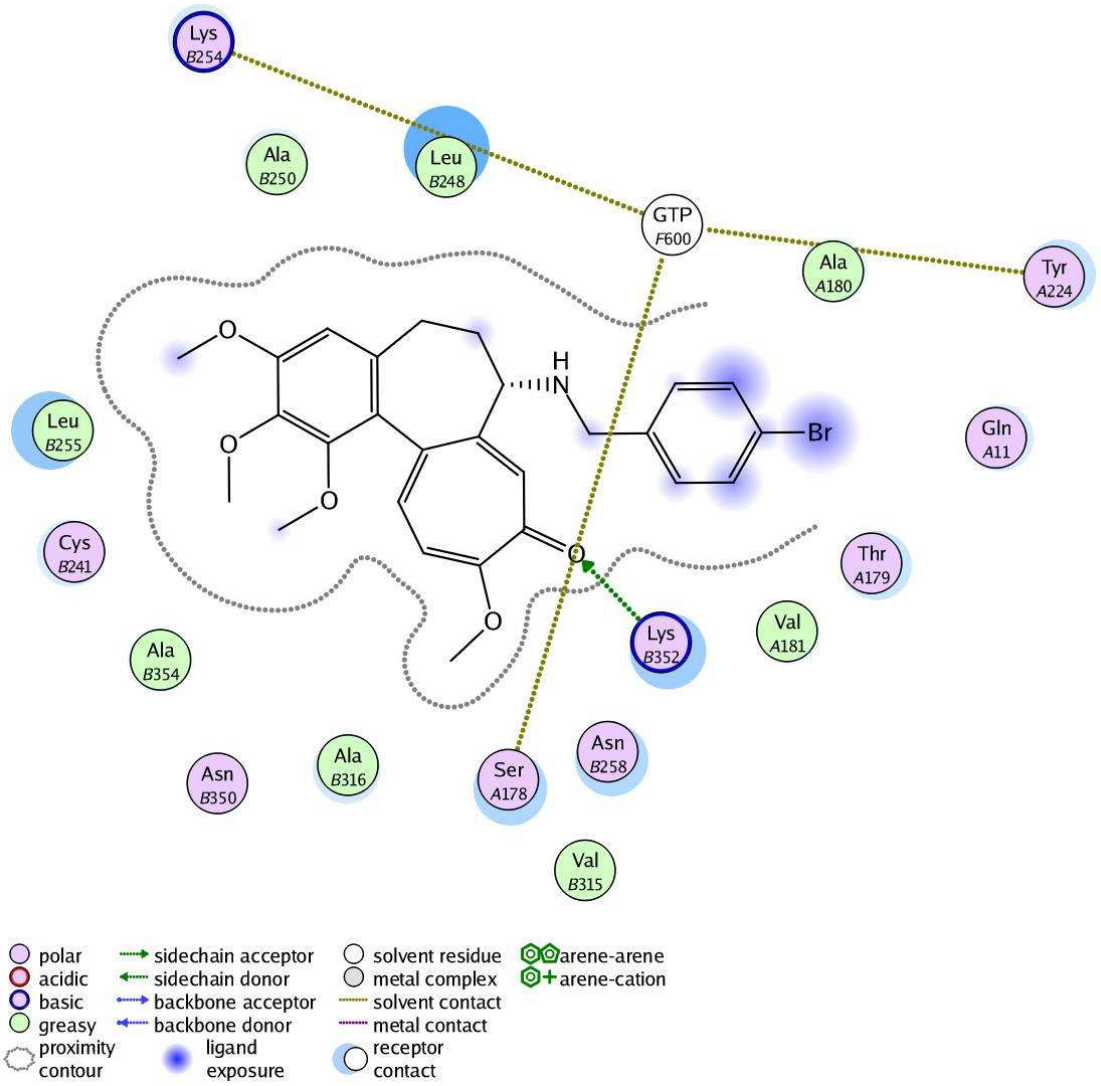


Figure S3 4-Chlorobenzyl-*N*-aminocolchicine docked into the colchicine binding domain

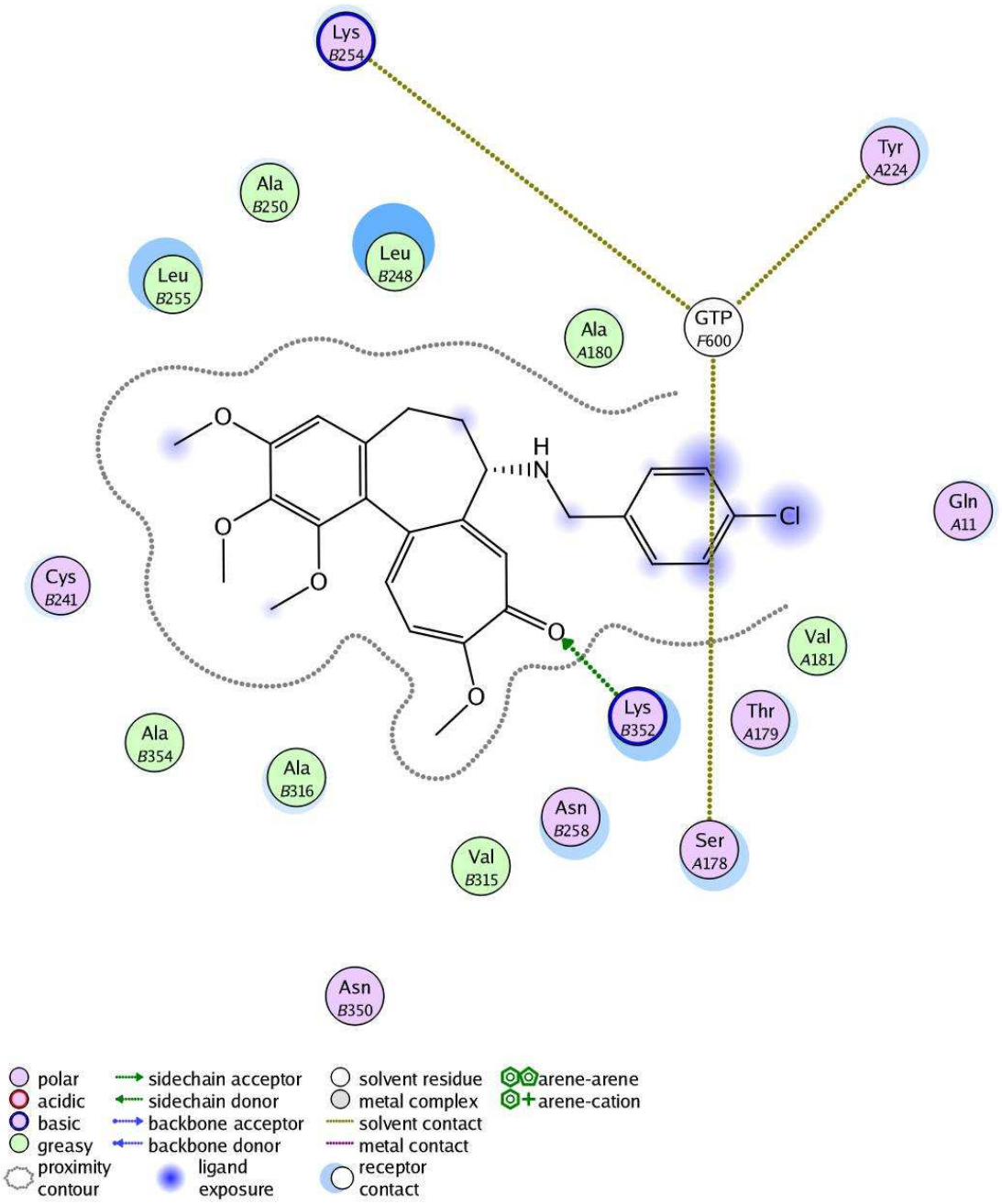


Figure S4 4-Iodobenzyl-*N*-aminocolchicine docked into the colchicine binding domain

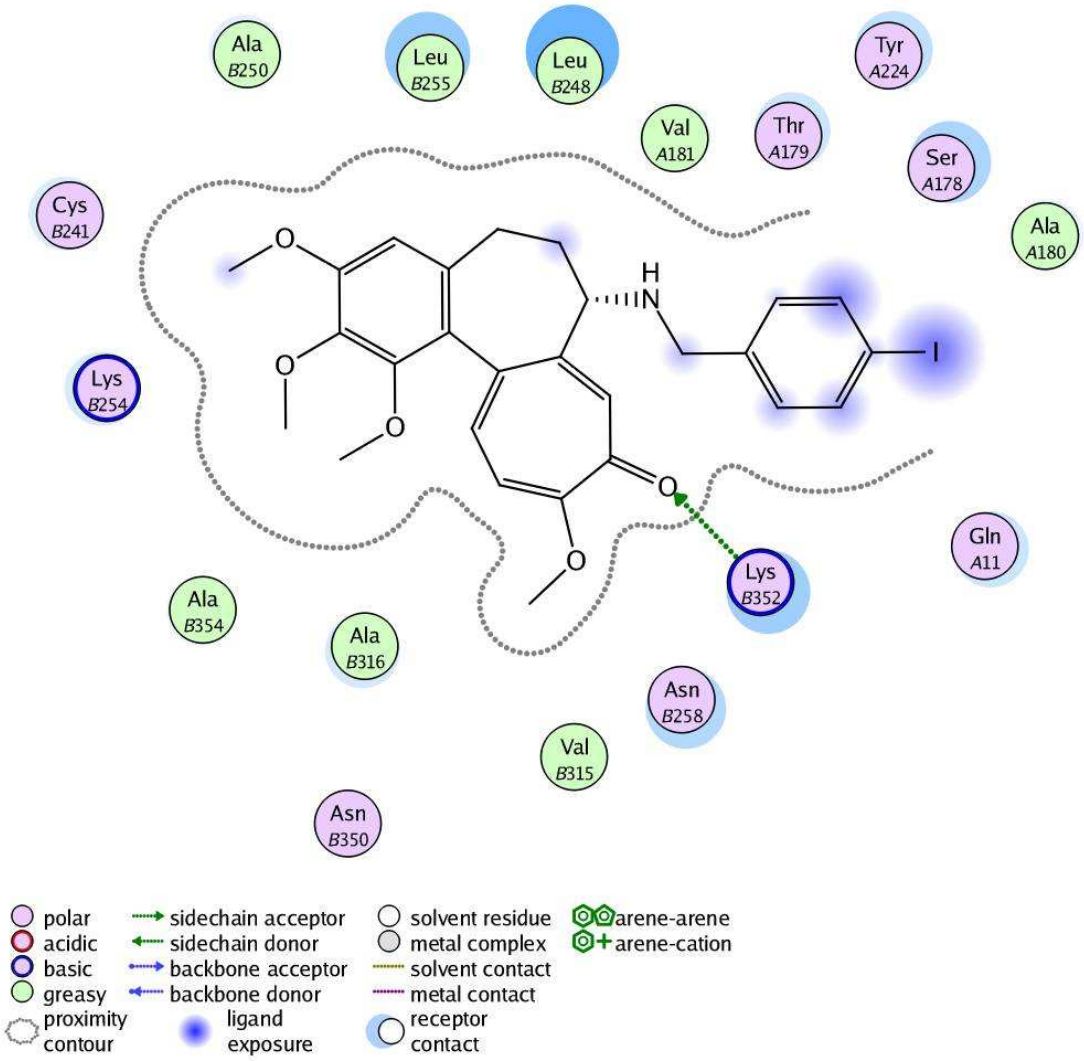


Figure S5 3-Bromobenzyl-*N*-aminocolchicine docked into the colchicine binding domain

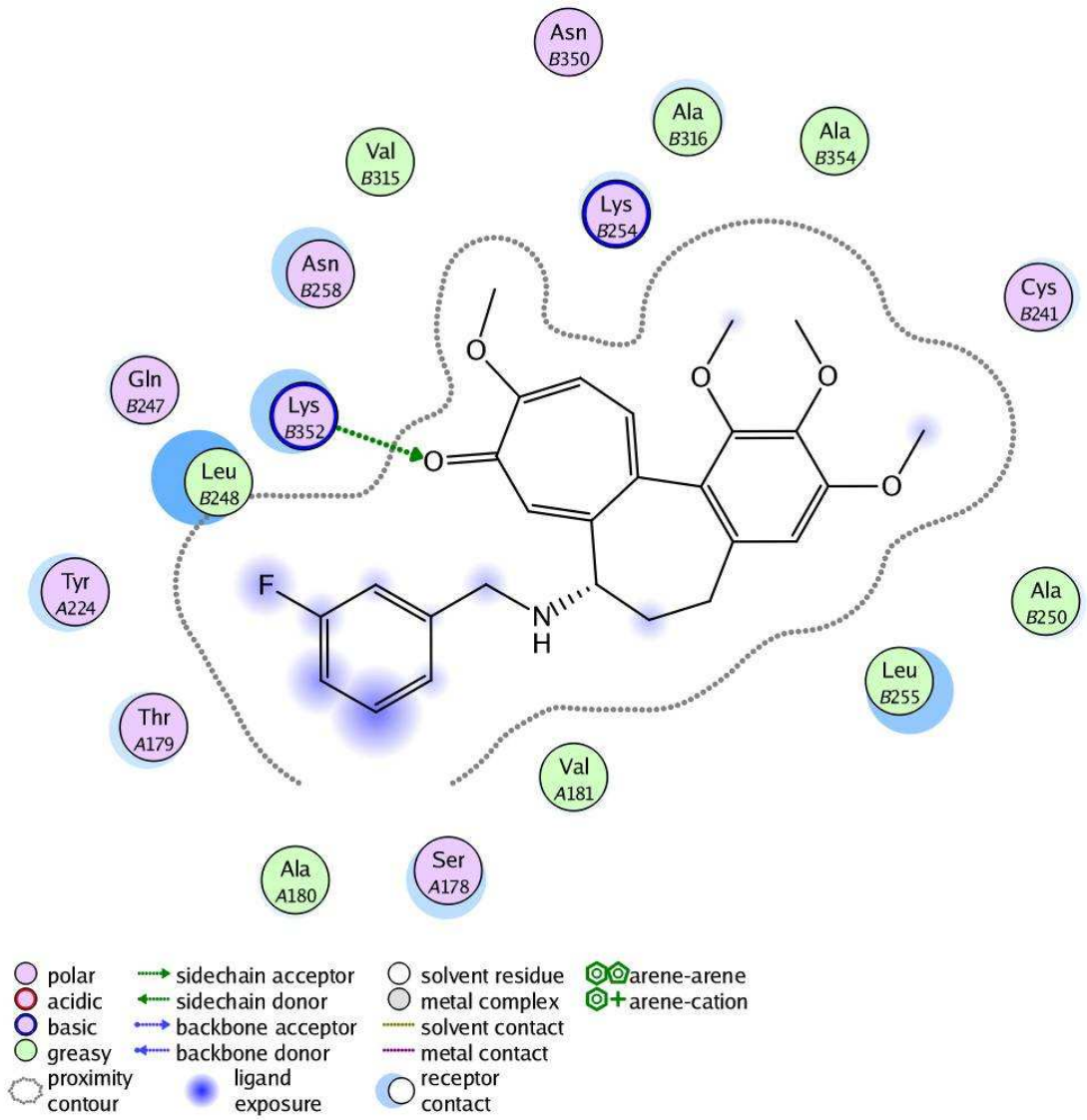


Figure S6 3,4,5-Tri-fluorobenzyl-*N*-aminocolchicine docked into the colchicine binding domain

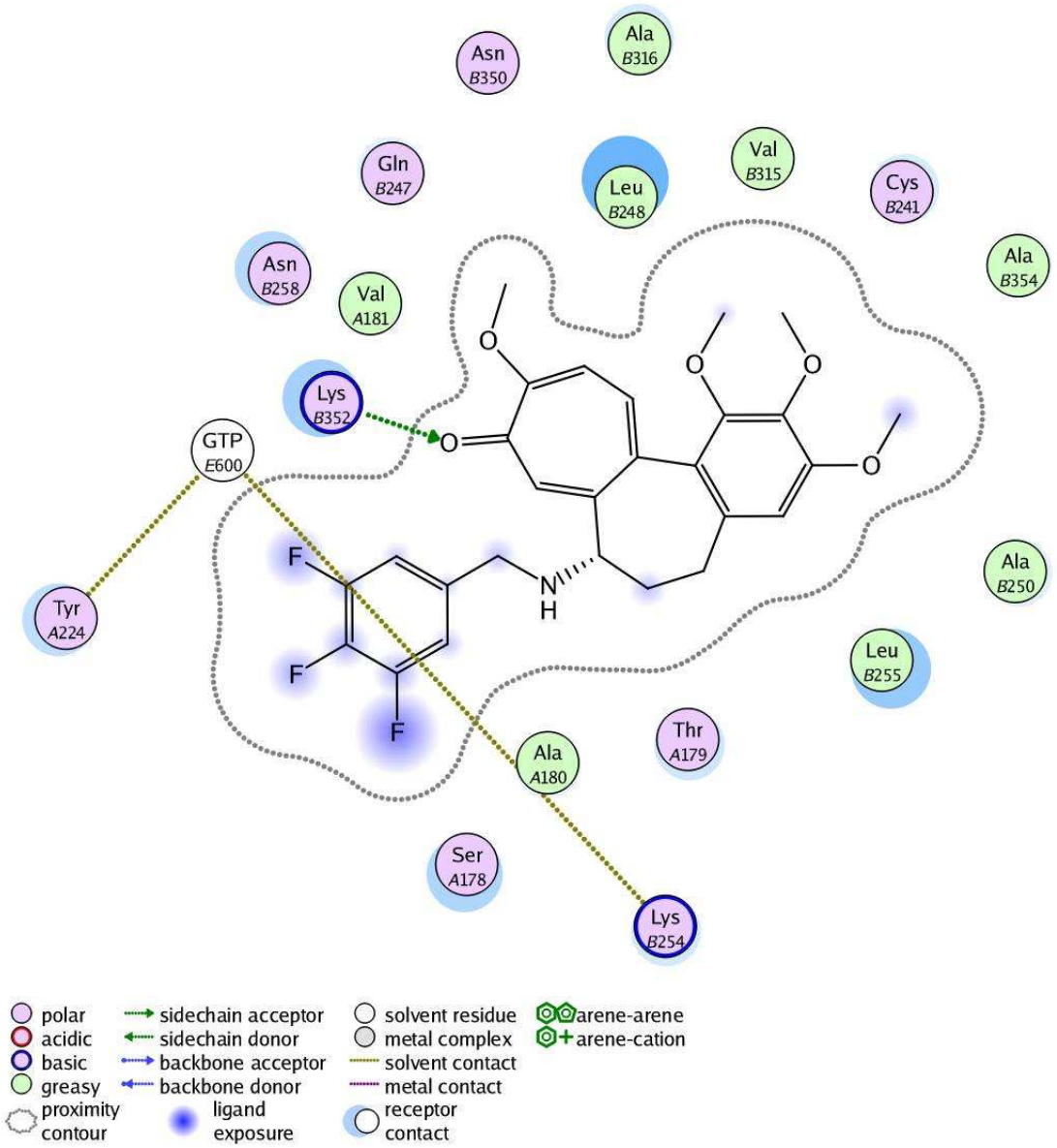


Figure S7 2,3-Di-fluorobenzyl-*N*-aminocolchicine docked into the colchicine binding domain

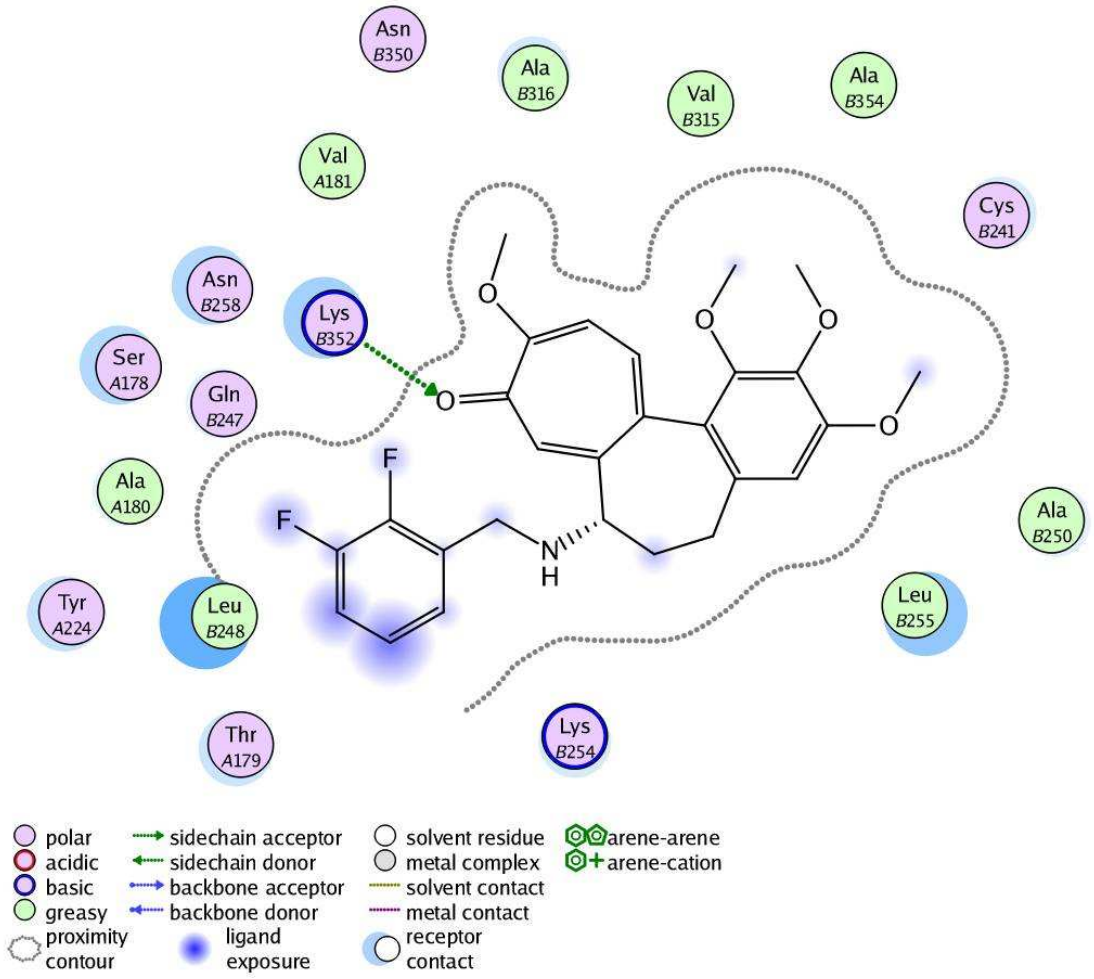


Figure S8 3,4-Di-fluorobenzyl-*N*-aminocolchicine docked into the colchicine binding domain

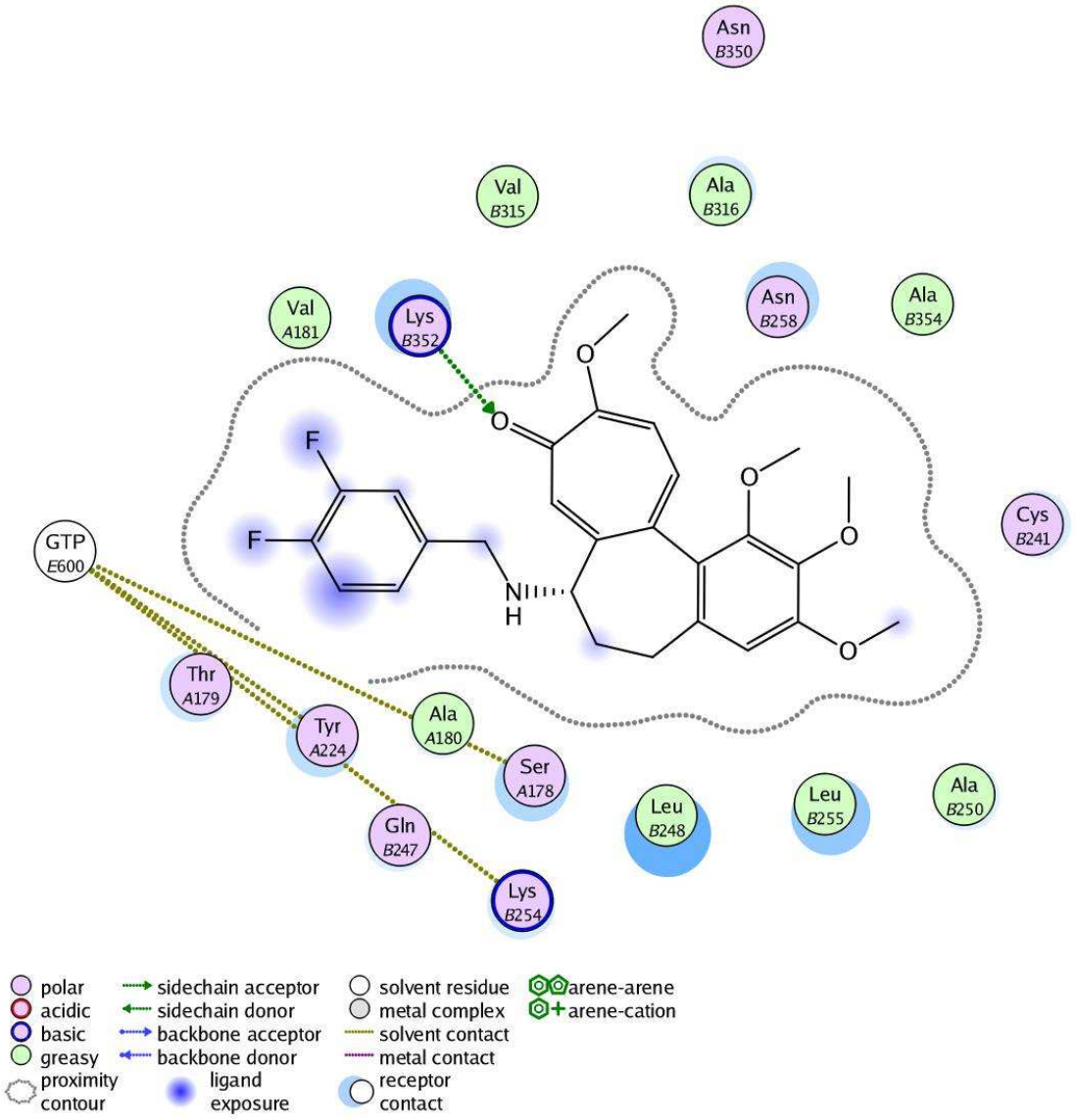


Figure S9 3,5-Di-fluorobenzyl-*N*-aminocolchicine docked into the colchicine binding domain

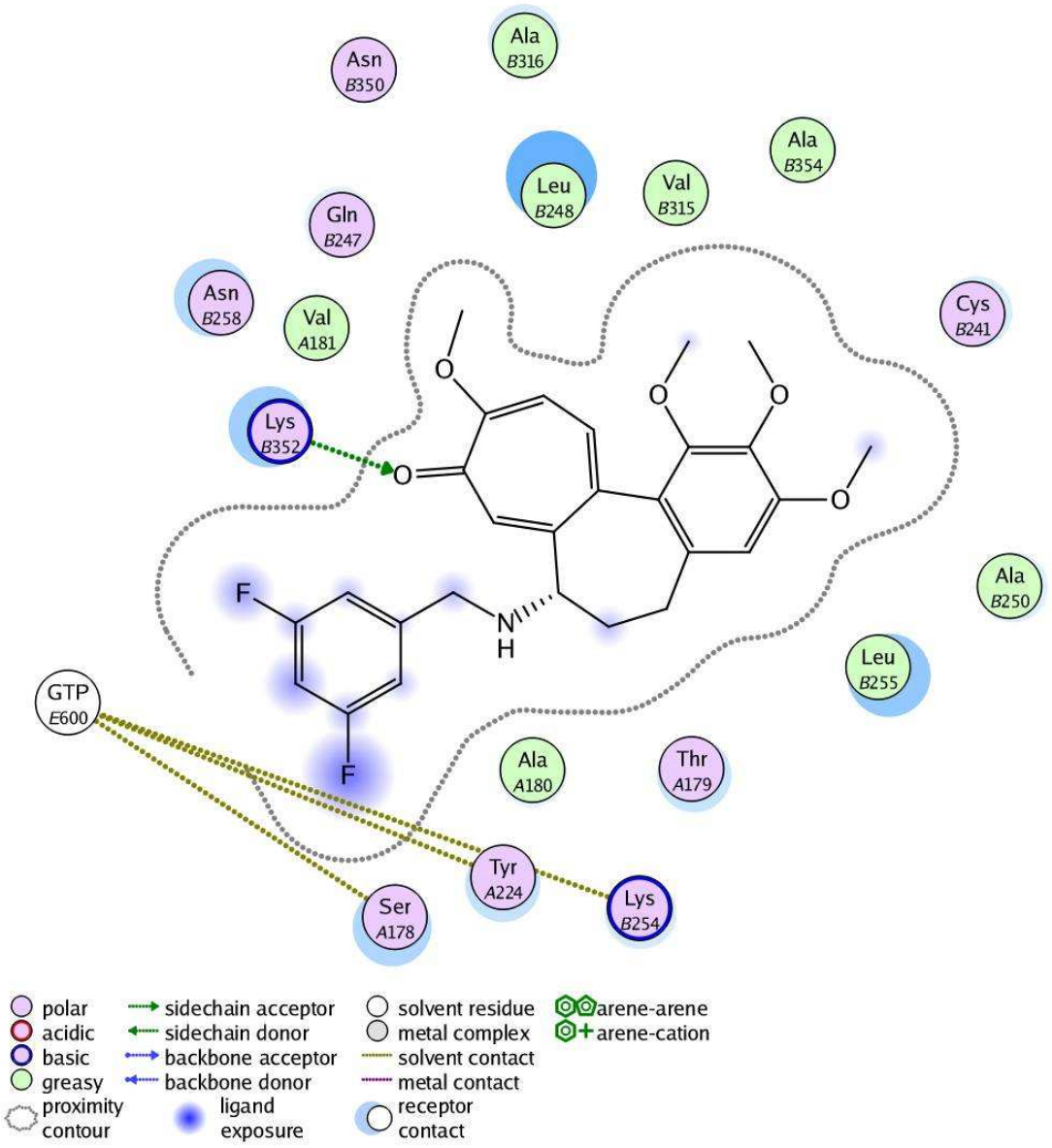


Figure S10 Nitrobenzyl-*N*-aminocolchicine docked into the colchicine binding domain

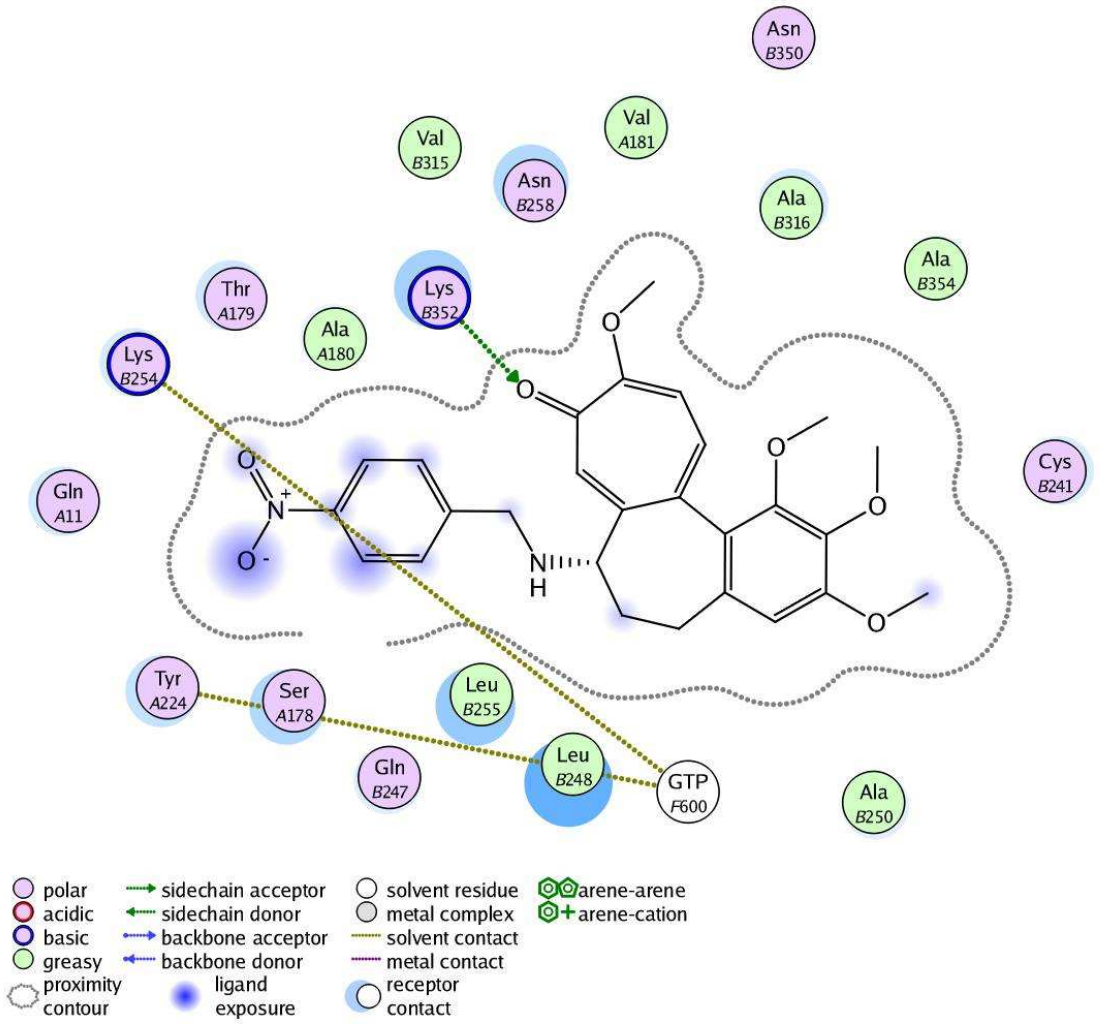


Figure S11 4-Methoxybenzyl-*N*-aminocolchicine docked into the colchicine binding domain

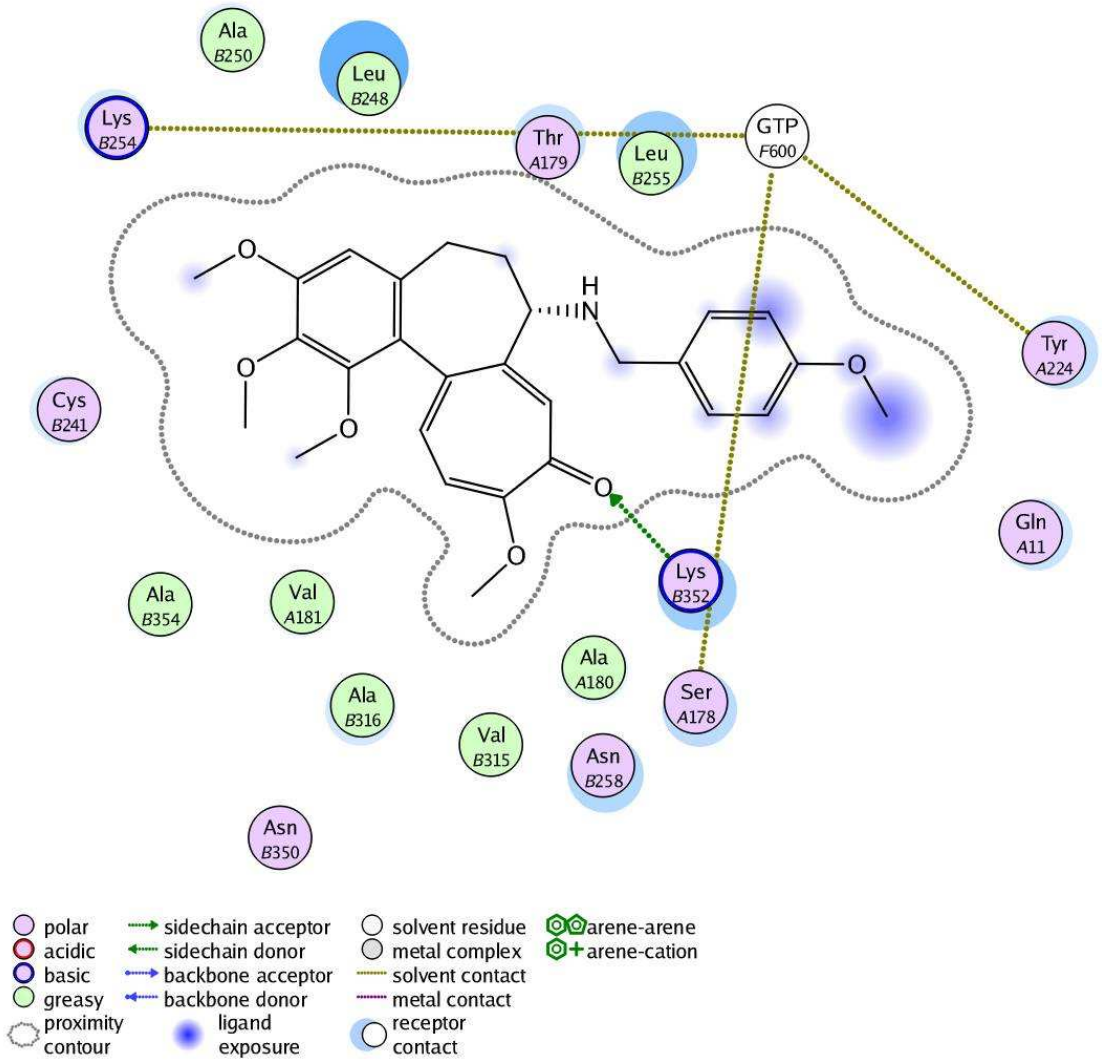
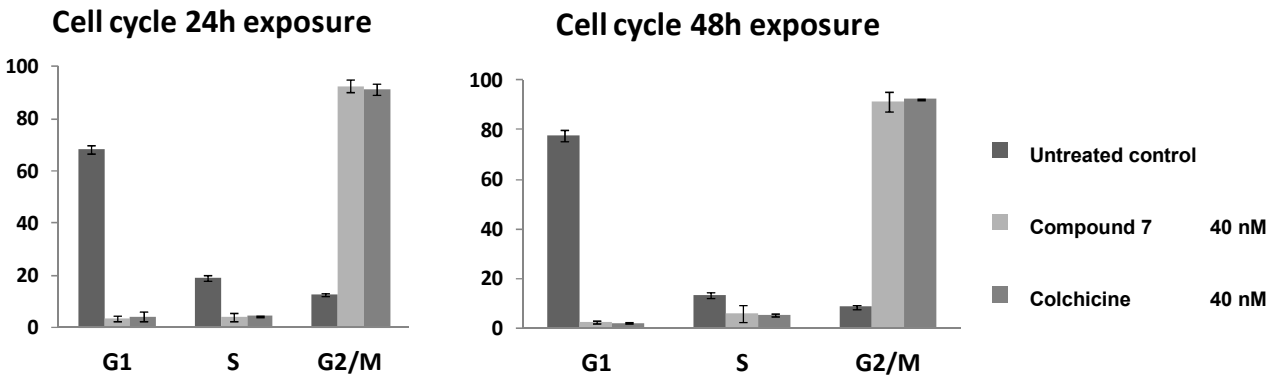
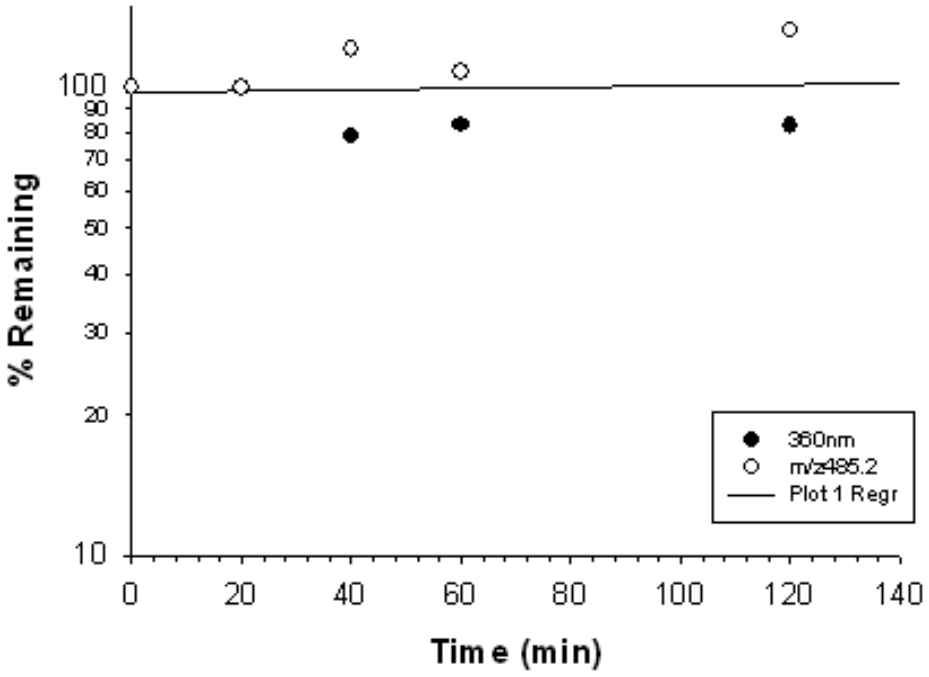


Figure S12 Cell cycle study of colchicine and compound 7 using FACS



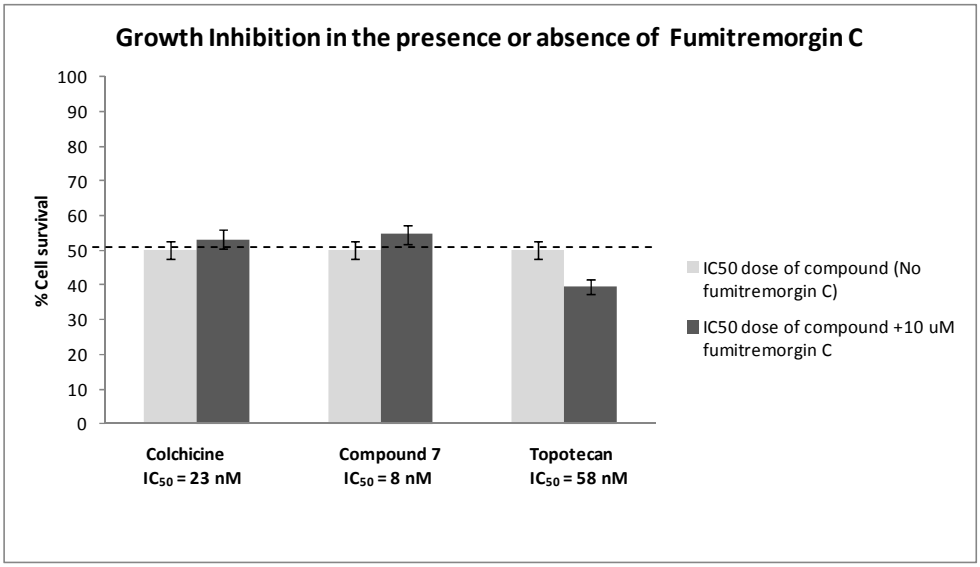
Cell cycle study HT29 cells at 70 % confluency were trypsinised and transferred into 6 well-plates (5 x 105 cells/well) and allowed to adhere overnight at 37 ^{o}C in a humidified incubator prior to the treatment. Cells were then exposed to compound **7** or colchicine at 40 nM for 24 or 48 hours. Cells were collected, permeabilized in ice-cold methanol (90%) for 30 min. Next, cells were washed in PBS and their phase in the cell cycle was deter-mined from their DNA content. Briefly, cells were treated with 250 µl propidiumiodide (200 µg/mL; PI; Sigma-Aldrich) containing RNAse A (200 µg/mL) for 30 min on ice in the dark. Finally, ice-cold PBS (250 µL) was added and a minimum of 10,000 stained cells were acquired on a FACScan (Becton Dickinson) and analyzed with the Cell-Quest software.

Figure S13 Stability study of compound 7 using mouse liver homogenate



Stability of compound 7 using mouse liver homogenates: The liver was excised from mice and was flash-frozen in liquid N2 immediately after rinsing in phosphate buffered saline solution (PBS) and weighing. Liver homogenate (1 g) was prepared with an addition of PBS (4 mL) and homogenized on ice with a tissue homogenizer (Ultra Turrax). Compound **7** stock solution (5 µL, 20 mM) was added into 1 mL of liver homogenate to give a final concentration of 100 µM. The homogenate was gently shaken with inversed mixing prior to incubation at 37°C. Aliquotes (100 µL) for LCMS analysis was taken at t = 0, 20, 40, 60 and 120 minutes and reactions quenched with the addition of acetonitrile (600 µL). After centrifugation, the supernatant was collected and analysed using LC/MS. Detection was performed on a Waters Alliance system using a photodiode array detector, and a Micromass ZMD Mass Spectrometer connected in series. Compound **7** was separated on a RPB reversed-phase high-performance liquid chromatography column (HiChrom) using a mobile phase of methanol/water/0.1% formic acid, with a gradient from 22.5% to 50% methanol over 30 minutes at 1.2 mL/min. Compound **7** was quantified using absorption measurements at 330 nm and detected as singularly charged ion (m/z 485.2). Figure S12 show no breakdown of compound **7** after 2 hours incubation.

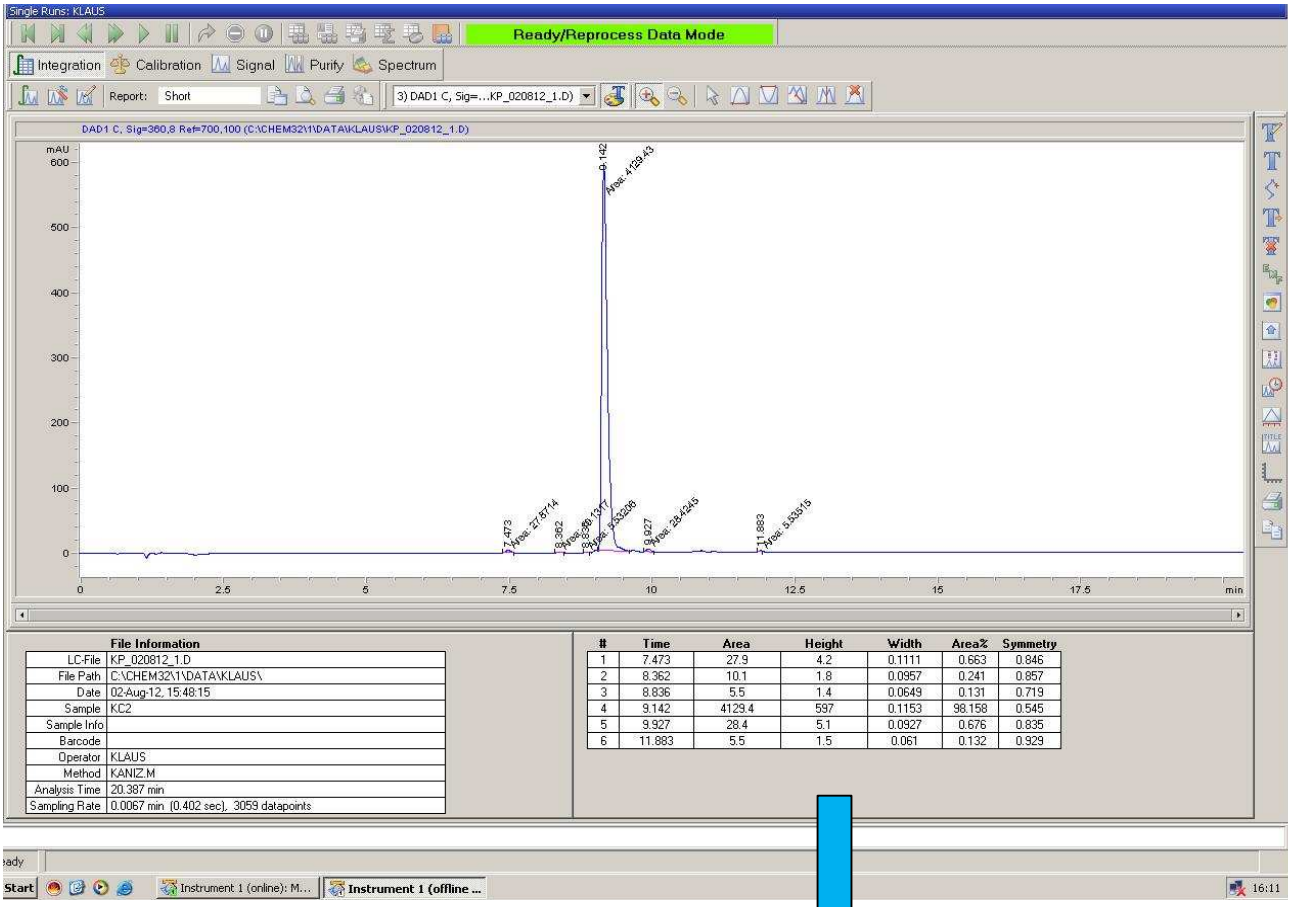
Figure S14 Chemosensitivity of compound 7, colchicine and topotecan in the presence of Fumitremorgin C



Chemosensitivity study in the presence/absence of Fumitremorgin C: The A549 cell line was cultured in RPMI 1640 cell culture medium supplemented with 1 mM sodium pyruvate, 2 mM L-glutamine and 10% fetal bovine serum (all from Sigma). 1×10^4 cells/ml were inoculated into each well of a 96-well plate and incubated overnight at 37 °C in a humidified atmosphere containing 5% CO_2. Compound **7**, colchicine and topotecan were dissolved in DMSO and diluted in complete cell culture medium to give a broad range of concentrations (0.001-10 μM), such that the final DMSO concentration was not greater than 0.1%. Medium was removed from each well and replaced with compound or control solutions. After 96 h incubation, the MTT assay was performed to assess chemosensitivity. The IC_{50} values were found to be 8 nM, 23 nM and 58 nM for compound 7, colchicine and topotecan respectively (the mean derived from 3 separate experiments). To evaluate the effect of including the ABCG2 inhibitor, Fumitremorgin C, A459 cells were incubated with the IC_{50} dose for each compound in the presence or absence of Fumitremorgin C (10 μM). After 96 h incubation, the MTT assay was performed again to assess if the potency of each compound was enhanced in the presence of the Fumitremorgin C. Figure S13 reveals that only the cytotoxicity of topotecan is enhanced (reduction in the cell survival from 50 to ~40%), indicating that neither compound **7** nor colchicine are affected by the ABCG2 transporter function in this short-term assay. Results illustrated as histogram bars shown in Figure S13 are the mean of three independent experiments.

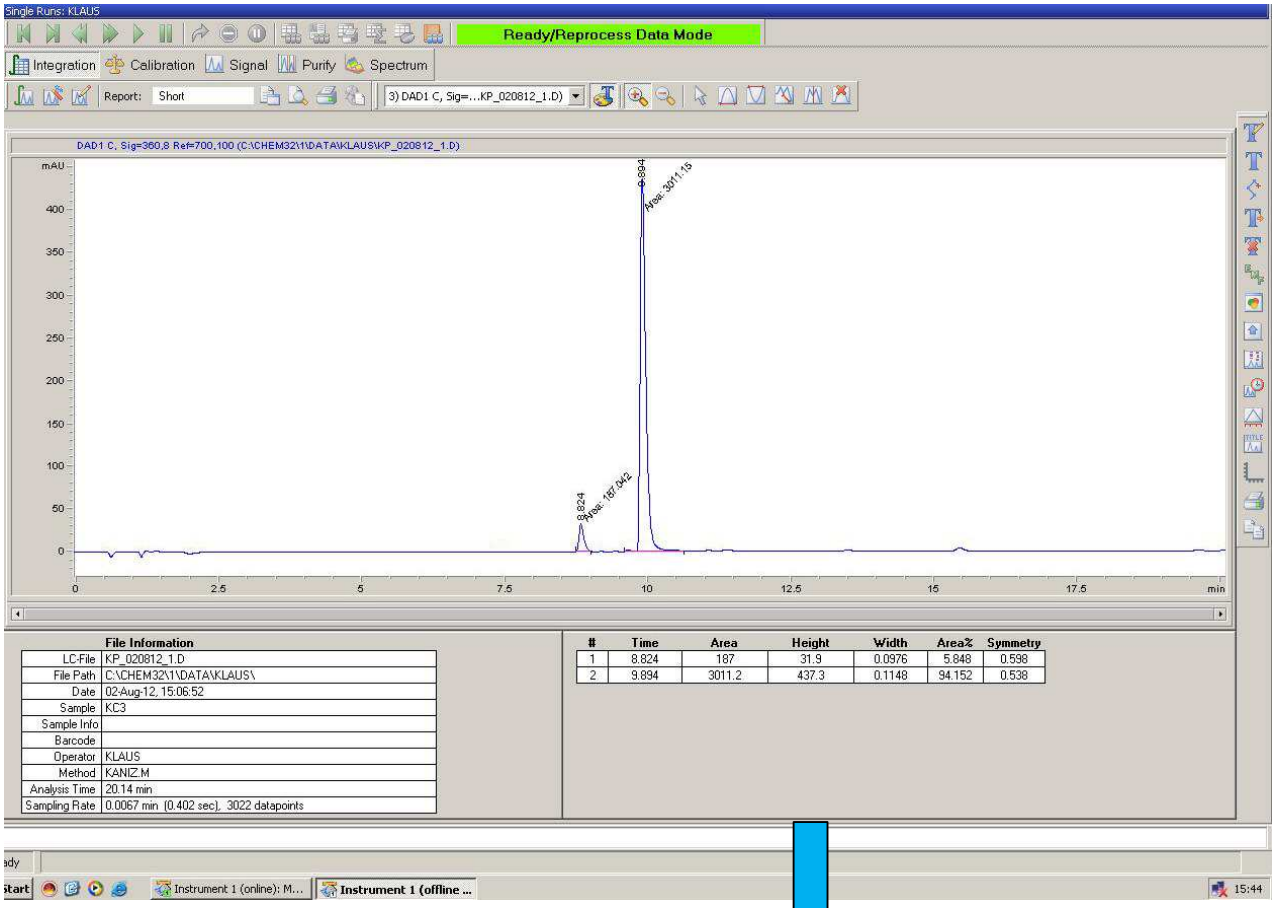
HPLC Chromatograms of Compounds 1-11

Benzyl-*N*-aminocolchicine: Purity = 98.2%



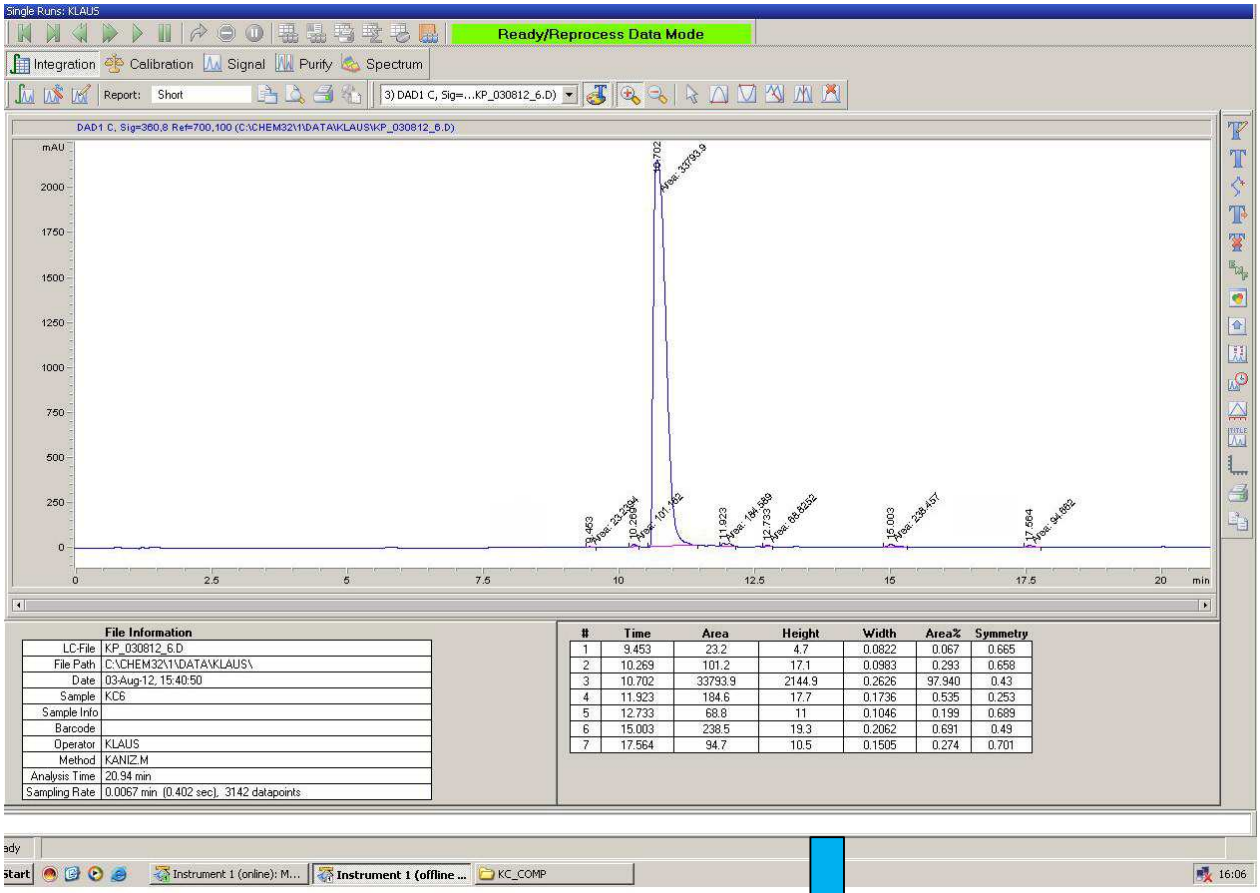
#	Time	Area	Height	Width	Area%	Symmetry
1	7.473	27.9	4.2	0.1111	0.663	0.846
2	8.362	10.1	1.8	0.0957	0.241	0.857
3	8.836	5.5	1.4	0.0649	0.131	0.719
4	9.142	4129.4	597	0.1153	98.158	0.545
5	9.927	28.4	5.1	0.0927	0.676	0.835
6	11.883	5.5	1.5	0.061	0.132	0.929

4-Bromobenzyl-*N*-aminocolchicine: Purity = 94.2%



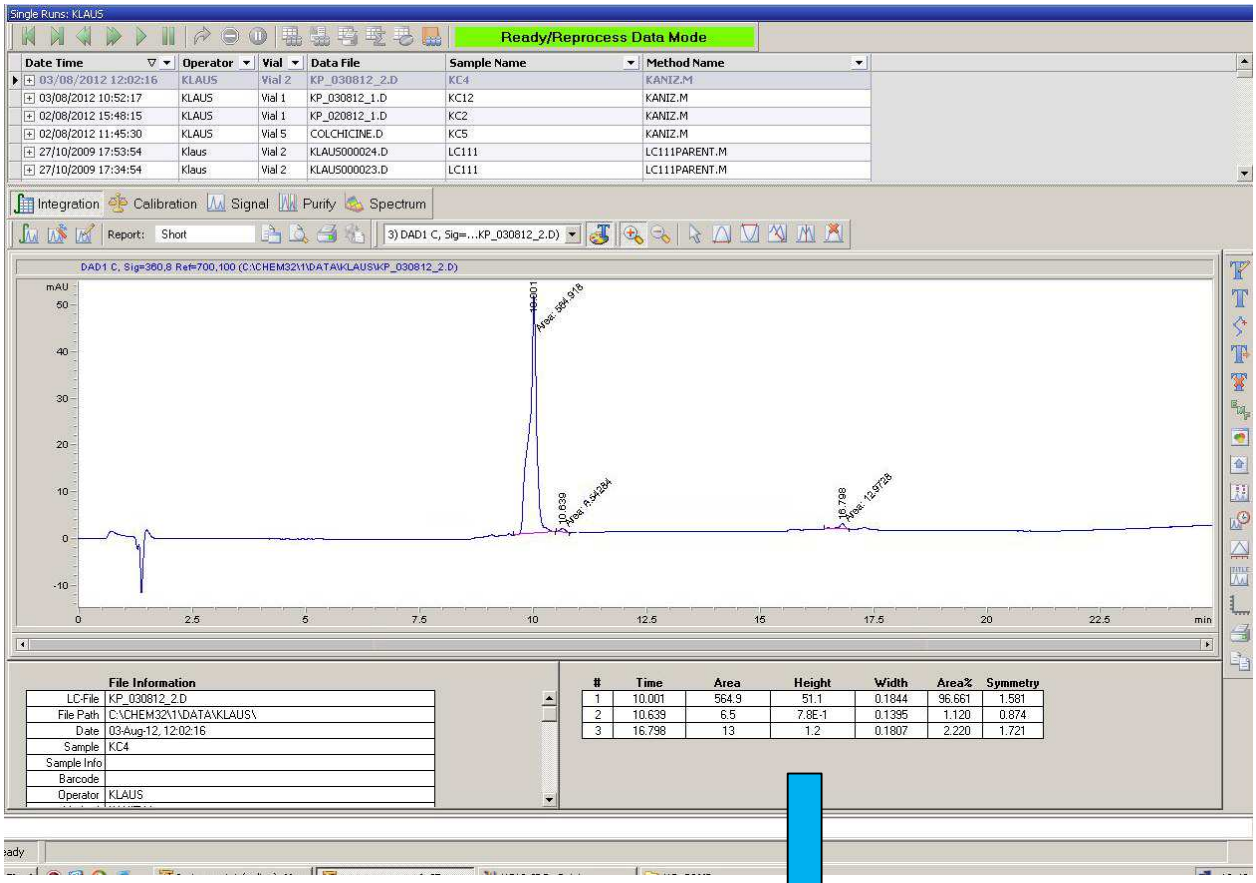
#	Time	Area	Height	Width	Area%	Symmetry
1	8.824	187	31.9	0.0976	5.848	0.598
2	9.894	3011.2	437.3	0.1148	94.152	0.538

3-Fluorobenzyl-*N*-aminocolchicine: Purity = 97.9%



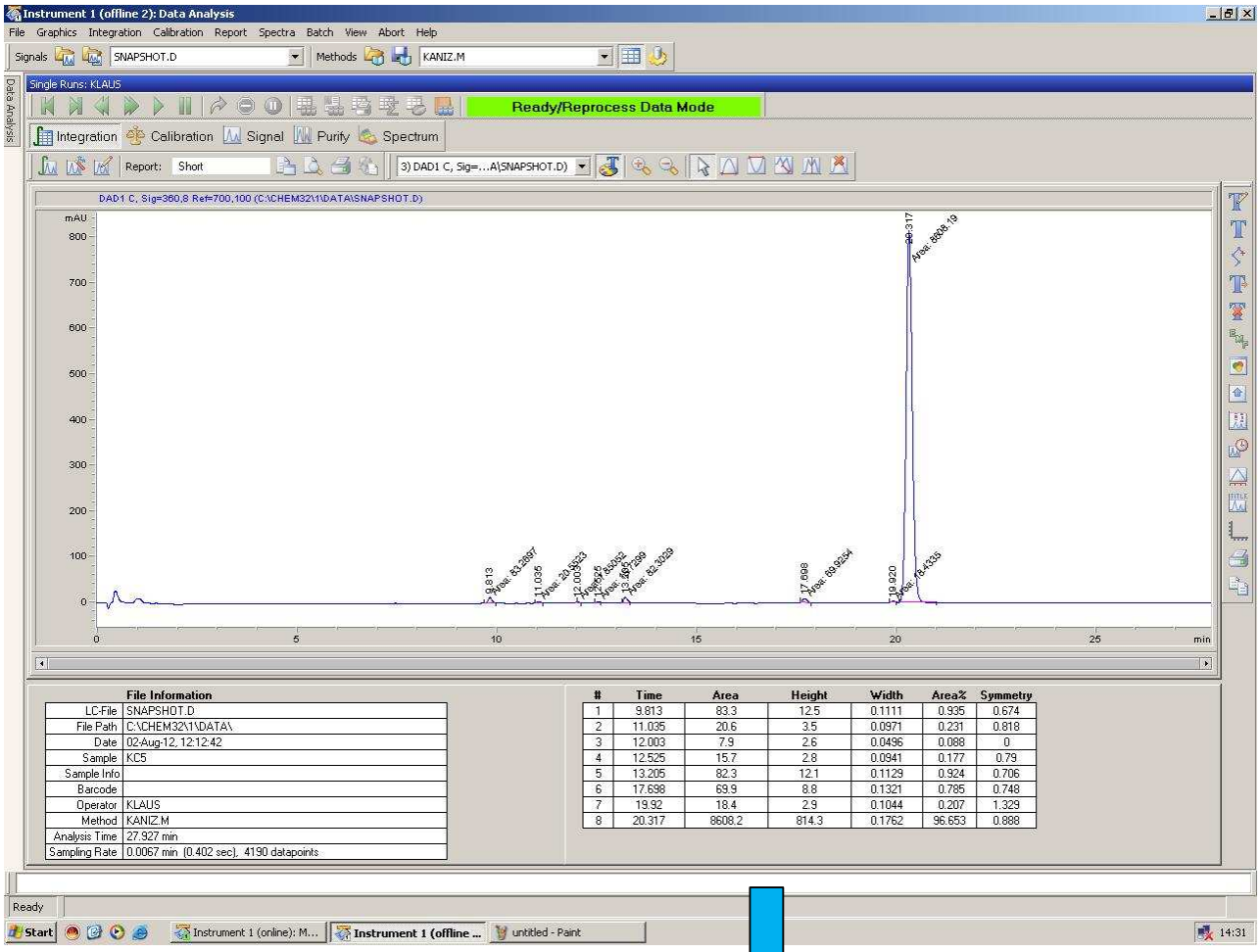
#	Time	Area	Height	Width	Area%	Symmetry
1	9.453	23.2	4.7	0.0822	0.067	0.665
2	10.269	101.2	17.1	0.0983	0.293	0.658
3	10.702	33793.9	2144.9	0.2626	97.940	0.43
4	11.923	184.6	17.7	0.1736	0.535	0.253
5	12.733	68.8	11	0.1046	0.199	0.689
6	15.003	238.5	19.3	0.2062	0.691	0.49
7	17.564	94.7	10.5	0.1505	0.274	0.701

4-Chlorobenzyl-*N*-aminocolchicine: Purity = 96.7%



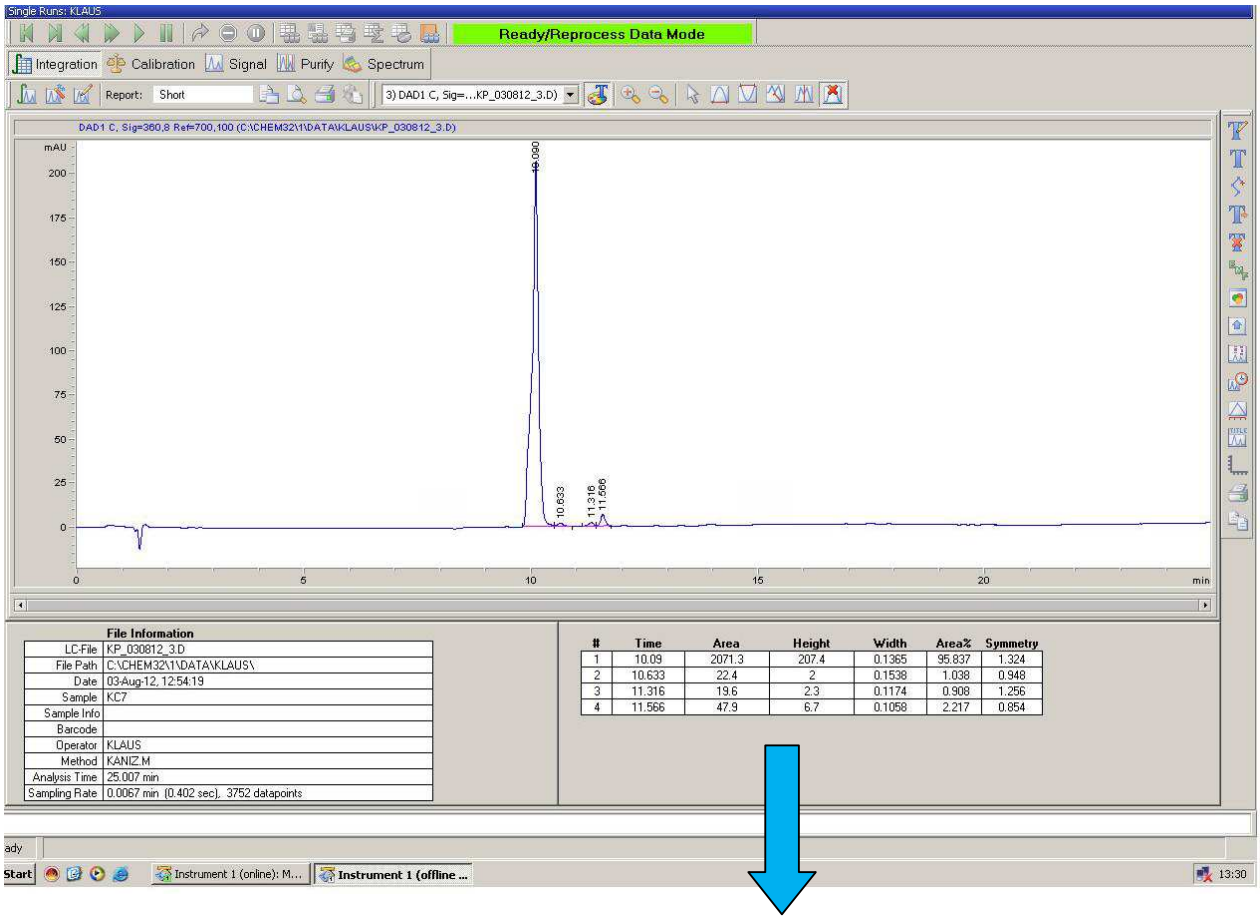
#	Time	Area	Height	Width	Area%	Symmetry
1	10.001	564.9	51.1	0.1844	96.661	1.581
2	10.639	6.5	7.8E-1	0.1395	1.120	0.874
3	16.798	13	1.2	0.1807	2.220	1.721

4-Iodobenzyl-*N*-aminocolchicine: Purity = 96.7%



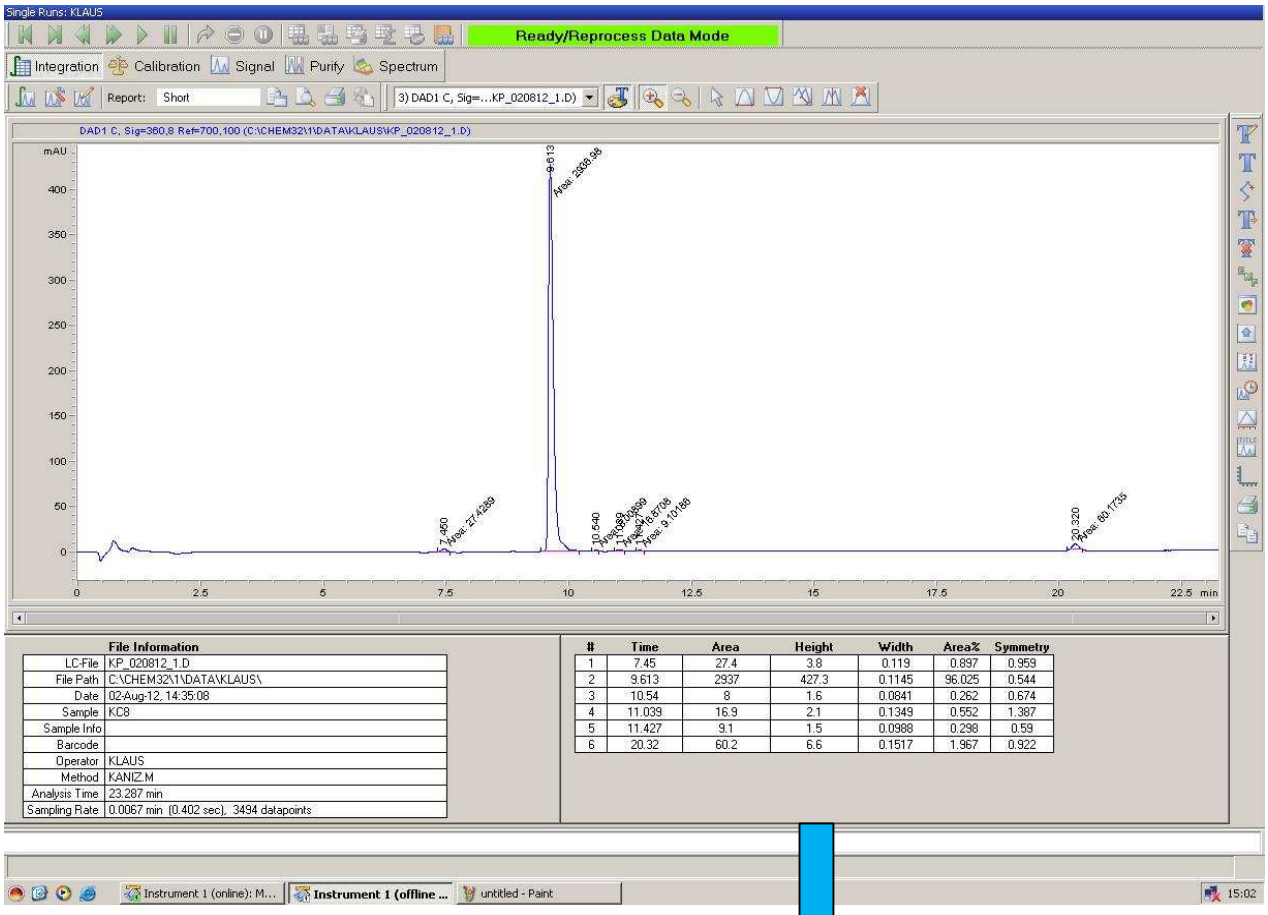
#	Time	Area	Height	Width	Area%	Symmetry
1	9.813	83.3	12.5	0.1111	0.935	0.674
2	11.035	20.6	3.5	0.0971	0.231	0.818
3	12.003	7.9	2.6	0.0496	0.088	0
4	12.525	15.7	2.8	0.0941	0.177	0.79
5	13.205	82.3	12.1	0.1129	0.924	0.706
6	17.698	69.9	8.8	0.1321	0.785	0.748
7	19.92	18.4	2.9	0.1044	0.207	1.329
8	20.317	8608.2	814.3	0.1762	96.653	0.888

2,3-Di-fluorobenzyl-*N*-aminocolchicine: Purity = 95.8%



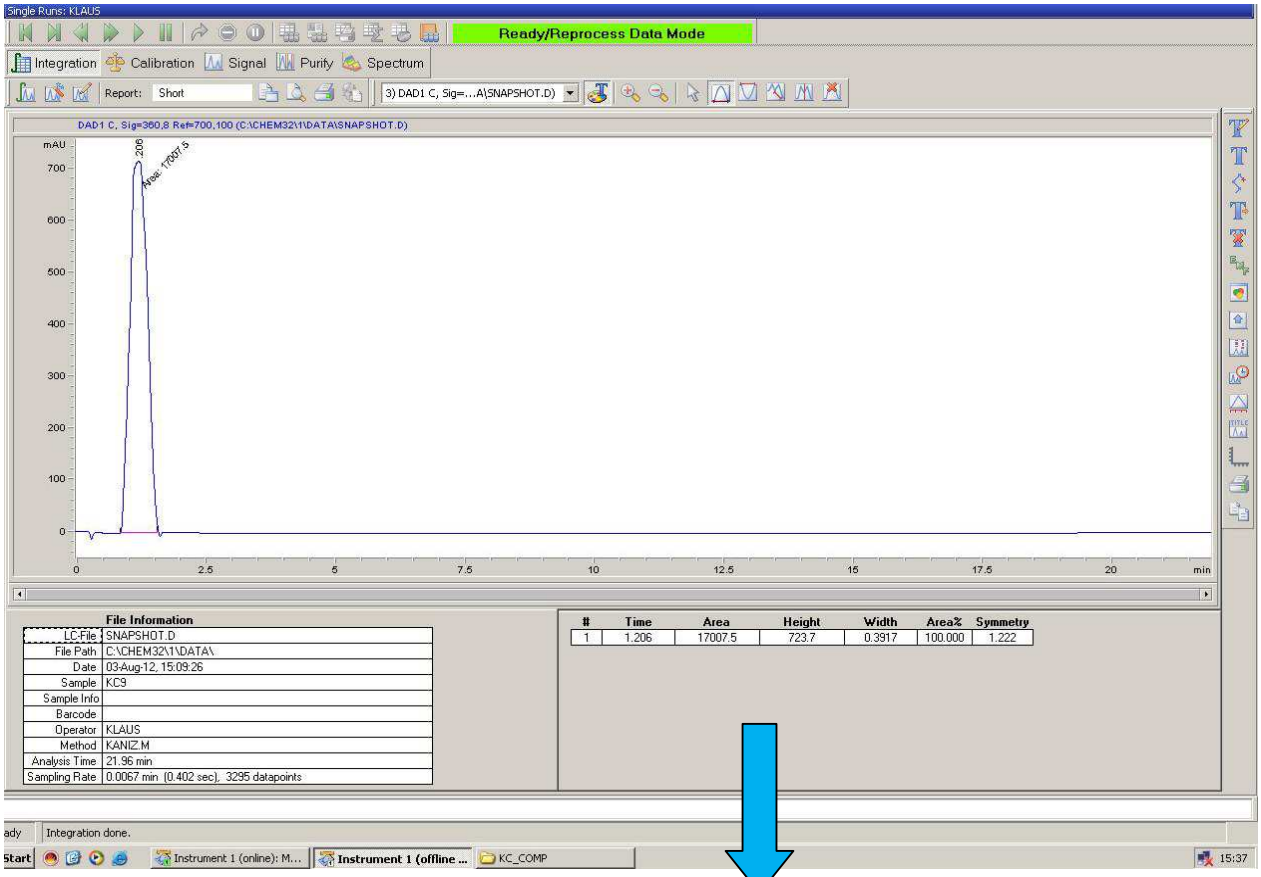
#	Time	Area	Height	Width	Area%	Symmetry
1	10.09	2071.3	207.4	0.1365	95.837	1.324
2	10.633	22.4	2	0.1538	1.038	0.948
3	11.316	19.6	2.3	0.1174	0.908	1.256
4	11.566	47.9	6.7	0.1058	2.217	0.854

3,4-Di-fluorobenzyl-*N*-aminocolchicine: Purity = 96.0%



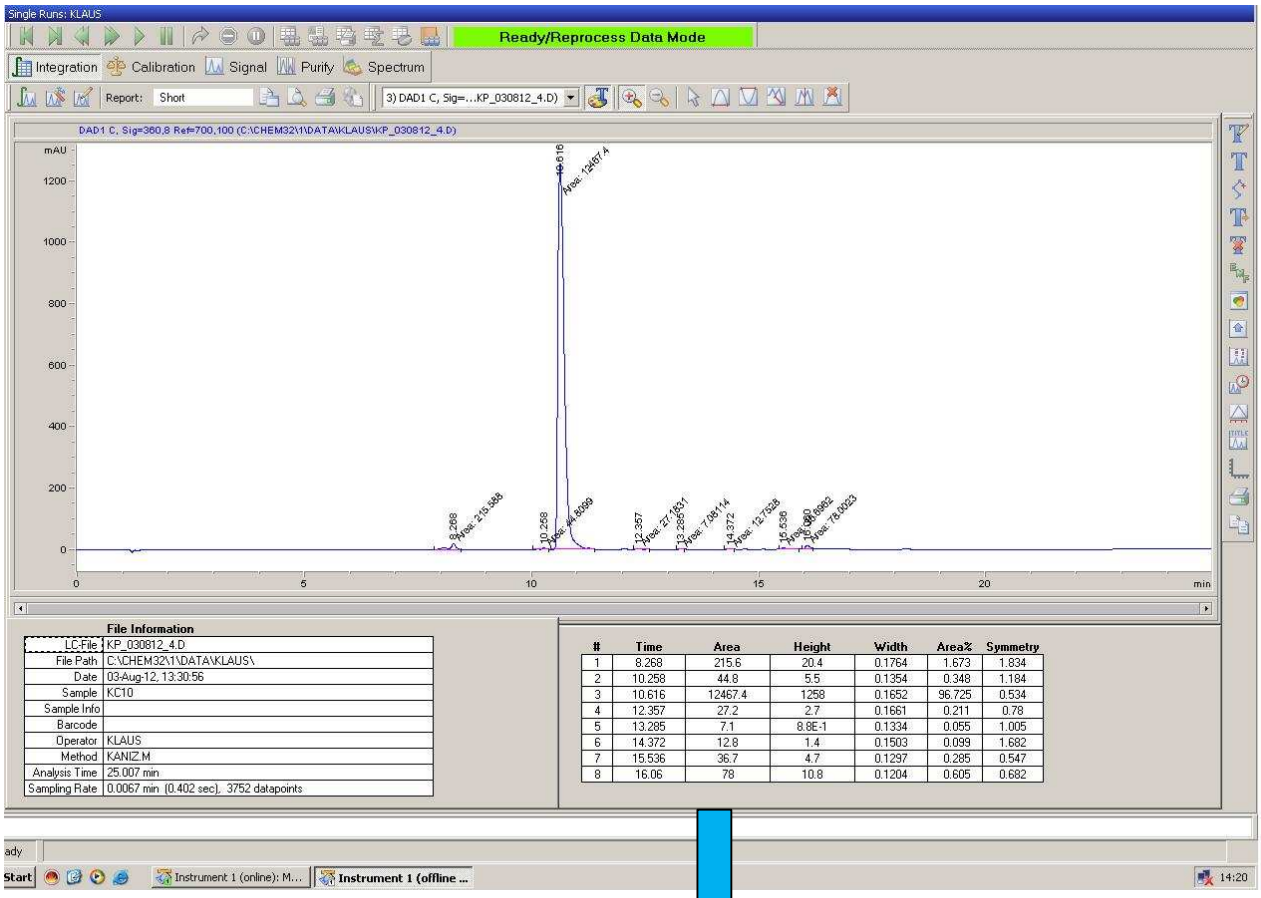
#	Time	Area	Height	Width	Area%	Symmetry
1	7.45	27.4	3.8	0.119	0.897	0.959
2	9.613	2937	427.3	0.1145	96.025	0.544
3	10.54	8	1.6	0.0841	0.262	0.674
4	11.039	16.9	2.1	0.1349	0.552	1.387
5	11.427	9.1	1.5	0.0988	0.298	0.59
6	20.32	60.2	6.6	0.1517	1.967	0.922

3,5-Di-fluorobenzyl-*N*-aminocolchicine: Purity = 100%



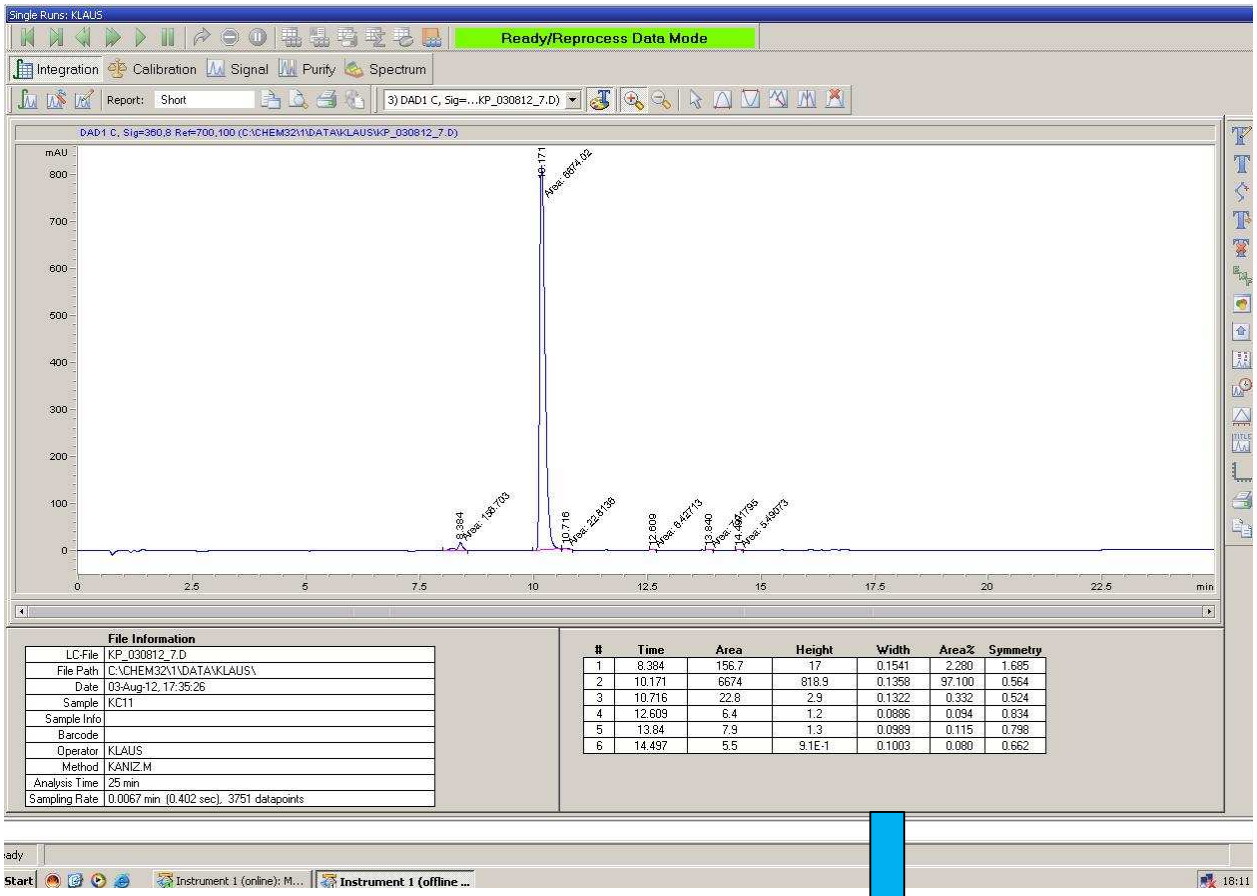
#	Time	Area	Height	Width	Area%	Symmetry
1	1.206	17007.5	723.7	0.3917	100.000	1.222

3,4,5-Tri-fluorobenzyl-*N*-aminocolchicine: Purity = 96.7%



#	Time	Area	Height	Width	Area%	Symmetry
1	8.268	215.6	20.4	0.1764	1.673	1.834
2	10.258	44.8	5.5	0.1354	0.348	1.184
3	10.616	12467.4	1258	0.1652	96.725	0.534
4	12.357	27.2	2.7	0.1661	0.211	0.78
5	13.285	7.1	8.8E-1	0.1334	0.055	1.005
6	14.372	12.8	1.4	0.1503	0.099	1.682
7	15.536	36.7	4.7	0.1297	0.285	0.547
8	16.06	78	10.8	0.1204	0.605	0.682

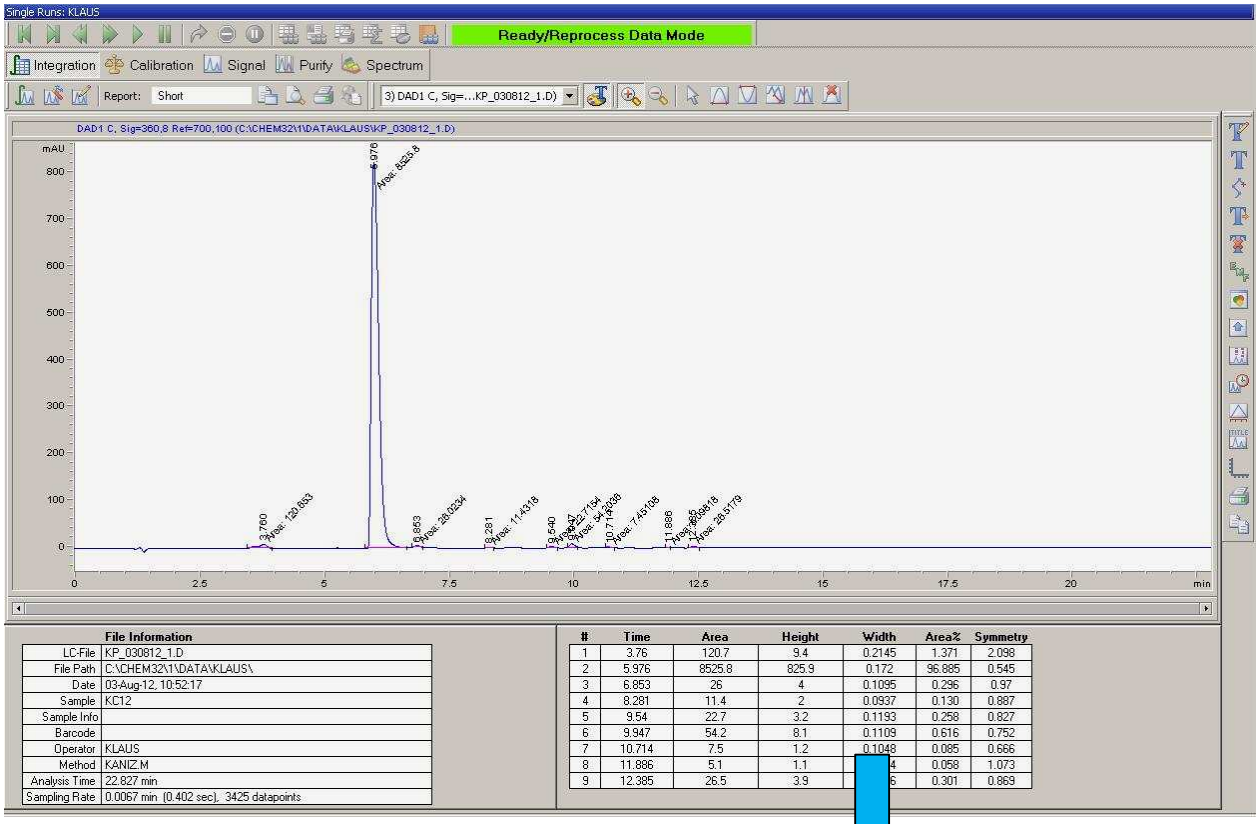
4-Nitrobenzyl-*N*-aminocolchicine: Purity = 97.1%



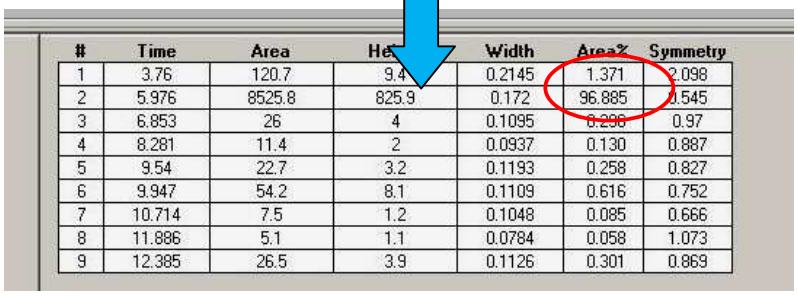
#	Time	Area	Height	Width	Area%	Symmetry
1	8.384	156.7	17	0.1541	2.280	1.685
2	10.171	6674	818.9	0.1358	97.100	0.564
3	10.716	22.8	2.9	0.1322	0.332	0.524
4	12.609	6.4	1.2	0.0886	0.094	0.834
5	13.84	7.9	1.3	0.0989	0.115	0.798
6	14.497	5.5	9.1E-1	0.1003	0.080	0.662

#	Time	Area	Height	Width	Area%	Symmetry
1	8.384	156.7	17	0.1541	2.280	1.685
2	10.171	6674	818.9	0.1358	97.100	0.564
3	10.716	22.8	2.9	0.1322	0.332	0.524
4	12.609	6.4	1.2	0.0886	0.094	0.834
5	13.84	7.9	1.3	0.0989	0.115	0.798
6	14.497	5.5	9.1E-1	0.1003	0.080	0.662

4-Methoxybenzyl-*N*-aminocolchicine: Purity = 96.9%



#	Time	Area	Height	Width	Area%	Symmetry
1	3.76	120.7	9.4	0.2145	1.371	2.098
2	5.976	8525.8	825.9	0.172	96.885	0.545
3	6.853	26	4	0.1095	0.296	0.97
4	8.281	11.4	2	0.0937	0.130	0.887
5	9.54	22.7	3.2	0.1193	0.258	0.827
6	9.947	54.2	8.1	0.1109	0.616	0.752
7	10.714	7.5	1.2	0.1048	0.085	0.666
8	11.886	5.1	1.1	[illegible]	0.058	1.073
9	12.385	26.5	3.9	[illegible]	0.301	0.869



#	Time	Area	Height	Width	Area%	Symmetry
1	3.76	120.7	9.4	0.2145	1.371	2.098
2	5.976	8525.8	825.9	0.172	96.885	0.545
3	6.853	26	4	0.1095	0.296	0.97
4	8.281	11.4	2	0.0937	0.130	0.887
5	9.54	22.7	3.2	0.1193	0.258	0.827
6	9.947	54.2	8.1	0.1109	0.616	0.752
7	10.714	7.5	1.2	0.1048	0.085	0.666
8	11.886	5.1	1.1	0.0784	0.058	1.073
9	12.385	26.5	3.9	0.1126	0.301	0.869