Exploration, Synthesis and studies of gel forming simple sugar chalcone derivatives

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1. Experimental Section

1.1 Materials and methods

D-Glucose was purchased from Sigma-Aldrich Chemicals Pvt. Ltd., USA and was of high purity. Butyraldehyde and the organic catalyst (pyrrolidine) were obtained from SRL, India. Other reagents, such as, hydrochloric acid, sodium hydrogen carbonate, and solvents (AR Grade) were obtained from Sd-fine, India, in high purity and were used without any further purification. Acetyl acetone was purchased from loba-chemie. Acetic anhydride was purchased from Fischer Chemicals Pvt. Ltd., India. The solvents were purified according to the standard methods. Column chromatography was performed on silica gel (100 – 200 mesh). NMR spectra were recorded on a Bruker DRX 300 MHz instrument in either $CDCl_3$ or DMSO-d_6. Chemical shifts are referenced to internal TMS. Elemental analysis were performed using a Perkin-Elmer 2400 series CHNS/O analyzer. While assigning the spectral data, several abbreviations were used and these include 'Ar' for aromatic, 'Sac' for saccharide 'Alk' for alkene respectively.

2.1 General procedure for the synthesis of sugar chalcone derivatives (5-22):

To a solution of *β-C*-glycosidic ketone, (**1** / **2** / **3**) (1 mmol) in dry DCM (5 ml) were added pyrrolidine (30% mol) and aldehyde (1.2 mmol). After stirring at room temperature for a given period of time, the reaction mixture was evaporated under reduced pressure and extracted using EtOAc-water mixture. The ethylacetate layer was dried over anhyd. Na_2SO_4 and concentrated to dryness. The product thus obtained was further purified by column chromatography.

2.1a Synthesis, physicochemical and spectral data of (*E*)-1-(4,6-*O*-butylidene-*β*-D-glucopyranosyl)-4-(4-bromophenyl)-but-3-en-2-one (5):

Compound, **5** was obtained by the aldol condensation of 4,6-*O*-butylidene-*β*-**D**-

glucopyranosyl-propane-2-one, **1** (0.27 g, 1 mmol) with 4-bromobenzaldehyde (0.22 g, 1.2 mmol) as a colourless fluffy solid.

Mp: 228-230 ^{o}C; Yield: 0.30 g (68%); ^{1}H NMR (300 MHz, $CDCl_3$ + DMSO-d_6): δ 7.65-7.45 (m, 5H, Alk-H, Ar-H), 6.77 (d, J = 16.2 Hz, 1H, Alk-H), 5.09 (s, 1H, Sac-OH), 4.87 (s, 1H, Sac-OH), 4.53 (t, J = 5.0 Hz, 1H, Sac-H), 4.05 (dd, J = 3.0 Hz, J = 10.1 Hz, 1H, Sac-H), 3.86 (t, J = 8.9 Hz, 1H, Sac-H), 3.60 (t, J = 9.0 Hz, 1H, Sac-H), 3.39 (t, J = 9.8 Hz, 1H, Sac-H), 3.31-3.27 (m, 1H, Sac-H), 3.40-3.10 (m, 2H, Sac-H), 3.12-3.09 (m, 1H, -CH_2), 2.82 (dd, J = 9.0 Hz, J = 15.9 Hz, 1H, -CH_2), 1.65-1.57 (m, 2H, -CH_2), 1.42 (q, J = 7.2 Hz, 2H, -CH_2), 0.90 (t, J = 7.2 Hz, 3H, -CH_3); ^{13}C NMR (75 MHz, $CDCl_3$ + DMSO-d_6): δ 202.7, 146.2, 138.3, 136.9, 134.6, 131.9, 129.2, 106.9, 85.5, 81.6, 79.5, 79.3, 75.4, 73.0, 48.3, 41.0, 22.1, 18.8; Elemental analysis Anal. Calc. for $C_{20}H_{25}BrO_6$: C, 54.43; H, 5.71%. Found: C, 54.47; H, 5.75.

2.1b Synthesis, physicochemical and spectral data of (*E*)-1-(4,6-*O*-butylidene-*β*-D-glucopyranosyl)-4-(4-fluorophenyl)-but-3-en-2-one (6):

Compound, **6** was obtained by the aldol condensation of 4,6-*O*-butylidene-*β*-**D**-glucopyranosyl-propane-2-one, **1** (0.27 g, 1 mmol) with 4-fluorobenzaldehyde, (0.15 g, 1.2 mmol) as a colourless fluffy solid.

Mp: 220-226 ^{o}C; Yield: 0.18 g (53%); ^{1}H NMR (300 MHz, $CDCl_3$ + DMSO-d_6): δ 7.56-7.47 (m, 5H, Alk-H, Ar-H), 6.79 (d, J = 16.2 Hz, 1H, Alk-H), 4.52 (t, J = 5.0 Hz, 1H, Sac-H), 4.03 (dd, J = 3.9 Hz, J = 9.9 Hz, 1H, Sac-H), 3.84 (t, J = 9.3 Hz, 1H, Sac-H), 3.54 (t, J = 8.6 Hz, 1H, Sac-H), 3.37 (t, J = 8.4 Hz, 2H, Sac-H), 3.26-3.19 (m, 2H, Sac-H), 3.12 (dd, J = 2.4 Hz, J = 15.9 Hz, 1H, -CH_2), 2.81 (dd, J = 9.0 Hz, J = 15.9 Hz, 1H, -CH_2), 1.64-1.56 (m, 2H, -CH_2), 1.41 (q, J = 7.8 Hz, 2H, -CH_2), 0.90 (t, J = 7.4 Hz, 3H, -CH_3); ^{13}C NMR (75 MHz, $CDCl_3$ + DMSO-d_6): δ 202.4, 146.0, 138.4, 136.9, 134.7, 132.0, 129.1, 106.9, 85.6, 81.6, 79.6, 79.4, 75.4, 73.0, 48.4, 41.1, 22.1, 18.8; Elemental analysis Anal. Calc. for $C_{20}H_{25}FO_6$: C, 63.15; H, 6.62%. Found: C, 63.19; H, 6.67.

2.1c Synthesis, physicochemical and spectral data of (*E*)-1-(4,6-*O*-butylidene-*β*-D-glucopyranosyl)-4-(4-allyloxyphenyl)-but-3-en-2-one (7):

Compound, **7** was obtained by the aldol condensation of 4,6-*O*-butylidene-*β*-**D**-glucopyranosyl-propane-2-one, **1** (0.27 g, 1 mmol) with 4-allyloxybenzaldehyde,

(0.19 g, 1.2 mmol) as a colourless fluffy solid.

Mp: 204-208 ^{o}C; Yield: 0.19 g (45%); ^{1}H NMR (300 MHz, $CDCl_3$ + DMSO-d_6): δ 7.86-7.80 (m, 3H, Alk-H, Ar-H), 7.24 (d, *J* = 8.7 Hz, 1H, Ar-H), 6.96 (d, *J* = 15.9 Hz, 1H, Alk-H), 6.40-6.30 (m, 1H, Alk-H), 5.73 (d, *J* = 17.1 Hz, 1H, Alk-H), 5.62 (d, *J* = 10.5 Hz, 1H, Alk-H), 5.28 (d, *J* = 4.5 Hz, 1H, -OCH_2), 5.05 (d, *J* = 3.0 Hz, 1H, Sac-OH), 4.89 (d, *J* = 5.1 Hz, 1H, -Sac-OH), 4.84 (t, *J* = 5.0 Hz, 1H, Ace-H), 4.38 (dd, *J* = 3.9 Hz, *J* = 9.9 Hz, 1H, Sac-H), 4.19 (t, *J* = 4.5 Hz, 1H, Sac-H), 3.93 (t, *J* = 4.2 Hz, 1H, Sac-H), 3.71 (t, *J* = 9.6 Hz, 1H, Sac-H), 3.63-3.45 (m, 4H, Sac-H, -CH_2), 3.12 (dd, *J* = 9.0 Hz, *J* = 15.9 Hz, 1H, -CH_2), 1.95-1.89 (m, 2H, -CH_2), 1.73 (q, *J* = 7.5 Hz, 2H, -CH_2), 1.21 (t, *J* = 7.4 Hz, 3H, -CH_3); ^{13}C NMR (75 MHz, $CDCl_3$ + DMSO-d_6): *δ* 202.7, 165.3, 147.6, 137.5, 134.8, 131.9, 129.1, 122.7, 119.9, 107.0, 85.4, 81.5, 79.7, 79.4, 75.3, 73.5, 73.1, 48.0, 41.0, 22.1, 18.7; ESI-MS Calc. for $C_{23}H_{30}O_7$, 418.20; *m/z* found, 419.20 $[M+H]^+$; Elemental analysis Anal. Calc. for $C_{23}H_{30}O_7$: C, 66.01; H, 7.23%. Found: C, 66.06; H, 7.27.

2.1d Synthesis, physicochemical and spectral data of (*E*)-1-(4,6-*O*-butylidene-*β*-D-glucopyranosyl)-4-(4-hydroxyphenyl)-but-3-en-2-one (8):

Compound, **8** was obtained by the aldol condensation of 4,6-*O*-butylidene-*β*-**D**-glucopyranosyl-propane-2-one, **1** (0.27 g, 1 mmol) with 4-hydroxybenzaldehyde, (0.14 g, 1.2 mmol) as a colourless solid.

Mp: 188-190 ^{o}C; Yield: 0.22 g (58%); ^{1}H NMR (300 MHz, $CDCl_3$ + DMSO-d_6): *δ* 9.50 (s, 1H, Ph-OH), 7.53-7.40 (m, 3H, Ar-H), 6.86 (d, *J* = 8.4 Hz, 2H, Ar-H), 6.60 (d, *J* = 15.9 Hz, 1H, Alk-H), 4.76 (s, 1H, Sac-OH), 4.53 (t, *J* = 5.0 Hz, 1H, Sac-H), 4.10-4.07 (m, 1H, Sac-H), 3.89 (t, *J* = 7.8 Hz, 1H, Sac-H), 3.64 (t, *J* = 7.8 Hz, 1H, Sac-H), 3.40 (t, *J* = 9.6 Hz, 1H, Sac-H), 3.32-3.21 (m, 3H, Sac-H), 3.15-3.09 (m, 1H, -CH_2), 2.80-2.77 (m, 1H, -CH_2), 1.64-1.61 (m, 2H, -CH_2), 1.40 (q, *J* = 7.2 Hz, 2H, -CH_2), 0.90 (t, *J* = 7.2 Hz, 3H, -CH_3); ^{13}C NMR (75 MHz, $CDCl_3$ + DMSO-d_6): *δ* 192.6, 154.8, 138.1, 124.9, 120.4, 118.1, 110.9, 96.9, 75.3, 71.0, 69.8, 69.5, 65.3, 63.1, 37.9, 31.0, 12.1, 8.6; Elemental analysis Anal. Calc. for $C_{20}H_{26}O_7$: C, 63.48; H, 6.93%. Found: C, 63.53; H, 6.97.

2.1e Synthesis, physicochemical and spectral data of (*E*)-1-(4,6-*O*-butylidene-*β*-D-glucopyranosyl)-4-(3-hydroxyphenyl)-but-3-en-2-one (9):

Compound, **9** was obtained by the aldol condensation of 4,6-*O*-butylidene-*β*-**D**-glucopyranosyl-propane-2-one, **1** (0.27 g, 1 mmol) with 3-hydroxybenzaldehyde, (0.14 g, 1.2 mmol) as a colourless solid.

Mp: 162-164 ^{o}C; Yield: 0.20 g (53%); ^{1}H NMR (300 MHz, $CDCl_3$ + DMSO-d_6): δ 9.60 (s, 1H, Ph-OH), 7.62 (t, J = 7.7 Hz, 1H, Ar-H), 7.93 (s, 1H, Ar-H), 7.45-7.42 (m, 2H, Alk-H, Ar-H), 7.31 (d, J = 7.8 Hz, 1H, Ar-H), 7.13 (d, J = 16.2 Hz, 1H, Alk-H), 5.30 (s, 1H, Sac-OH), 5.02 (s, 1H, Sac-OH), 4.95 (t, J = 5.0 Hz, 1H, Sac-H), 4.50 (dd, J = 3.3 Hz, J = 10.1 Hz, 1H, Sac-H), 4.30 (t, J = 8.5 Hz, 1H, Sac-H), 4.05 (t, J = 8.1 Hz, 1H, Sac-H), 3.82 (t, J = 9.6 Hz, 1H, Sac-H), 3.74-3.62 (m, 3H, Sac-H), 3.55 (dd, J = 2.4 Hz, J = 15.9 Hz, 1H, -CH_2), 3.24 (dd, J = 9.0 Hz, J = 15.9 Hz, 1H, -CH_2), 2.08-2.02 (m, 2H, -CH_2), 1.83 (q, J = 7.2 Hz, 2H, -CH_2), 1.40 (t, J = 7.2 Hz, 3H, -CH_3); ^{13}C NMR (75 MHz, $CDCl_3$ + DMSO-d_6): δ 192.7, 152.4, 138.0, 130.3, 124.5, 121.0, 114.4, 112.7, 109.4, 96.9, 75.2, 71.3, 69.7, 69.4, 65.2, 63.0, 37.9, 30.9, 12.0, 8.6; Elemental analysis Anal. Calc. for $C_{20}H_{26}O_7$: C, 63.48; H, 6.93%. Found: C, 63.53; H, 6.97.

2.1f Synthesis, physicochemical and spectral data of (*E*)-1-(4,6-*O*-butylidene-*β*-D-glucopyranosyl)-4-(5-chloro-2-hydroxyphenyl)-but-3-en-2-one (10):

Compound, **10** was obtained by the reaction of aldol condensation of 4,6-*O*-butylidene-*β*-**D**-glucopyranosyl-propane-2-one, **1** (0.27 g, 1 mmol) with 5-chloro-2-hydroxybenzaldehyde, (0.18 g, 1.2 mmol) as a colourless solid.

Mp: 81-82 ^{o}C; Yield: 0.23 g (56%); ^{1}H NMR (300 MHz, $CDCl_3$ + DMSO-d_6): δ 10.3 (s, 1H, Ph-OH), 8.20 (d, J = 16.2 Hz, 1H, Alk-H), 7.81 (s, 1H, Ar-H), 7.53 (d, J = 7.8 Hz, 1H, Ar-H), 7.28 (d, J = 8.4 Hz, 1H, Ar-H), 7.21 (d, J= 15.9 Hz, 1H, Alk-H), 5.26 (bs, 1H, Sac-H), 5.01-4.93 (m, 2H, Sac-H), 4.50 (bs, 1H, Sac-H), 4.29 (bs, 1H, Sac-H), 4.02 (bs, 1H, Sac-H), 3.80-3.51 (m, 2H, Sac-H), 3.30-3.20 (m, 2H, -CH_2), 2.02 (bs, 2H, -CH_2), 1.86-1.81 (m, 2H, -CH_2), 1.32-1.30 (m, 3H, -CH_3); ^{13}C NMR (75 MHz, $CDCl_3$ + DMSO-d_6): δ 202.9, 160.6, 142.2, 135.7, 132.4, 131.8, 128.8, 127.8, 122.6, 107.0, 85.4, 81.3,

80.0, 79.5, 75.4, 73.1, 48.0, 41.0, 22.1, 18.7; Elemental analysis Anal. Calc. for $C_{20}H_{25}ClO_7$: C, 58.18; H, 6.10%. Found: C, 58.23; H, 6.14.

2.1g Synthesis, physicochemical and spectral data of (*E*)-1-(4,6-*O*-butylidene-*β*-D-glucopyranosyl)-4-(3-bromo-2-hydroxyphenyl)-but-3-en-2-one (11):

Compound, **11** was obtained by the reaction of aldol condensation of 4,6-*O*-butylidene-*β*-**D**-glucopyranosyl-propane-2-one, **1** (0.27 g, 1 mmol) with 3-bromo-2-hydroxybenzaldehyde, (0.24 g, 1.2 mmol) as a colourless solid.

Mp: 146-148 ^oC; Yield: 0.23 g (50%); ^1H NMR (300 MHz, $CDCl_3$ + DMSO-d_6): δ 10.5 (s, 1H, Ph-OH), 8.51 (d, J = 16.2 Hz, 1H, Alk-H), 8.26-8.25 (m, 1H, Ar-H), 7.96 (q, J = 8.7 Hz, 1H, Ar-H), 7.55-7.49 (m, 2H, Alk-H, Ar-H), 5.34 (d, J = 4.2 Hz, 1H, Sac-OH), 5.24 (t, J = 5.0 Hz, 1H, Sac-H), 5.05 (d, J = 2.7 Hz, 1H, Sac-OH), 4.80 (dd, J = 3.9 Hz, J = 9.9 Hz, 1H, Sac-H), 4.62 (t, J = 8.3 Hz, 1H, Sac-H), 4.36 (t, J = 8.5 Hz, 1H, Sac-H), 4.11 (t, J = 9.8 Hz, 1H, Sac-H), 4.03-3.95 (m, 3H, Sac-H), 3.84 (dd, J = 2.7 Hz, J = 15.9 Hz, 1H, -CH_2), 3.56 (dd, J = 8.7 Hz, J = 16.2 Hz, 1H, -CH_2), 2.38-2.30 (m, 2H, -CH_2), 2.13 (q, J = 7.5 Hz, 2H, -CH_2), 1.61 (t, J = 7.2 Hz, 3H, -CH_3); ^{13}C NMR (75 MHz, $CDCl_3$ + DMSO-d_6): δ 193.0, 151.0, 132.3, 128.6, 125.4, 121.9, 118.4, 113.1, 106.1, 97.0, 75.3, 71.2, 69.9, 69.6, 65.4, 63.1, 38.0, 31.0, 12.2, 8.7; Elemental analysis Anal. Calc. for $C_{20}H_{25}BrO_7$: C, 52.53; H, 5.51%. Found: C, 52.56; H, 5.54.

2.1h Synthesis, physicochemical and spectral data of (*E*)-1-(4,6-*O*-butylidene-*β*-D-glucopyranosyl)-4-(4-formylphenyl)-but-3-en-2-one (12):

Compound, **12** was obtained by the aldol condensation of 4,6-*O*-butylidene-*β*-**D**-glucopyranosyl-propane-2-one, **1** (0.27 g, 1 mmol) with terephthaldehyde, (0.16 g, 1.2 mmol) as a yellow solid.

Mp: 190-192 ^oC; Yield: 0.27 g (69%); ^1H NMR (300 MHz, $CDCl_3$): δ 10.04 (s, 1H, -CHO), 7.92 (d, J = 8.4 Hz, 2H, Ar-H), 7.75 (d, J = 8.4 Hz, 2H, Ar-H), 7.59 (d, J = 16.2 Hz, 1H, Alk-H), 6.88 (d, J = 16.2 Hz, 1H, Alk-H), 4.86 (d, J = 4.5 Hz, 1H, Sac-OH), 4.57 (d, J = 3.3 Hz, 1H, Sac-OH), 4.54 (t, J = 5.1 Hz, 1H, Sac-H), 4.08 (dd, J = 3.9 Hz, J = 9.8 Hz, 1H, Sac-H), 3.90 (t, J = 9.2 Hz, 1H, Sac-H), 3.65 (t, J = 8.7 Hz, 1H, Sac-H), 3.41 (t, J = 9.8 Hz, 1H, Sac-H), 3.35-3.24 (m, 4H, Sac-H, -CH_2), 3.18 (dd, J = 2.7 Hz, J = 15.9 Hz,

1H, -CH_2), 1.65-1.59 (m, 2H, -CH_2), 1.42 (q, *J* = 7.5 Hz, 2H, -CH_2), 0.91 (t, *J* = 7.4 Hz, 3H, -CH_3); ^{13}C NMR (75 MHz, $CDCl_3$): δ 197.4, 191.4, 141.6, 140.1, 137.4, 130.2, 128.8, 102.5, 80.4, 76.0, 75.4, 74.4, 70.6, 68.3, 43.7, 36.2, 17.5, 13.9; Elemental analysis Anal. Calc. for $C_{21}H_{26}O_7$: C, 64.60; H, 6.71%. Found: C, 64.65; H, 6.74.

2.1i Synthesis, physicochemical and spectral data of (*E*)-1-(4,6-*O*-butylidene-*β*-D-glucopyranosyl)-4-(4-cyanophenyl)-but-3-en-2-one (13):

Compound, **13** was obtained by the aldol condensation of 4,6-*O*-butylidene-*β*-**D**-glucopyranosyl-propane-2-one, **1** (0.27 g, 1 mmol) with 4-cyanobenzaldehyde, (0.15 g, 1.2 mmol) as a yellow solid.

Mp: 172-174 ^{o}C; Yield: 0.23 g (59%); ^{1}H NMR (300 MHz, $CDCl_3$ + DMSO-d_6): δ 7.71-7.62 (m, 4H, Ar-H), 7.55 (d, *J* = 16.2 Hz, 1H, Alk-H), 6.82 (d, *J* = 15.9 Hz, 1H, Alk-H), 4.53 (t, *J* = 5.1 Hz, 1H, Ace-H), 4.12 (dd, *J* = 3.9 Hz, *J* = 9.6 Hz, 1H, Sac-H), 3.97-3.90 (m, 1H, Sac-H), 3.72 (t, *J* = 8.9 Hz, 1H, Sac-H), 3.44-3.30 (m, 3H, Sac-H), 3.23 (t, *J* = 9.0 Hz, 1H, Sac-H), 3.15 (dd, *J* = 3.3 Hz, *J* = 16.2 Hz, 1H, -CH_2), 2.92 (dd, *J* = 7.8 Hz, *J* = 16.1 Hz, 1H, -CH_2), 1.66-1.59 (m, 2H, -CH_2), 1.42 (q, *J* = 7.8 Hz, 2H, -CH_2), 0.92 (t, *J* = 7.2 Hz, 3H, -CH_3); ^{13}C NMR (75 MHz, $CDCl_3$ + DMSO-d_6): δ 197.3, 140.8, 138.7, 132.7, 129.1, 128.7, 118.3, 113.7, 102.5, 80.4, 76.0, 75.3, 74.3, 70.6, 68.3, 43.7, 36.2, 17.5, 13.9; Elemental analysis Anal. Calc. for $C_{21}H_{25}NO_6$: C, 65.10; H, 6.50%. Found: C, 65.16; H, 6.55.

2.1j Synthesis, physicochemical and spectral data of (*E*)-1-(4,6-*O*-butylidene-*β*-D-glucopyranosyl)-4-(4-carboxyphenyl)-but-3-en-2-one (14):

Compound, **14** was obtained by the aldol condensation of 4,6-*O*-butylidene-*β*-**D**-glucopyranosyl-propane-2-one, **1** (0.27 g, 1 mmol) with 4-carboxybenzaldehyde, (0.18 g, 1.2 mmol) as a colourless solid.

Mp: 184-186 ^{o}C; Yield: 0.24 g (59%); ^{1}H NMR (300 MHz, $CDCl_3$ + DMSO-d_6): δ 8.04 (d, *J* = 8.4 Hz, 2H, Ar-H), 7.64 (d, *J* = 8.4 Hz, 2H, Ar-H), 7.58 (d, *J* = 16.2 Hz, 1H, Alk-H), 6.85 (d, *J* = 16.2 Hz, 1H, Alk-H), 4.53 (t, *J* = 5.1 Hz, 1H, Sac-H), 4.05 (dd, *J* = 4.2 Hz, *J* = 10.1 Hz, 1H, Sac-H), 3.87 (t, *J* = 9.2 Hz, 1H, Sac-H), 3.59 (t, *J* = 8.7 Hz, 1H, Sac-H), 3.26-3.13 (m, 5H, Sac-H, -CH_2), 2.84 (dd, *J* = 8.7 Hz, 1H, -CH_2), 1.65-1.57 (m, 2H, -CH_2), 1.42 (q, *J* = 7.5 Hz, 2H, -CH_2), 0.90 (t, *J* = 7.4 Hz, 3H, -CH_3); ^{13}C NMR(75

MHz, $CDCl_3$ + DMSO-d_6): δ 202.5, 146.1, 143.3, 137.3, 134.9, 133.2, 132.9, 106.8, 85.6, 81.6, 79.6, 79.4, 75.4, 73.0, 48.4, 41.1, 22.2, 18.8; Elemental analysis Anal. Calc. for $C_{21}H_{26}O_8$: C, 62.06; H, 6.45%. Found: C, 62.10; H, 6.49.

2.1k Synthesis, physicochemical and spectral data of (*E*)-1-(4,6-*O*-butylidene-*β*-D-glucopyranosyl)-4-(5-bromo-2-hydroxy-3-formylphenyl)-but-3-en-2-one (15):

Compound, **15** was obtained by the aldol condensation of 4,6-*O*-butylidene-*β*-**D**-glucopyranosyl-propane-2-one, **1** (0.27 g, 1 mmol) with 5-bromo-2-hydroxy-3-formyl benzaldehyde, (0.27 g, 1.2 mmol) as a colourless crystalline solid.

Mp: 236-238 ^oC; Yield: 0.32 g (65%); ^1H NMR (300 MHz, $CDCl_3$ + DMSO-d_6): δ 9.95 (s, 1H, -CHO), 7.89 (d, J = 16.5 Hz, 1H, Alk-H), 7.76 (s, 1H, Ar-H), 7.71 (s, 1H, Ar-H), 6.94 (d, J = 16.5 Hz, 1H, Alk-H), 5.22 (s, 1H, Sac-OH), 5.01 (s, 1H, Sac-OH), 4.51 (t, J = 5.0 Hz, 1H, Sac-H), 4.03 (dd, J = 3.3 Hz, J = 9.5 Hz, 1H, Sac-H), 3.84 (t, J = 8.1 Hz, 1H, Sac-H), 3.23-3.10 (m, 6H, Sac-H, -CH_2), 2.81 (dd, J = 9.0 Hz, J = 15.6 Hz, 1H, -CH_2), 1.58-1.57 (m, 2H, -CH_2), 1.40 (q, J = 7.5 Hz, 2H, -CH_2), 0.89 (t, J = 7.2 Hz, 3H, -CH_3); ^{13}C NMR (75 MHz, $CDCl_3$ + DMSO-d_6): δ 197.6, 194.8, 158.1, 136.8, 136.1, 133.5, 128.8, 126.1, 123.7, 111.3, 101.2, 80.6, 76.7, 74.3, 74.0, 70.3, 67.5, 43.9, 35.9, 17.0, 13.8; ESI-MS: Calc. for $C_{21}H_{25}BrO_8$, 484.07; *m/z* found, 485.08 $[M+H]^+$; Elemental analysis Anal. Calc. for $C_{21}H_{25}BrO_8$: C, 51.97; H, 5.19%. Found: C, 52.03; H, 5.24.

2.1l Synthesis, physicochemical and spectral data of (*E*)-1-(4,6-*O*-butylidene-*β*-D-glucopyranosyl)-4-(3-indolyl)-but-3-en-2-one (16):

Compound, **16** was obtained by the reaction of aldol condensation of 4,6-*O*-butylidene-*β*-**D**-glucopyranosyl-propane-2-one, **1** (0.27 g, 1 mmol) with indole-3-carboxaldehyde, (0.17 g, 1.2 mmol) as a yellow solid.

Mp: 195-198 ^oC; Yield: 0.30 g (75%); ^1H NMR (300 MHz, $CDCl_3$): δ 7.86 (d, J = 16.2 Hz, 1H, Alk-H), 7.61 (s, 1H, Ind-H), 7.61 (s, 1H, Alk-H), 7.53-7.47 (m, 2H, Ar-H), 7.24-7.22 (m, 2H, Ar-H), 6.81 (d, J = 15.9 Hz, 1H, Alk-H), 4.91 (s, 1H, Sac-OH), 4.64 (s, 1H, Sac-OH), 4.55 (t, J = 5.1 Hz, 1H, Sac-H), 4.10 (dd, J = 3.3 Hz, J = 9.0 Hz, 1H, Sac-H), 3.93 (t, J = 7.5 Hz, 1H, Sac-H), 3.65 (t, J = 7.5 Hz, 1H, Sac-H), 3.43 (t, J = 9.6 Hz, 1H, Sac-H), 3.36-3.26 (m, 3H, Sac-H), 3.15 (dd, J = 3.0 Hz, J = 18.0 Hz, 1H, -CH_2), 2.84 (dd, J = 8.7 Hz, J = 15.6 Hz, 1H, -CH_2), 1.68-1.59 (m, 2H, -CH_2), 1.43 (q, J = 7.5 Hz, 2H, -

CH_2), 0.91 (t, J = 7.4 Hz, 3H, -CH_3); ^{13}C NMR (75 MHz, $CDCl_3$): δ 202.8, 142.5 (2C), 135.9, 130.1, 127.6, 126.1, 125.9, 124.9, 117.5, 117.2, 107.0, 85.4, 78.0, 79.8, 79.6, 75.4, 73.1, 48.0, 41.0, 22.1, 18.7; Elemental analysis Anal. Calc. for $C_{22}H_{27}NO_6$: C, 65.82; H, 6.78; N, 3.49%. Found: C, 65.86; H, 6.81; N, 3.53.

2.1m Synthesis, physicochemical and spectral data of (*E*)-1-(4,6-*O*-butylidene-*β*-D-glucopyranosyl)-4-(3-pyrrolyl)-but-3-en-2-one (17):

Compound, **17** was obtained by the aldol condensation of 4,6-*O*-butylidene-*β*-**D**-glucopyranosyl-propane-2-one, **1** (0.27 g, 1 mmol) with pyrrole-3-carboxaldehyde, (0.11 g, 1.2 mmol) as a yellow liquid.

Yield: 0.25 g (71%); ^{1}H NMR (300 MHz, $CDCl_3$ + DMSO-d_6): δ 11.1 (s, 1H, -NH), 7.42 (d, J = 15.9 Hz, 1H, Alk-H), 6.93 (s, 1H, Ar-H), 6.57-6.52 (m, 2H, Alk-H, Ar-H), 6.21 (s, 1H, Ar-H), 4.96 (d, J = 4.2 Hz, 1H, Sac-OH), 4.80 (d, J = 3.0 Hz, 1H, Sac-OH), 4.52 (t, J = 4.7 Hz, 1H, Sac-H), 4.04 (dd, J = 3.9 Hz, J = 9.6 Hz, 1H, Sac-H), 3.83 (t, J = 9.4 Hz, 1H, Sac-H), 3.58 (t, J = 8.4 Hz, 1H, Sac-H), 3.38 (t, J = 9.6 Hz, 1H, Sac-H), 3.27-3.18 (m, 3H, Sac-H), 3.09-3.03 (m, 1H, -CH_2), 2.73 (dd, J = 9.0 Hz, J = 15.8 Hz, 1H, -CH_2), 1.61-1.59 (m, 2H, -CH_2), 1.41 (q, J = 7.2 Hz, 2H, -CH_2), 0.90 (t, J = 7.2 Hz, 3H, -CH_3); ^{13}C NMR (75 MHz, $CDCl_3$ + DMSO-d_6): δ 197.1, 132.9, 128.2, 123.1, 119.6, 115.0, 110.1, 101.7, 80.2, 76.5, 74.5, 74.3, 70.1, 67.8, 42.5, 35.8, 16.5, 13.5; Elemental analysis Anal. Calc. for $C_{18}H_{25}NO_6$: C, 61.52; H, 7.17%. Found: C, 61.56; H, 7.22.

2.1n Synthesis, physicochemical and spectral data of (*E*)-1-(4,6-*O*-butylidene-*β*-D-glucopyranosyl)-4-(3-quinolyl)-but-3-en-2-one (18):

Compound, **18** was obtained by the aldol condensation of 4,6-*O*-butylidene-*β*-**D**-glucopyranosyl-propane-2-one, **1** (0.27 g, 1 mmol) with quinoline-3-carbaldehyde, (0.19 g, 1.2 mmol) as a colourless solid.

Mp: 240-243 °C; Yield: 0.38 g (93%); ^{1}H NMR (300 MHz, $CDCl_3$): δ 8.27 (d, J = 8.4 Hz, 1H, Ar-H), 8.06 (d, J = 8.4 Hz, 1H, Ar-H), 7.89 (d, J = 7.8 Hz, 1H, Ar-H), 7.77-7.69 (m, 3H, Alk-H, Ar-H), 7.59 (t, J = 7.4 Hz, 1H, Ar-H), 7.27 (d, J = 16.2 Hz, 1H, Alk-H), 5.21 (d, J = 5.1 Hz, 1H, Sac-OH), 5.06 (d, J = 3.6 Hz, 1H, Sac-OH), 4.52 (t, J = 4.7 Hz, 1H, Sac-H), 4.03 (dd, J = 3.3 Hz, J = 9.8 Hz, 1H, Sac-H), 3.89 (t, J = 8.3 Hz, 1H, Sac-H), 3.56-3.52 (m, 1H, Sac-H), 3.42-3.20 (m, 5H, Sac-H, -CH_2), 2.91 (dd,

J = 9.0 Hz, *J* = 16.2 Hz, 1H, -CH_2), 1.60-1.57 (m, 2H, -CH_2), 1.41 (q, *J* = 7.5 Hz, 2H, -CH_2), 0.90 (t, *J* = 7.2 Hz, 3H, -CH_3); ^{13}C NMR (75 MHz, $CDCl_3$): δ 197.6, 153.0, 147.7, 141.6, 136.5, 130.8, 129.7, 129.1, 127.6, 127.3, 127.0, 120.2, 101.6, 80.4, 76.4, 74.3, 74.2, 70.2, 67.8, 43.2, 35.8, 16.9, 13.6; Elemental analysis Anal. Calc. for $C_{23}H_{27}NO_6$: C, 66.81; H, 6.58; N, 3.39%. Found: C, 66.84; H, 6.62; N, 3.43.

2.1o Synthesis, physicochemical and spectral data of (*E*)-1-(4,6-*O*-butylidene-2,3-diacetyl-β-D-glucopyranosyl)-4-(4-bromophenyl)-but-3-en-2-one (19):

Compound, **19** was obtained as a colourless cryatalline solid by the acetylation of sugar chalcone, **5** (0.44 g, 1 mmol) using NaOAc (0.25 g, 3 mmol) and Ac_2O (4 ml, 40 mmol).

Mp: 158-160 ^{o}C; Yield: 0.45 g (85%); ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.55-7.39 (m, 5H, Ar-H, Alk-H), 6.70 (d, *J* = 15.9 Hz, 1H, Alk-H), 5.23 (t, *J* = 9.2 Hz, 1H, Sac-H), 4.93 (t, *J* = 9.5 Hz, 1H, Sac-H), 4.48 (t, *J* = 5.1 Hz, 1H, Sac-H), 4.19-4.13 (m, 2H, Sac-H), 3.41-3.39 (m, 2H, Sac-H), 2.92 (dd, *J* = 8.7 Hz, *J* = 16.4 Hz, 1H, -CH_2), 2.65 (dd, *J* = 3.3 Hz, *J* = 16.2 Hz, 1H, -CH_2), 2.06 (s, 3H, -$COCH_3$), 2.03 (s, 3H, -$COCH_3$), 1.59-1.56 (m, 2H, -CH_2), 1.37 (q, *J* = 7.8 Hz, 2H, -CH_2), 0.89 (t, *J* = 7.4 Hz, 3H, -CH_3); ^{13}C NMR (75 MHz, $CDCl_3$): δ 195.9, 170.2 (2C), 142.2, 132.3, 129.7, 126.6, 102.6, 78.4, 74.5, 73.1, 72.5, 70.8, 68.1, 43.0, 36.0, 20.8 (2C), 17.4, 13.8; Elemental analysis Anal. Calc. for $C_{24}H_{29}BrO_8$: C, 54.87; H, 5.56%. Found: C, 54.92; H, 5.60.

2.1p Synthesis, physicochemical and spectral data of (*E*)-1-(4,6-*O*-butylidene-2,3-diacetyl-β-D-glucopyranosyl)-4-(4-fluorophenyl)-but-3-en-2-one (20):

Compound, **20** was obtained as a yellow solid by the acetylation of sugar chalcone, **6** (0.38 g, 1 mmol) using NaOAc (0.25 g, 3 mmol) and Ac_2O (4 ml, 40 mmol).

Mp: 58-60 ^{o}C; Yield: 0.38 g (83%); ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.56-7.51 (m, 3H, Alk-H, Ar-H), 7.09 (t, *J* = 8.6 Hz, 2H, Ar-H), 6.65 (d, *J* = 16.2 Hz, 1H, Alk-H), 5.23 (t, *J* = 7.2 Hz, 1H, Sac-H), 4.94 (t, *J* = 9.5 Hz, 1H, Sac-H), 4.48 (t, *J* = 5.3 Hz, 1H, Sac-H), 4.21-4.13 (m, 2H, Sac-H), 4.42-3.40 (m, 3H, Sac-H), 2.93 (dd, *J* = 8.4 Hz, *J* = 16.1 Hz, 1H, -CH_2), 2.65 (dd, *J* = 3.3 Hz, *J* = 16.2 Hz, 1H, -CH_2), 2.06 (s, 3H, -$OCOCH_3$), 2.03 (s, 3H, -$OCOCH_3$), 1.63-1.56 (m, 2H, -CH_2), 1.37 (q, *J* = 7.5 Hz, 2H, -CH_2), 0.89 (t, *J* = 6.3 Hz, 3H, -CH_3); ^{13}C NMR (75 MHz, $CDCl_3$): δ 195.8, 170.1, 169.6, 150.1, 138.4, 130.5,

124.7, 116.8, 102.4, 78.4, 74.5, 73.0, 72.6, 72.4, 71.8, 70.7, 42.8, 36.0, 20.8, 20.6, 17.3, 13.8; Elemental analysis Anal. Calc. for $C_{24}H_{29}FO_8$: C, 62.06; H, 6.29%. Found: C, 62.10; H, 6.32.

2.1q Synthesis, physicochemical and spectral data of (*E*)-1-(4,6-*O*-butylidene 2,3-diacetyl-*β*-D-glucopyranosyl)-4-(4-allyloxyphenyl)-but-3-en-2-one (21):

Compound, **21** was obtained as a colourless solid by the acetylation of sugar chalcone, **7** (0.42 g, 1 mmol) using NaOAc (0.25 g, 3 mmol) and Ac_2O (4 ml, 40 mmol).

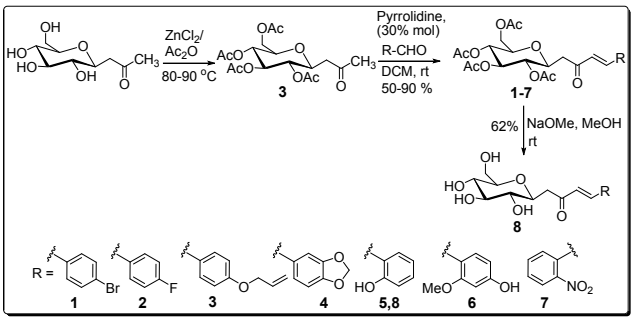
Mp: 126-128 ^oC; Yield: 0.40 g (80%); ^1H NMR (300 MHz, $CDCl_3$): δ 7.50 (t, 3H, Ar-H, Alk-H), 6.93 (d, J = 8.7 Hz, 2H, Ar-H), 6.61 (d, J = 16.2 Hz, 1H, Alk-H), 6.12-5.99 (m, 1H, Alk-H), 5.42 (d, J = 17.3 Hz, 1H, Alk-H), 5.32 (d, J = 10.5 Hz, 1H, Alk-H), 5.23 (t, J = 9.2 Hz, 1H, Sac-H), 4.94 (t, J = 9.6 Hz, 1H, Sac-H), 4.58 (d, J = 5.1 Hz, 2H, $-CH_2$), 4.48 (t, J = 5.1 Hz, 1H, Sac-H), 4.20-4.14 (m, 2H, Sac-H), 3.40-3.42 (m, 3H, Sac-H), 2.91 (dd, J = 8.4 Hz, J = 16.2 Hz, 1H, $-CH_2$), 2.63 (dd, J = 3.3 Hz, J = 16.1 Hz, 1H, $-CH_2$), 2.06 (s, 3H, $-COCH_3$), 2.03 (s, 3H, $-COCH_3$), 1.43-1.40 (m, 2H, $-CH_2$), 1.37 (q, J = 8.1 Hz, 2H, $-CH_2$), 0.89 (t, J = 7.4 Hz, 3H, $-CH_3$); ^{13}C NMR (75 MHz, $CDCl_3$): δ 196.0, 170.3, 170.2, 160.9, 143.5, 132.7, 130.2, 127.1, 124.1, 118.1, 115.3, 102.6, 78.5, 74.8, 73.2, 72.6, 70.8, 68.9, 68.2, 42.8, 36.1, 20.8 (2C), 17.5, 13.9; Elemental analysis Anal. Calc. for $C_{27}H_{34}O_9$: C, 64.53; H, 6.82%. Found: C, 64.58; H, 6.85.

2.1r Synthesis, physicochemical and spectral data of (*E*)-1-(4,6-*O*-butylidene-2,3-diacetyl-*β*-D-glucopyranosyl)-4-(3,4-dioxanephenyl)-but-3-en-2-one (22):

Compound, **22** was obtained as a yellow solid by the acetylation of its corresponding sugar chalcone, (0.41 g, 1 mmol) using NaOAc (0.25 g, 3 mmol) and Ac_2O (4 ml, 40 mmol).

Mp: 114-116 ^oC; Yield: 0.40 g (82%); ^1H NMR (300 MHz, $CDCl_3$): δ 7.45 (d, J = 16.2 Hz, 1H, Alk-H), 7.04-7.02 (m, 2H, Ar-H), 6.83 (d, J = 8.7 Hz, 1H, Ar-H), 6.56 (d, J = 15.9 Hz, 1H, Alk-H), 6.02 (s, 2H, $-OCH_2$), 5.23 (t, J = 9.3 Hz, 1H, Sac-H), 4.93 (t, J = 9.5 Hz, 1H, Sac-H), 4.48 (t, J = 5.1 Hz, 1H, Sac-H), 4.19-4.13 (m, 2H, Sac-H), 3.41-3.39 (m, 3H, Sac-H), 2.90 (dd, J = 8.7 Hz, J = 16.1 Hz, 1H, $-CH_2$), 2.63 (dd, J = 3.3 Hz, J = 16.1 Hz, 1H, $-CH_2$), 2.06 (s, 3H, $-COCH_3$), 2.03 (s, 3H, $-COCH_3$),

1.63-1.56 (m, 2H, -CH_2), 1.37 (q, J = 7.5 Hz, 2H, -CH_2), 0.89 (t, J = 7.4 Hz, 3H, -CH_3); ^{13}C NMR (75 MHz, $CDCl_3$): δ 195.9, 170.2 (2C), 150.1, 148.5, 143.4, 128.7, 125.2, 124.3, 108.7, 106.6, 102.6, 101.7, 78.5, 74.7, 73.1, 72.5, 70.7, 68.2, 42.9, 36.0, 20.8, 17.4, 13.8; Elemental analysis Anal. Calc. for $C_{25}H_{30}O_{10}$: C, 61.22; H, 6.16%. Found: C, 61.26; H, 6.19.



Scheme 1 Synthesis of sugar-chalconederivatives, **1-8**.

2.1s Synthesis, physicochemical and spectral data of (*E*)-1-(2,3,4,6-tetra-*O*-acetyl-*β*-D-glucopyranosyl)-4-(4-bromophenyl)-but-3-en-2-one (1):

Compound, **1** was obtained by the aldol condensation of 2,3,4,6-tetra-*O*-acetyl-*β*-**D**-glucopyranosyl-propane-2-one, **3** (0.39 g, 1 mmol) with 4-bromobenzaldehyde, (0.22 g, 1.2 mmol) as a colourless crystalline solid.

Mp: 138-142 ^{o}C; Yield: 0.48 g (86%); ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.56-7.40 (m, 5H, Alk-H, Ar-H), 6.72 (d, J = 16.2 Hz, 1H, Alk-H), 5.23 (t, J = 9.3 Hz, 1H, Sac-H), 5.07 (t, J = 9.6 Hz, 1H, Sac-H), 4.98 (t, J = 9.8 Hz, 1H, Sac-H), 4.26 (dd, J = 4.8 Hz, J = 12.5 Hz, 1H, Sac-H), 4.15-4.08 (m, 1H, Sac-H), 4.02 (dd, J = 2.1 Hz, J = 12.3 Hz, 1H, Sac-H), 3.75-3.69 (m, 1H, Sac-H), 3.02 (dd, J = 8.4 Hz, J = 16.5 Hz, 1H, -CH_2), 2.67 (dd, J = 3.0 Hz, J = 16.4 Hz, 1H, -CH_2), 2.03-2.02 (m, 12H, -$COCH_3$); ^{13}C NMR (75 MHz, $CDCl_3$): δ 195.9, 170.6, 170.2, 170.0, 169.6, 142.3, 133.1, 132.3, 129.7, 126.7, 125.1, 75.8, 74.2, 74.1, 71.7, 68.5, 62.0, 42.7, 20.7 (2C), 20.6 (2C); Elemental analysis Anal. Calc. for $C_{24}H_{27}BrO_{10}$: C, 51.90; H, 4.90%. Found: C, 51.95; H, 4.94.

2.2t Synthesis, physicochemical and spectral data of (*E*)-1-(2,3,4,6-tetra-*O*-acetyl-*β*-D-glucopyranosyl)-4-(4-fluorophenyl)-but-3-en-2-one (2):

Compound, **2** was obtained by the aldol condensation of 2,3,4,6-tetra-*O*-acetyl-*β*-**D**-glucopyranosyl-propane-2-one, **3** (0.39 g, 1 mmol) with 4-fluorobenzaldehyde, (0.15

g, 1.2 mmol) as a colourless crystalline solid.

Mp: 128-130 ^{o}C; Yield: 0.37 g (76%); ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.57-7.46 (m, 3H, Alk-H, Ar-H), 7.09 (d, J = 8.4 Hz, 2H, Ar-H), 6.66 (d, J = 16.2 Hz, 1H, Alk-H), 5.24 (t, J = 9.3 Hz, 1H, Sac-H), 5.08 (t, J = 9.6 Hz, 1H, Sac-H), 4.98 (t, J = 9.6 Hz, 1H, Sac-H), 4.26 (dd, J = 4.8 Hz, J = 12.3 Hz, 1H, Sac-H), 4.13-4.09 (m, 1H, Sac-H), 4.02 (dd, J = 2.1 Hz, J = 12.3 Hz, 1H, Sac-H), 3.73-3.69 (m, 1H, Sac-H), 3.02 (dd, J = 8.4 Hz, J = 16.2 Hz, 1H, -CH_2), 2.67 (dd, J = 3.0 Hz, J = 16.4 Hz, 1H, -CH_2), 2.03-1.98 (m, 12H, -$COCH_3$); ^{13}C NMR (75 MHz, $CDCl_3$): δ 195.9, 170.6, 170.2, 170.0, 169.5, 142.4, 130.5, 130.3, 125.9, 116.4, 116.1, 76.6, 75.8, 74.2, 71.8, 68.6, 62.1, 42.7, 20.7, 20.6 (3C); Elemental analysis Anal. Calc. for $C_{24}H_{27}FO_{10}$: C, 58.30; H, 5.50%. Found: C, 58.34; H, 5.54.

2.2u Synthesis, physicochemical and spectral data of (*E*)-1-(2,3,4,6-tetra-*O*-acetyl-β-D-glucopyranosyl)-4-(4-allyloxyphenyl)-but-3-en-2-one (3):

Compound, **3** was obtained by the aldol condensation of 2,3,4,6-tetra-*O*-acetyl-β-**D**-glucopyranosyl-propane-2-one, **3** (0.39 g, 1 mmol) with 4-allyloxybenzaldehyde, (0.20 g, 1.2 mmol) as a colourless solid.

Mp: 90-94 ^{o}C; Yield: 0.39 g (74%); ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.55-7.50 (m, 3H, Ar-H, Alk-H), 6.95 (d, J = 8.4 Hz, 2H, Ar-H), 6.64 (d, J = 16.2 Hz, 1H, Alk-H), 6.13-6.00 (m, 1H, Alk-H), 5.44 (d, J = 17.1 Hz, 1H Alk-H), 5.33 (d, J = 10.5 Hz, 1H, Alk-H), 5.24 (t, J = 9.5 Hz, 1H, Sac-H), 5.09 (t, J = 9.8 Hz, 1H, Sac-H), 5.00 (t, J = 9.6 Hz, 1H, Sac-H), 4.60 (d, J = 5.4 Hz, 2H, -CH_2), 4.27 (dd, J = 5.1 Hz, J = 12.5 Hz, 1H, Sac-H), 4.17-4.10 (m, 1H, Sac-H), 4.06-4.01 (m, 1H, Sac-H), 3.76-3.71 (m, 1H, Sac-H), 3.01 (dd, J = 8.4 Hz, J = 16.2 Hz, 1H, -CH_2), 2.67 (dd, J = 3 Hz, J = 16.1 Hz, 1H, -CH_2), 2.04-2.02 (m, 12H, -$COCH_3$); ^{13}C NMR (75 MHz, $CDCl_3$): δ 196.0, 170.6, 170.2, 170.0, 169.5, 160.8, 143.5, 132.7, 130.2, 127.0, 124.1, 118.0, 115.2, 75.7, 74.2, 71.7, 68.8, 68.5, 62.1, 42.5, 20.7 (2C), 20.6 (2C); Elemental analysis Anal. Calc. for $C_{27}H_{32}O_{11}$: C, 60.90; H, 6.06%. Found: C, 60.94; H, 6.12.

2.2v Synthesis, physicochemical and spectral data of (*E*)-1-(2,3,4,6-tetra-*O*-acetyl-β-D-glucopyranosyl)-4-(3,4-dioxanephenyl)-but-3-en-2-one (4):

Compound, **4** was obtained by the aldol condensation of 2,3,4,6-tetra-*O*-acetyl-β-**D**-

glucopyranosyl-propane-2-one, **3** (0.39 g, 1 mmol) with piperonyl aldehyde, (0.18 g, 1.2 mmol) as a yellow solid.

Mp: 112-114 °C; Yield: 0.37 g (71%); ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.47 (d, J = 16.2 Hz, 1H, Alk-H), 7.06-7.03 (m, 2H, Ar-H), 6.83 (d, J = 8.1 Hz, 1H, Ar-H), 6.57 (d, J = 16.2 Hz, 1H, Alk-H), 6.03 (s, 2H, -OCH_2), 5.23 (t, J = 9.3 Hz, 1H, Sac-H), 5.08 (t, J = 9.8 Hz, 1H, Sac-H), 4.98 (t, J = 9.6 Hz, 1H, Sac-H), 4.26 (dd, J = 4.8 Hz, J = 12.6 Hz, 1H, Sac-H), 4.13-4.11 (m, 1H, Sac-H), 4.12 (dd, J = 1.2 Hz, J = 12.5 Hz, 1H, Sac-H), 3.73-3.70 (m, 1H, Sac-H), 2.99 (dd, J = 8.4 Hz, J = 16.2 Hz, 1H, -CH_2), 2.66 (dd, J = 3.3 Hz, J = 16.2 Hz, 1H, -CH_2), 2.03-2.01 (m, 12H, -$COCH_3$); ^{13}C NMR (75 MHz, $CDCl_3$): δ 196.0, 170.7, 170.2, 170.0, 169.6, 150.1, 148.5, 143.6, 128.6, 125.3, 124.3, 108.7, 106.6, 101.7, 75.7, 74.2, 71.7, 68.5, 62.1, 42.6, 20.7 (2C), 20.6 (2C); Elemental analysis Anal. Calc. for $C_{25}H_{28}O_{12}$: C, 57.69; H, 5.42%. Found: C, 57.73; H, 5.45.

2.2w Synthesis, physicochemical and spectral data of (E)-1-(2,3,4,6-tetra-*O*-acetyl-*β*-D-glucopyranosyl)-4-(2-hydroxyphenyl)-but-3-en-2-one (5):

Compound, **5** was obtained by the aldol condensation of 2,3,4,6-tetra-*O*-acetyl-*β*-**D**-glucopyranosyl-propane-2-one, **3** (0.39 g, 1 mmol) with salicylaldehyde, (0.15 g, 1.2 mmol) as a colourless solid.

Mp: 138-140 ^{o}C; Yield: 0.37 g (76%); ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.87 (d, J = 16.2 Hz, 1H, Alk-H), 7.51 (d, J = 7.8 Hz, 1H, Ar-H), 7.32-7.27 (m, 1H, Ar-H), 6.97 (t, J = 7.4 Hz, 1H, Ar-H), 6.91-6.85 (m, 2H, Ar-H, Alk-H), 6.18 (s, 1H, Ph-OH), 5.25 (t, J = 9.3 Hz, 1H, Sac-H), 5.10 (t, J = 9.6 Hz, 1H, Sac-H), 5.02 (t, J = 9.6 Hz, 1H, Sac-H), 4.30 (dd, J = 5.1 Hz, J = 12.5 Hz, 1H, Sac-H), 4.17-4.10 (m, 1H, Sac-H), 4.05 (dd, J = 2.1 Hz, J = 12.3 Hz, 1H, Sac-H), 3.76-3.71 (m, 1H, Sac-H), 3,07 (dd, J = 8.1 Hz, J = 16.1 Hz, 1H, -CH_2), 2.71 (dd, J = 3.3 Hz, J = 15.9 Hz, 1H, -CH_2), 2.05-2.02 (m, 12H, -$COCH_3$); ^{13}C NMR(75 MHz, $CDCl_3$): δ 197.6, 171.0, 170.3, 170.2, 169.7, 155.8, 139.9, 132.1, 129.3, 126.9, 121.6, 120.9, 116.6, 75.7, 74.4, 74.2, 71.8, 68.6, 62.2, 42.2, 20.8 (2C), 20.6 (2C); Elemental analysis Anal. Calc. for $C_{24}H_{28}O_{11}$: C, 58.53; H, 5.73%. Found: C, 58.57; H, 5.76.

2.2x Synthesis, physicochemical and spectral data of (*E*)-1-(2,3,4,6-tetra-*O*-

acetyl-*β*-D-glucopyranosyl)-4-(4-hydroxy-2-methoxyphenyl)-but-3-en-2-one (6):

Compound, **6** was obtained by the aldol condensation of 2,3,4,6-tetra-*O*-acetyl-*β*-**D**-glucopyranosyl-propane-2-one, **3** (0.39 g, 1 mmol) with vanillin, (0.18 g, 1.2 mmol) as a colourless crystalline solid.

Mp: 100-102 ^{o}C; Yield: 0.43 g (83%); ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.84 (d, J = 16.5 Hz, 1H, Alk-H), 7.10 (d, J = 7.2 Hz, 1H, Ar-H), 6.90-6.84 (m, 3H, Alk-H, Ar-H), 6.21 (s, 1H, Sac-OH), 5.23 (t, J = 9.3 Hz, 1H, Sac-H), 5.08 (t, J = 9.6 Hz, 1H, Sac-H), 4.99 (t, J = 9.6 Hz, 1H, Sac-H), 4.26 (dd, J = 4.8 Hz, J = 12.3 Hz, 1H, Sac-H), 4.14 (t, J = 9.2 Hz, 1H, Sac-H), 4.03 (d, J = 12.3 Hz, 1H, Sac-H), 3.92 (s, 3H, -OCH_3), 3.75-3.70 (m, 1H, Sac-H), 3.05 (dd, J = 8.4 Hz, J = 16.2 Hz, 1H, -CH_2), 2.70 (dd, J = 3.3 Hz, J = 16.2 Hz, 1H, -CH_2), 2.02-2.01 (m, 12H, -$COCH_3$); ^{13}C NMR (75 MHz, $CDCl_3$): δ 196.7, 170.7, 170.3, 170.0, 169.6, 146.9, 145.7, 138.7, 127.2, 120.7, 120.6, 119.8, 112.2, 75.7, 74.3, 74.2, 71.7, 68.5, 62.1, 56.2, 42.3, 20.7 (2C), 20.6 (2C); Elemental analysis Anal. Calc. for $C_{25}H_{30}O_{12}$: C, 57.47; H, 5.79%. Found: C, 57.51; H, 5.83.

2.2y Synthesis, physicochemical and spectral data of (*E*)-1-(2,3,4,6-tetra-*O*-acetyl-*β*-D-glucopyranosyl)-4-(2-nitrophenyl)-but-3-en-2-one (7):

Compound, **7** was obtained by the aldol condensation reaction of 2,3,4,6-tetra-*O*-acetyl-*β*-**D**-glucopyranosyl-propane-2-one, **3** (0.39 g, 1 mmol) with 2-nitrobenzaldehyde, (0.18 g, 1.2 mmol) as a yellow liquid.

Yield: 0.32 g (62%); ^{1}H NMR (300 MHz, $CDCl_3$): δ 8.08 (d, J = 7.8 Hz, 1H, Ar-H), 8.00 (d, J = 16.2 Hz, 1H, Alk-H), 7.61-7.55 (m, 1H, Ar-H), 7.21-7.13 (m, 1H, Ar-H), 6.72 (d, J = 8.7 Hz, 1H, Ar-H), 6.61 (d, J = 15.9 Hz, 1H, Alk-H), 5.24 (t, J = 9.3 Hz, 1H, Sac-H), 5.09 (t, J = 9.6 Hz, 1H, Sac-H), 4.99 (t, J = 9.6 Hz, 1H, Sac-H), 4.25 (dd, J = 4.8 Hz, J = 12.5 Hz, 1H, Sac-H), 4.17-4.10 (m, 1H, Sac-H), 4.06 (dd, J = 2.1 Hz, J = 12.5 Hz, 1H, Sac-H), 3.76-3.71 (m, 1H, Sac-H), 3.06 (dd, J = 8.4 Hz, J = 16.2 Hz, 1H, -CH_2), 2.74 (dd, J = 3.3 Hz, J = 16.2 Hz, 1H, -CH_2), 2.05-2.02 (m, 12H, -$COCH_3$); ^{13}C NMR (75 MHz, $CDCl_3$): δ 195.8, 170.7, 170.3, 170.0, 169.5, 139.2, 133.7, 130.7, 130.6, 129.1, 125.1, 75.8, 74.2, 74.1, 71.7, 68.4, 62.0, 42.6, 20.7 (2C), 20.6 (2C); Elemental analysis Anal. Calc. for $C_{24}H_{27}NO_{12}$: C, 55.28; H, 5.22; N, 2.69%. Found: C, 55.32; H, 5.25; N, 2.73.

2.2z Synthesis, physicochemical and spectral data of (*E*)-1-(2,3,4,6-tetra-*O*-hydroxy-*β*-D-glucopyranosyl)-4-(2-hydroxyphenyl)-but-3-en-2-one (8):

Compound, **8** was obtained as a wine red liquid by the deacetylation reaction of compound, **34** (0.32 g, 1 mmol) using sodiummethoxide.

Yield: 0.20 g (62%); ^{1}H NMR (300 MHz, $CDCl_3$ + DMSO-d_6): δ 8.05 (d, J = 16.2 Hz, 1H, Alk-H), 7.63 (d, J = 7.5 Hz, 1H, Ar-H), 7.35 (t, J = 7.7 Hz, 1H, Ar-H), 7.10-6.95 (m, 3H, Alk-H, Ar-H), 3.95-3.77 (m, 4H, Sac-H), 3.30-3.23 (m, 4H, Sac-H, -CH_2), 3.02 (dd, J = 9.0 Hz, J = 15.9 Hz, 1H, -CH_2); ^{13}C NMR (75 MHz, $CDCl_3$ + DMSO-d_6): δ 203.7, 162.1, 143.7, 136.4, 133.2, 131.1, 126.3, 124.3, 121.4, 84.7, 83.3, 80.9, 78.6, 75.5, 66.7, 47.9; Elemental analysis Anal. Calc. for $C_{16}H_{20}O_7$: C, 59.25; H, 6.22%. Found: C, 59.30; H, 6.28.

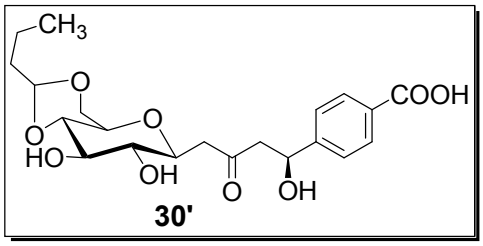
2.2z' Synthesis, physicochemical and spectral data of 2,3,4,6-tetra-*O*-acetyl-*β*-D-glucopyranosyl)-4'-(R)-hydroxy-(2'-nitrophenyl)-butan-2-one (30):

Aldol product, **30** was obtained as a by-product in the aldol condensation of *β*-C-glycosidic ketone, **3** (0.39 g, 1 mmol) with 2-nitro-benzaldehyde, (0.18 g, 1.2 mmol).

Mp: 142-143 ^{o}C; Yield: 0.19 g (35%); ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.98 (d, J = 8.1 Hz, 1H, Ar-H), 7.89 (d, J = 7.5 Hz, 1H, Ar-H), 7.68 (t, J = 7.4 Hz, 1H, Ar-H), 7.45 (t, J = 7.2 Hz, 1H, Ar-H), 5.72 (d, J = 9.3 Hz, 1H, Sac-H), 5.22 (t, J = 9.3 Hz, 1H, Sac-H), 5.05 (t, J = 9.8 Hz, 1H, Sac-H), 4.92 (t, J = 9.8 Hz, 1H, Sac-H), 4.18-4.15 (m, 1H, Sac-H), 4.07-4.00 (m, 1H, Sac-H), 3.74-3.69 (m, 1H, Sac-H), 3.51 (s, 1H, Sac-H), 3.16-3.10 (m, 1H, Sac-H), 2.86 (dd, J = 8.7 Hz, J = 15.9 Hz, 1H, Sac-H), 2.72 (dd, J = 9.6 Hz, J = 17.1 Hz, 1H, Sac-H), 2.54 (dd, J = 2.7 Hz, J = 16.2 Hz, 1H, Sac-H), 2.06 (s, 6H, -$COCH_3$), 2.03 (s, 3H, -$COCH_3$), 2.01 (s, 3H, -$COCH_3$); ^{13}C NMR (75 MHz, $CDCl_3$): δ 206.3, 170.7, 170.2, 169.9, 169.5, 147.1, 138.9, 133.8, 128.3, 128.2, 124.4, 75.8, 74.0, 73.9, 71.5, 68.4, 65.1, 62.0, 52.1, 44.8, 20.7, 20.6; Elemental analysis Anal. Calc. for $C_{24}H_{29}NO_{13}$: C, 55.43; H, 5.42; N, 2.60%. Found: C, 55.47; H, 5.45; N, 2.63.

2.2z'' Synthesis, physicochemical and spectral data of 4,6-*O*-butylidene-*β*-D-glucopyranosyl)-4'-(R)-hydroxy-(4''-carboxyphenyl)-butan-2-one 30':

Aldol product, **30'** that was obtained as a by-product in the aldol condensation of *β*-C-glycosidic ketone, **2** (0.27 g, 1 mmol) with 4-formyl-benzoic acid, (0.18 g, 1.2 mmol).



30'

Yield: 0.13 g (31%); ^{1}H NMR (300 MHz, $CDCl_3$): *δ* 7.89 (d, *J* = 7.5 Hz, 2H, Ar-H), 7.50 (bs, 2H, Ar-H), 4.51 (bs, 1H, Sac-H), 4.41-4.39 (m, 2H, Sac-H), 3.39-3.22 (m, 5H, Sac-H), 3.14-3.07 (m, 3H, -CH, $-CH_2$), 2.86-2.81 (m, 1H, $-CH_2$), 2.54-2.46 (m, 1H, $-CH_2$), 1.57-1.56 (m, 2H, $-CH_2$), 1.44-1.40 (m, 2H, $-CH_2$), 0.91 (t, *J* = 6.9 Hz, 3H, $-CH_3$); ^{13}C NMR (75 MHz, $CDCl_3$): *δ* 206.5, 206.2, 167.9, 143.6, 129.2, 128.3, 101.3, 80.5, 76.8, 73.9, 70.3, 67.4, 60.6, 45.7, 44.7, 35.9, 23.8, 17.1, 13.9; Elemental analysis Anal. Calc. for $C_{21}H_{28}O_9$: C, 59.43; H, 6.65%, Found: C, 59.47; H, 6.68.

2.2 General procedure for synthesis of sugar ketone derivatives (23-29):

Sugar chalcone (1 mmol) in ethanol (50 ml) was added to water solution containing NH_4Cl (20 mmol) at room temperature and stirred vigorously with Zn powder (3 mmol) added in three equal portions at intervals of 15 minutes. Stirring was continued for 15 minutes by warming the reaction mixture. The completion of the reaction was monitored through TLC and the reaction mixture was filtered using celite bed to remove the unreacted Zn. The filtrate was then evaporated under reduced pressure and extracted using EtOAc-water mixture. The ethylacetate layer was dried over anhyd. Na_2SO_4 and concentrated to dryness. The product thus obtained was further purified by column chromatography.

2.2a Synthesis, physicochemical and spectral data of 1-(4,6-*O*-butylidene-*β*-D-glucopyranosyl)-4-(4-bromophenyl)-butan-2-one (23):

Compound, **23** was obtained as a colourless solid by the reduction of sugar-chalcone, **5** (0.44 g, 1 mmol) using Zn (0.19 g, 3 mmol) and NH_4Cl (1.06 g, 20 mmol).

Mp: 126-128 ^{o}C; Yield: 0.37 g (84%); ^{1}H NMR (300 MHz, $CDCl_3$): *δ* 7.39 (d, *J* = 8.4 Hz, 2H, Ar-H), 7.05 (d, *J* = 8.4 Hz, 2H, Ar-H), 4.52 (t, *J* = 5.1 Hz, 1H, Ace-H), 4.09 (dd, *J* = 4.2 Hz, *J* = 9.6 Hz, 1H, Sac-H), 3.86-3.79 (m, 1H, Sac-H), 3.66 (t, *J* = 8.9 Hz, 1H, Sac-H), 3.41-3.28 (m, 3H, Sac-H), 3.17 (t, *J* = 9.0 Hz, 1H, Sac-H), 2.87-2.75 (m, 5H, -

CH_2), 2.62 (dd, J = 7.8 Hz, J = 15.9 Hz, 1H, -CH_2), 1.64-1.59 (m, 2H, -CH_2), 1.42 (q, J = 7.8 Hz, 2H, -CH_2), 0.92 (t, J = 7.4 Hz, 3H, -CH_3); ^{13}C NMR (75 MHz, $CDCl_3$): δ 207.5, 140.0, 131.5, 130.1, 119.9, 102.5, 80.4, 75.9, 75.3, 74.2, 70.6, 68.2, 45.3, 45.0, 36.2, 30.9, 17.5, 13.9; Elemental analysis Anal. Calc. for $C_{20}H_{27}BrO_6$: C, 54.18; H, 6.14%. Found: C, 54.20; H, 6.17.

2.2b Synthesis, physicochemical and spectral data of 1-(4,6-*O*-butylidene-β-D-glucopyranosyl)-4-(4-fluorophenyl)-butan-2-one (24):

Compound, **24** was obtained as a colourless solid by the reduction of sugar-chalcone, **6** (0.38 g, 1 mmol) using Zn (0.20 g, 3 mmol) and NH_4Cl (1.06 g, 20 mmol).

Mp: 116-118 ^{o}C; Yield: 0.30 g (79%); ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.12 (t, J = 6.9 Hz, 2H, Ar-H), 6.95 (t, J = 8.6 Hz, 2H, Ar-H), 4.51 (t, J = 5.0 Hz, 1H, Sac-H), 4.09 (dd, J = 4.2 Hz, J = 10.1 Hz, 1H, Sac-H), 3.83 (t, J = 8.6 Hz, 1H, Sac-H), 3.74-3.63 (m, 1H, Sac-H), 3.45-3.26 (m, 3H, -CH_2, Sac-H), 3.19 (m, 1H, Sac-H), 2.89-2.82 (m, 4H, -CH_2, Sac-H), 2.79-2.77 (m, 1H, -CH_2), 2.62 (dd, J = 7.8 Hz, J = 16.2 Hz, 1H, -CH_2), 1.64-1.59 (m, 2H, -CH_2), 1.48-1.36 (m, 2H, -CH_2), 0.92 (t, J = 7.2 Hz, 3H, -CH_3); ^{13}C NMR (75 MHz, $CDCl_3$): δ 206.4, 135.4, 128.6, 126.3, 113.9, 101.3, 79.3, 74.7, 74.2, 73.1, 69.4, 67.1, 44.3, 44.2, 35.1, 27.4, 16.3, 12.8; Elemental analysis Anal. Calc. for $C_{20}H_{27}FO_6$: C, 62.81; H, 7.12%. Found: C, 62.83; H, 7.14.

2.2c Synthesis, physicochemical and spectral data of 1-(4,6-*O*-butylidene-β-D-glucopyranosyl)-4-(4-allyloxyphenyl)-butan-2-one (25):

Compound, **25** was obtained as a liquid by the reduction of sugar-chalcone, **7** (0.42 g, 1 mmol) using Zn (0.20 g, 3 mmol) and NH_4Cl (1.07 g, 20 mmol).

Yield: 0.30 g (71%); ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.09 (d, J = 8.1 Hz, 2H, Ar-H), 6.85 (d, J = 6.9 Hz, 2H, Ar-H), 6.11-6.04 (m, 1H, Alk-H), 5.42 (d, J = 17.4 Hz, 1H, Alk-H), 5.30 (d, J = 9.3 Hz, 1H, Alk-H), 4.53 (bs, 3H, -OCH_2, Ace-H), 4.12 (t, J = 4.8 Hz, 1H, Sac-H), 3.84 (t, J = 10.5 Hz, 1H, Sac-H), 3.65 (t, J = 9.1 Hz, 1H, Sac-H), 3.44-3.20 (m, 5H, Sac-H), 2.97-2.79 (m, 4H, -CH_2), 2.64 (dd, J = 7.2 Hz, J = 15.6 Hz, 1H, -CH_2), 1.65-1.60 (m, 2H, -CH_2), 1.45-1.42 (m, 2H, -CH_2), 0.93 (t, J = 7.4 Hz, 3H, -CH_3); ^{13}C NMR (75 MHz, $CDCl_3$): δ 208.4, 133.4, 129.2, 117.6, 114.8, 102.5, 80.5, 76.1, 75.2, 74.2, 70.6,

68.9, 45.6, 45.4, 36.2, 29.7, 28.5, 17.5, 13.9; Elemental analysis Anal. Calc. for $C_{23}H_{32}O_7$: C, 65.70; H, 7.67%. Found: C, 65.74; H, 7.71.

2.2d Synthesis, physicochemical and spectral data of 1-(4,6-*O*-butylidene-*β*-D-glucopyranosyl)-4-(5-chloro-2-hydroxyphenyl)-butan-2-one (26):

Compound, **26** was obtained as a colourless solid by the reduction of sugar-chalcone, **10** (0.42 g, 1 mmol) using Zn (0.20 g, 3 mmol) and NH_4Cl (1.07 g, 20 mmol).

Yield: 0.24 g (59%); ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.07 (s, 1H, Ar-H), 7.05-7.02 (m, 1H, Ar-H), 6.80 (d, J = 8.4 Hz, 1H, Ar-H), 4.50 (t, J = 5.0 Hz, 1H, Ace-H), 4.14 (m, 2H, Sac-H), 3.75 (t, J = 8.9 Hz, 1H, Sac-H), 3.65 (t, J = 9.0 Hz, 1H, Sac-H), 3.47-3.25 (m, 5H, -CH_2, Sac-H), 2.90-2.76 (m, 3H, -CH_2), 2.64 (dd, J = 7.5 Hz, J = 15.2 Hz, 1H, -CH_2), 1.62-1.59 (m, 2H, -CH_2), 1.45-1.40 (m, 2H, -CH_2), 1.28 (t, J = 7.2 Hz, 3H, -CH_3); ^{13}C NMR (75 MHz, $CDCl_3$): δ 211.4, 130.0, 129.2, 127.7, 125.3, 123.8, 118.4, 102.6, 80.3, 75.0, 74.3, 70.5, 68.1, 45.0, 44.9, 36.2, 31.5, 23.4, 17.4, 13.9; Elemental analysis Anal. Calc. for $C_{20}H_{27}ClO_7$: C, 57.90; H, 6.56%. Found: C, 57.96; H, 6.61.

2.2e Synthesis, physicochemical and spectral data of 1-(4,6-*O*-butylidene-*β*-D-glucopyranosyl)-4-(2-hydroxyphenyl)-butan-2-one (27):

Compound, **27** was obtained as a colourless liquid by the reduction of its corresponding sugar-chalcone (0.38 g, 1 mmol) using Zn (0.20 g, 3 mmol) and NH_4Cl (1.07 g, 20 mmol).

Yield: 0.24 g (63%); ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.14-7.04 (m, 2H, Ar-H), 6.91-6.82 (m, 2H, Ar-H), 4.52 (t, J = 5.9 Hz, 1H, Ace-H), 4.14 (d, J = 4.5 Hz, J = 9.9 Hz, 1H, Sac-H), 3.83-3.72 (m, 2H, Sac-H), 3.48-3.22 (m, 7H, Sac-H, -CH_2), 2.94-2.87 (m, 2H, -CH_2), 2.66 (dd, J = 7.8 Hz, J = 16.4 Hz, 1H, -CH_2), 1.65-1.61 (m, 2H, -CH_2), 1.47-1.43 (m, 2H, -CH_2), 0.93 (t, J = 6.7 Hz, 3H, -CH_3); ^{13}C NMR (75 MHz, $CDCl_3$): δ 208.0, 130.4, 129.2, 127.8, 127.2, 125.0, 117.1, 80.4, 76.1, 74.9, 74.2, 70.5, 68.2, 45.1, 44.9, 36.2, 31.8, 29.7, 17.5, 13.9; Elemental analysis Anal. Calc. for $C_{20}H_{28}O_7$: C, 63.14; H, 7.42%. Found: C, 63.18; H, 7.47.

2.2f Synthesis, physicochemical and spectral data of 1-(4,6-*O*-butylidene-*β*-D-glucopyranosyl)-4-(3-quinolinyl)-butan-2-one (28):

Compound, **28** was obtained as a brown solid by the reduction of sugar-chalcone, **18** (0.41 g, 1 mmol) using Zn (0.19 g, 3 mmol) and NH_4Cl (1.05 g, 20 mmol).

Mp: 121-123 ^oC; Yield: 0.32 g (76%); ^1H NMR (300 MHz, $CDCl_3$): δ 7.99 (d, J = 8.4 Hz, 1H, Ar-H), 7.94 (d, J = 8.4 Hz, 1H, Ar-H), 7.71 (d, J = 8.4 Hz, 1H, Ar-H), 7.61 (t, J = 7.4 Hz, 1H, Ar-H), 7.42 (t, J = 7.7 Hz, 1H, Ar-H), 7.25 (d, J = 8.4 Hz, 1H, Ar-H), 4.43 (t, J = 5.0 Hz, 1H, Ace-H), 4.01 (dd, J = 4.2 Hz, J = 9.6 Hz, 1H, Sac-H), 3.83-3.76 (m, 1H, Sac-H), 3.61 (t, J = 10.1 Hz, 1H, Sac-H), 3.35-3.19 (m, 4H, Sac-H), 3.12 (t, J = 9.0 Hz, 2H, $-CH_2$), 3.00 (q, J = 5.1 Hz, 2H, $-CH_2$), 2.92 (dd, J = 4.5 Hz, J = 16.1 Hz, 1H, $-CH_2$), 2.73 (dd, J = 6.9 Hz, J = 15.9 Hz, 1H, $-CH_2$), 1.56-1.51 (m, 2H, $-CH_2$), 1.34 (q, J = 7.8 Hz, 2H, $-CH_2$), 0.84 (t, J = 7.4 Hz, 3H, $-CH_3$); ^{13}C NMR (75 MHz, $CDCl_3$): δ 208.1, 160.8, 136.4, 129.4, 128.6, 127.5, 125.9, 121.7, 102.4, 80.5, 76.0, 75.3, 74.4, 70.6, 68.3, 45.7, 42.2, 36.2, 32.3, 17.5, 13.9; Elemental analysis Anal. Calc. for $C_{23}H_{29}NO_6$: C, 66.49; H, 7.04; N 3.37%. Found: C, 66.52; H, 7.07; N, 3.39.

2.2g Synthesis, physicochemical and spectral data of 1-(4,6-*O*-butylidene-β-D-glucopyranosyl)-4-(1-pyrene)-butan-2-one (29):

Compound, **29** was obtained as a colourless solid by the reduction of its corresponding sugar-chalcone (0.49 g, 1 mmol) using Zn (0.20 g, 3 mmol) and NH_4Cl (1.07 g, 20 mmol).

Mp: 188-190 ^oC; Yield: 0.40 g (82%); ^1H NMR (300 MHz, $CDCl_3$): δ 8.23-7.97 (m, 8H, Ar-H), 7.87 (d, J = 7.8 Hz, 1H, Ar-H), 4.33 (t, J = 5.1 Hz, 1H, Ace-H), 4.03 (d, J = 5.4 Hz, 1H, Sac-H), 3.84-3.77 (m, 1H, Sac-H), 3.65-3.59 (m, 3H, Sac-H), 3.28-3.18 (m, 3H, Sac-H), 3.06-2.95 (m, 3H, $-CH_2$, Sac-H), 2.87 (dd, J = 3.9 Hz, J = 15.8 Hz, 1H, $-CH_2$), 2.77-2.60 (m, 3H,$-CH_2$), 1.60-1.54 (m, 2H, $-CH_2$), 1.38 (q, J = 7.8 Hz, 2H, $-CH_2$), 0.91 (t, J = 7.2 Hz, 3H, $-CH_3$); ^{13}C NMR (75 MHz, $CDCl_3$): δ 208.0, 135.1, 131.4, 130.8, 130.1, 128.5, 127.6, 127.5, 127.2, 126.8, 125.9, 125.1, 125.0, 124.9, 122.9, 102.4, 80.3, 76.0, 75.2, 74.1, 70.5, 68.1, 45.5, 45.4, 36.2, 27.0, 17.4, 13.9; ESI-MS Calc. for $C_{30}H_{32}O_6$, 488; *m/z* found, 511 $[M+Na]^+$; Elemental analysis Anal. Calc. for $C_{30}H_{32}O_6$: C, 73.75; H, 6.60%. Found: C, 73.78; H, 6.62.

2.3 General procedure for synthesis of dimers (37-41):

To a solution of *β*-C-glycosidic ketone, **1** or **3** (1 mmol) in dry DCM (5 ml) were added pyrrolidine (50% mol) and *O*-alkylated aldehyde. After stirring at room temperature for a given period of time, the reaction mixture was evaporated under reduced pressure and extracted using EtOAc-water mixture. The ethylacetate layer was dried over anhyd. Na_2SO_4 and concentrated to dryness. Product thus obtained was further purified by column chromatography.

2.3a Synthesis, physicochemical and spectral data of (1*E*,4*E*)-1,5-*bis*(4-(allyloxy)phenyl)penta-1,4-dien-3-one (37):

Compound, **37** was obtained by the reaction of *β-C*-glycoside, **4** (0.27 g, 1 mmol) with 4-allyloxybenzaldehyde, (0.19 g, 1.2 mmol) as yellow fluffy solid. However, the formation of corresponding sugar-chalcone, **31** was also observed.

Mp: 120-122 ^oC; Yield: 0.05 g (14%); ^1H NMR (300 MHz, $CDCl_3$): δ 7.71 (d, J = 15.9 Hz, 2H, Alk-H), 7.58 (d, J = 8.4 Hz, 4H, Ar-H), 7.00-6.95 (m, 6H, Alk-H, Ar-H), 6.15-6.02 (m, 2H, -C≡CH), 5.45 (d, J = 17.1 Hz, 2H, Alk-H), 5.34 (d, J = 10.8 Hz, 1H, Alk-H), 4.61 (d, J = 5.1 Hz, 4H, $-OCH_2$); ^{13}C NMR (75 MHz, $CDCl_3$): δ 188.9, 160.6, 142.7, 132.8, 130.1, 127.8, 123.6, 118.1, 115.2, 77.2, 68.9; Elemental analysis Anal. Calc. for $C_{23}H_{22}O_3$: C, 79.74; H, 6.40%. Found: C, 79.79; H, 6.46.

2.3b Synthesis, physicochemical and spectral data of (1*E*,4*E*)-1,5-*bis*(2-(prop-2-ynyloxy)naphthalen-1-yl)penta-1,4-dien-3-one (38):

Compound, **38** was obtained by the reaction of *β-C*-glycoside, **2** (0.27 g, 1 mmol) with 2-(prop-2-ynyloxy)-1-naphthaldehyde (0.25 g, 1.2 mmol) as a dark yellow solid in addition to the formation of corresponding sugar-chalcone, **32**.

Mp: 134-136 ^oC; Yield: 0.09 g (20%); ^1H NMR (300 MHz, $CDCl_3$): δ 8.43 (d, J = 16.2 Hz, 2H, Alk-H), 8.29 (d, J = 8.4 Hz, 2H, Ar-H), 7.90 (d, J = 9.3 Hz, 2H, Ar-H), 7.83 (d, J = 8.1 Hz, 2H, Ar-H), 7.56 (t, J = 7.1 Hz, 2H, Ar-H), 7.51-7.41 (m, 6H, Alk-H, Ar-H), 4.93 (d, J = 2.1 Hz, 4H, $-OCH_2$), 2.55 (t, J = 2.3 Hz, 2H, -C≡CH); ^{13}C NMR (75 MHz, $CDCl_3$): δ 190.5, 154.6, 136.1, 132.9, 131.9, 131.3, 129.6, 128.6, 127.5, 124.5 123.9, 119.0, 114.4, 78.5, 78.2, 57.1; ESI-MS Calc. for $C_{31}H_{22}O_3$, 442.16; *m/z* found, 443.16

$[M+H]^+$; Elemental analysis Anal. Calc. for $C_{31}H_{22}O_3$: C, 84.14; H, 5.01%. Found: C, 84.20; H, 5.09.

2.3c Synthesis, physicochemical and spectral data of (1*E*,4*E*)-1,5-*bis*(2-(prop-2-ynyloxy)benz-1-yl)penta-1,4-dien-3-one (39):

Compound, **39** was obtained by the reaction of *β-C*-glycoside, **2** (0.27 g, 1 mmol) with 2-(prop-2-ynyloxy)-1-benzaldehyde (0.19 g, 1.2 mmol) as a yellow liquid in addition to the formation of corresponding sugar-chalcone, **33**.

Yield: 0.03 g (10%); ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.89 (d, J = 16.8 Hz, 2H, Alk-H), 7.58 (d, J = 7.5 Hz, 2H, Ar-H), 7.38 (t, J = 7.9 Hz, 2H, Ar-H), 7.14-7.01 (m, 4H, Ar-H), 6.75 (d, J = 16.5 Hz, 2H, Alk-H), 4.80 (d, J = 2.4 Hz, 4H, -OCH_2), 2.55 (t, J = 2.4 Hz, 2H, -C≡CH); ^{13}C NMR (75 MHz, $CDCl_3$): δ 199.0, 156.2, 138.3, 131.6, 128.6, 128.3, 121.8, 112.9, 78.1, 76.0, 56.3, 27.2; Elemental analysis Anal. Calc. for $C_{23}H_{18}O_3$: C, 80.68; H, 5.30%. Found: C, 80.73; H, 5.35.

2.3d Synthesis, physicochemical and spectral data of (1*E*,4*E*)-1,5-*bis*(5-chloro-2-(prop-2-ynyloxy)benz-1-yl)penta-1,4-dien-3-one (40):

Compound, **40** was obtained by the reaction of *β-C*-glycoside, **2** (0.27 g, 1 mmol) with 5-chloro-2-(prop-2-ynyloxy)-1-benzaldehyde (0.23 g, 1.2 mmol) as a yellow liquid in addition to the formation of corresponding sugar-chalcone, **34**.

Yield: 0.02 g (5%); ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.82 (s, 2H, Ar-H), 7.53-7.47 (m, 4H, Alk-H, Ar-H), 7.13-7.08 (m, 4H, Alk-H, Ar-H), 4.74 (d, J = 2.4 Hz, 4H, -OCH_2), 2.55 (t, J = 2.3 Hz, 2H, -C≡CH); Elemental analysis Anal. Calc. for $C_{23}H_{16}Cl_2O_3$: C, 67.17; H, 3.92%. Found: C, 67.21; H, 3.95.

2.3e Synthesis, physicochemical and spectral data of (1*E*,4*E*)-1,5-*bis*(4-(prop-2-ynyloxy)benz-1-yl)penta-1,4-dien-3-one (41):

Compound, **41** was obtained by the aldol condensation of *β-C*-glycoside, **2** (0.27 g, 1 mmol) with 4-(prop-2-ynyloxy)-1-benzaldehyde, (0.19 g, 1.2 mmol) as a yellow solid in addition to the formation of corresponding sugar-chalcone, **35**.

M.Pt: 94-96 °C; Yield: 0.04 g (12%); ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.70 (d, J = 15.9 Hz, 2H, Alk-H), 7.59 (d, J = 8.7 Hz, 4H, Ar-H), 7.02 (d, J = 9.0 Hz, 2H, Ar-H), 6.97

(d, J = 15.9 Hz, 4H, Ar-H), 4.61 (d, J = 2.1 Hz, 4H, -OCH_2), 2.55 (bs, 2H, -C≡CH); ^{13}C NMR (75 MHz, $CDCl_3$): δ 187.0, 157.6, 140.7, 128.2, 126.7, 122.1, 113.5, 76.2, 74.2, 54.1; Elemental analysis Anal. Calc. for $C_{23}H_{18}O_3$: C, 80.68; H, 5.30%. Found: C, 80.74; H, 5.36.

2.3f Synthesis, physicochemical and spectral data of (*E*)-1-(2,3,4-tri-*O*-acetyl-*β*-D-xylopyranosyl)-4-(4-allyloxyphenyl)-but-3-en-2-one (31):

Compound, **31** was obtained by the aldol condensation reaction of 2,3,4-tri-*O*-acetyl-*β*-**D**-xylopyranosyl-propane-2-one, **4** (0.32 g, 1 mmol) with 4-allyloxybenzaldehyde (0.20 g, 1.2 mmol) as a yellow solid.

Mp: 116-118 ^{o}C; Yield: 0.38 g (83%); ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.55-7.50 (m, 3H, Ar-H, Alk-H), 6.94 (d, J = 8.7 Hz, 2H, Ar-H), 6.64 (d, J = 16.2 Hz, 1H, Alk-H), 6.09-6.02 (m, 1H, Alk-H), 5.43 (d, J = 17.1Hz, 1H, Alk-H), 5.33 (d, J = 10.5 Hz, 1H, Alk-H), 5.23 (t, J = 9.3 Hz, 1H, Sac-H), 5.04-4.91 (m, 2H, Sac-H), 4.59 (d, J = 5.1 Hz, 2H, -CH_2), 4.09-4.01 (m, 2H, Sac-H), 3.34 (t, J = 10.8 Hz, 1H, Sac-H), 2.97 (dd, J = 8.7 Hz, J = 15.9 Hz, 1H, -CH_2), 2.63 (dd, J = 2.7 Hz, J = 8.0 Hz, 1H, -CH_2), 2.04 (s, 9H, -$COCH_3$); ^{13}C NMR (75 MHz, $CDCl_3$): δ 196.3, 170.2, 170.1, 169.9, 160.8, 143.6, 132.7, 130.2, 127.0, 124.2, 118.1, 115.2, 74.9, 73.8, 72.0, 69.3, 68.9, 66.8, 42.5, 20.7 (3C); Elemental analysis Anal. Calc. for $C_{24}H_{28}O_9$: C, 62.60; H, 6.13%. Found: C, 62.64; H, 6.16.

2.3g Synthesis, physicochemical and spectral data of (*E*)-1-(4,6-*O*-butylidene-*β*-D-glucopyranosyl)-4-(2-prop-2-ynyloxy-1-napthyl)-but-3-en-2-one (32):

Compound, **32** was obtained by the aldol condensation of *β*-*C*-glycoside, **2** (0.27 g, 1 mmol) with 2-(prop-2-ynyloxy)-1-naphthaldehyde (0.25 g, 1.2 mmol) as a yellow solid.

Mp: 202-204 ^{o}C; Yield: 0.37 g (79%); ^{1}H NMR (300 MHz, $CDCl_3$): δ 8.24 (d, J = 16.5 Hz, 1H, Alk-H), 8.15 (d, J = 8.4Hz, 1H, Ar-H), 7.89 (d, J = 9.0 Hz, 1H, Ar-H), 7.82 (d, J = 7.8 Hz, 1H, Ar-H), 7.54 (t, J = 7.7 Hz, 1H, Ar-H), 7.44-7.37 (m, 2H, Ar-H), 7.08 (d, J = 16.5 Hz, 1H, Alk-H), 4.89 (d, J = 2.4 Hz, 2H, -OCH_2), 4.55 (t, J = 5.1 Hz, 1H, Sac-H), 4.18 (dd, J = 3.9 Hz, J = 9.6 Hz, 1H, Sac-H), 4.02-3.96 (m, 1H, Sac-H), 3.76 (t, J = 8.7 Hz, 1H, Sac-H), 3.50-3.35 (m, 3H, Sac-H), 3.31-3.19 (m, 2H, Sac-H, -CH_2), 3.04 (dd, J = 7.2 Hz, J = 16.2 Hz, 1H, -CH_2), 2.56 (t, J = 2.4 Hz, 1H, -C≡CH), 1.65-1.61 (m, 2H, -

CH_2), 1.43 (q, J = 7.8 Hz, 2H, -CH_2), 0.92 (t, J = 7.4 Hz, 3H, -CH_3); ^{13}C NMR (75 MHz, $CDCl_3$): δ 198.9, 154.7, 136.9, 132.7, 132.0, 131.7, 129.5, 128.7, 127.6, 124.5, 123.5, 118.1, 114.2, 102.5, 80.5, 78.3, 77.2, 76.3, 75.4, 74.7, 70.7, 68.4, 57.0, 43.8, 36.3, 17.5, 13.9; ESI-MS Calc. for $C_{27}H_{30}O_7$, 466.20; *m/z* found, 467.21 $[M+H]^+$; Elemental analysis Anal. Calc. for $C_{27}H_{30}O_7$: C, 69.51; H, 6.48%. Found: C, 69.56; H, 6.53.

2.3h Synthesis, physicochemical and spectral data of (*E*)-1-(4,6-*O*-butylidene-*β*-D-glucopyranosyl)-4-(2-prop-2-ynyloxyphenyl)-but-3-en-2-one (33):

Compound, **33** was obtained by the aldol condensation of *β*-*C*-glycoside, **2** (0.27 g, 1 mmol) with 2-(prop-2-ynyloxy)benzaldehyde (0.19 g, 1.2 mmol) as a colourless solid.

Mp: 107-108 ^{o}C; Yield: 0.29 g (69%); ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.95 (d, J = 16.5 Hz, 1H, Alk-H), 7.57 (d, J = 7.5 Hz, 1H, Ar-H), 7.39 (t, J = 8.0 Hz, 1H, Ar-H), 7.07-7.00 (m, 2H, Ar-H), 6.82 (d, J = 16.5 Hz, 1H, Alk-H), 4.79 (d, J = 2.4 Hz, 2H, -OCH_2), 4.53 (t, J = 5.1 Hz, 1H, Sac-H), 4.14 (dd, J = 4.2 Hz, J = 9.6 Hz, 1H, Sac-H), 3.98-3.91 (m, 1H, Sac-H), 3.73 (t, J = 8.9 Hz, 1H, Sac-H), 3.46-3.31 (m, 3H, Sac-H), 3.25 (t, J = 8.9 Hz, 1H, Sac-H), 3.25 (t, J = 8.9 Hz, 1H, Sac-H), 3.14 (dd, J = 4.2 Hz, J = 16.4 Hz, 1H, -CH_2), 3.00 (dd, J = 7.2 Hz, J = 16.1 Hz, 1H, -CH_2), 2.55 (t, J = 2.4 Hz, 1H, -C≡CH), 1.62-1.60 (m, 2H,-CH_2), 1.42 (q, J = 7.8 Hz, 2H, -CH_2), 0.92 (t, J = 7.4 Hz, 3H, -CH_3); ^{13}C NMR (75 MHz, $CDCl_3$): δ 198.7, 156.4, 138.8, 131.8, 128.7, 127.3, 124.0, 121.8, 112.8, 102.5, 80.5, 78.1, 76.2, 75.4, 74.6, 70.6, 68.3, 56.2, 43.2, 36.2, 17.5, 13.9; Elemental analysis Anal. Calc. for $C_{23}H_{28}O_7$: C, 66.33; H, 6.78%. Found: C, 66.36; H, 6.81.

2.3i Synthesis, physicochemical and spectral data of (*E*)-1-(4,6-*O*-butylidene-*β*-D-glucopyranosyl)-4-(5-chloro-2-prop-2-ynyloxyphenyl)-but-3-en-2-one (34):

Compound, **34** was obtained by the aldol condensation of *β*-*C*-glycoside, **2** (0.27 g, 1 mmol) with 5-chloro-2-(prop-2-ynyloxy)benzaldehyde (0.23 g, 1.2 mmol) as a colourless solid.

Mp: 124-125 ^{o}C; Yield: 0.34 g (76%); ^{1}H NMR (300 MHz, $CDCl_3$): δ 7.82 (d, J = 16.2 Hz, 1H, Alk-H), 7.51 (s, 1H, Ar-H), 7.31 (dd, J = 2.4 Hz, J = 8.9 Hz, 1H, Ar-H), 6.98 (d, J = 9.0 Hz, 1H, Ar-H), 6.77 (d, J = 16.5 Hz, 1H, Alk-H), 4.76 (d, J = 2.1 Hz, 2H, -OCH_2), 4.53 (t, J = 5.0 Hz, 1H, Sac-H), 4.15-4.10 (m, 1H, Sac-H), 3.97-3.90 (m, 1H,

Sac-H), 3.73 (t, *J* = 8.9 Hz, 1H, Sac-H), 3.44-3.22 (m, 4H, Sac-H, -CH_2), 3.14 (dd, *J* = 3.6 Hz, *J* = 16.1 Hz, 1H, -CH_2), 2.58 (t, *J* = 2.4 Hz, 1H, -C≡CH), 1.64-1.60 (m, 2H, -CH_2), 1.43 (q, *J* = 7.2 Hz, 2H, -CH_2), 0.91 (t, *J* = 7.4 Hz, 3H, -CH_3); ^{13}C NMR (75 MHz, $CDCl_3$): *δ* 198.3, 154.8, 137.0, 131.1, 128.1, 128.0, 127.0, 125.6, 114.3, 102.5, 80.5, 77.7, 76.2, 75.3, 74.5, 70.6, 68.3, 56.6, 43.4, 36.2, 17.5, 13.9; Elemental analysis Anal. Calc. for $C_{23}H_{27}ClO_7$: C, 61.26; H, 6.04%. Found: C, 61.29; H, 6.08.

2.3j Synthesis, physicochemical and spectral data of (*E*)-1-(4,6-*O*-butylidene-*β*-D-glucopyranosyl)-4-(4-prop-2-ynyloxyphenyl)-but-3-en-2-one (35):

Compound, **35** was obtained by the aldol condensation of *β*-*C*-glycoside, **2** (0.27 g, 1 mmol) with 4-(prop-2-ynyloxy)benzaldehyde (0.19 g, 1.2 mmol) as a colourless solid.

Mp: 178-180 ^{o}C; Yield: 0.26 g (62%); ^{1}H NMR (300 MHz, $CDCl_3$): *δ* 8.44-8.39 (m, 3H, Ar-H, Alk-H), 7.88 (d, *J* = 8.7 Hz, 2H, Ar-H), 7.56 (d, *J* = 16.2 Hz, 2H, Alk-H), 5.63 (d, *J* = 2.4 Hz, 2H, -OCH_2), 5.43 (t, *J* = 5.0 Hz, 1H, Sac-H), 5.35 (d, *J* = 3.6 Hz, 1H, Sac-OH), 5.06 (s, 1H, Sac-OH), 4.99 (dd, *J* = 3.6 Hz, *J* = 9.6 Hz, 1H, Sac-H), 4.80 (t, *J* = 8.4 Hz, 1H, Sac-H), 4.56 (t, *J* = 8.4 Hz, 1H, Sac-H), 4.30 (t, *J* = 9.8 Hz, 1H, Sac-H), 4.24-4.11 (m, 3H, Sac-H), 4.03 (dd, *J* = 2.4 Hz, *J* = 14.4 Hz, 1H, -CH_2), 3.73 (dd, *J* = 8.7 Hz, *J* = 15.9 Hz, 1H, -CH_2), 3.49 (t, *J* = 2.3 Hz, 1H, -C≡CH), 2.55-2.49 (m, 2H, -CH_2), 2.32 (q, *J* = 7.5 Hz, 2H, -CH_2), 1.80 (t, *J* = 7.4 Hz, 3H, -CH_3); ^{13}C NMR (75 MHz, $CDCl_3$): *δ* 192.5, 154.2, 137.3, 124.7, 122.7, 119.5, 110.1, 97.1, 75.3, 72.7, 72.1, 71.3, 70.8, 69.9, 69.6, 65.3, 63.1, 50.6, 38.1, 31.0, 12.1, 8.6; Elemental analysis Anal. Calc. for $C_{20}H_{26}O_7$: C, 63.48; H, 6.93%. Found: C, 66.53; H, 6.97.

2.3k Synthesis, physicochemical and spectral data of (*E*)-1-(4,6-*O*-butylidene-*β*-D-glucopyranosyl)-4-(3-methoxy-4-prop-2-ynyloxyphenyl)-but-3-en-2-one (36):

Compound, **36** was obtained by the aldol condensation of *β*-*C*-glycoside, **2** (0.27 g, 1 mmol) with 3-methoxy-4-(prop-2-ynyloxy)benzaldehyde (0.23 g, 1.2 mmol) as a colourless solid.

Mp: 179-180 ^{o}C; Yield: 0.35 g (78%); ^{1}H NMR (300 MHz, $CDCl_3$): *δ* 7.54 (d, *J* = 15.9 Hz, 1H, Alk-H), 7.26 (s, 1H, Ar-H), 7.15-7.02 (m, 3H, Ar-H), 6.66 (dd, *J* = 15.9 Hz, 1H, Alk-H), 4.82 (s, 2H, -OCH_2), 4.54 (bs, 1H, Sac-H), 4.14 (t, *J* = 4.8 Hz, 1H, Sac-H), 3.92 (s, 3H, -OCH_3), 3.72 (t, *J* = 9.2 Hz, 1H, Sac-H), 3.43 (t, *J* = 9.5 Hz, 1H, Sac-H), 3.35-

3.24 (m, 4H, Sac-H), 3.10-2.96 (m, 2H, -CH_2), 2.01 (bs, 1H, -C≡CH), 1.64-1.60 (m, 2H, -CH_2), 1.46-1.41 (m, 2H, -CH_2), 0.92 (t, J = 7.2 Hz, 3H, -CH_3); ^{13}C NMR (75 MHz, $CDCl_3$): δ 202.5, 154.5, 153.7, 147.5, 133.3, 129.8, 127.3, 118.6, 115.3, 107.0, 85.4, 81.3, 79.8, 79.4, 73.1, 61.4, 60.7, 48.1, 41.0, 22.1, 18.7; Elemental analysis Anal. Calc. for $C_{24}H_{30}O_8$: C, 64.56; H, 6.77%. Found: C, 64.60; H, 6.79.

^{1}H NMR, ^{13}C NMR, DEPT-135, ^{1}H-^{1}H [COSY] spectra, Mass spectra are given below:

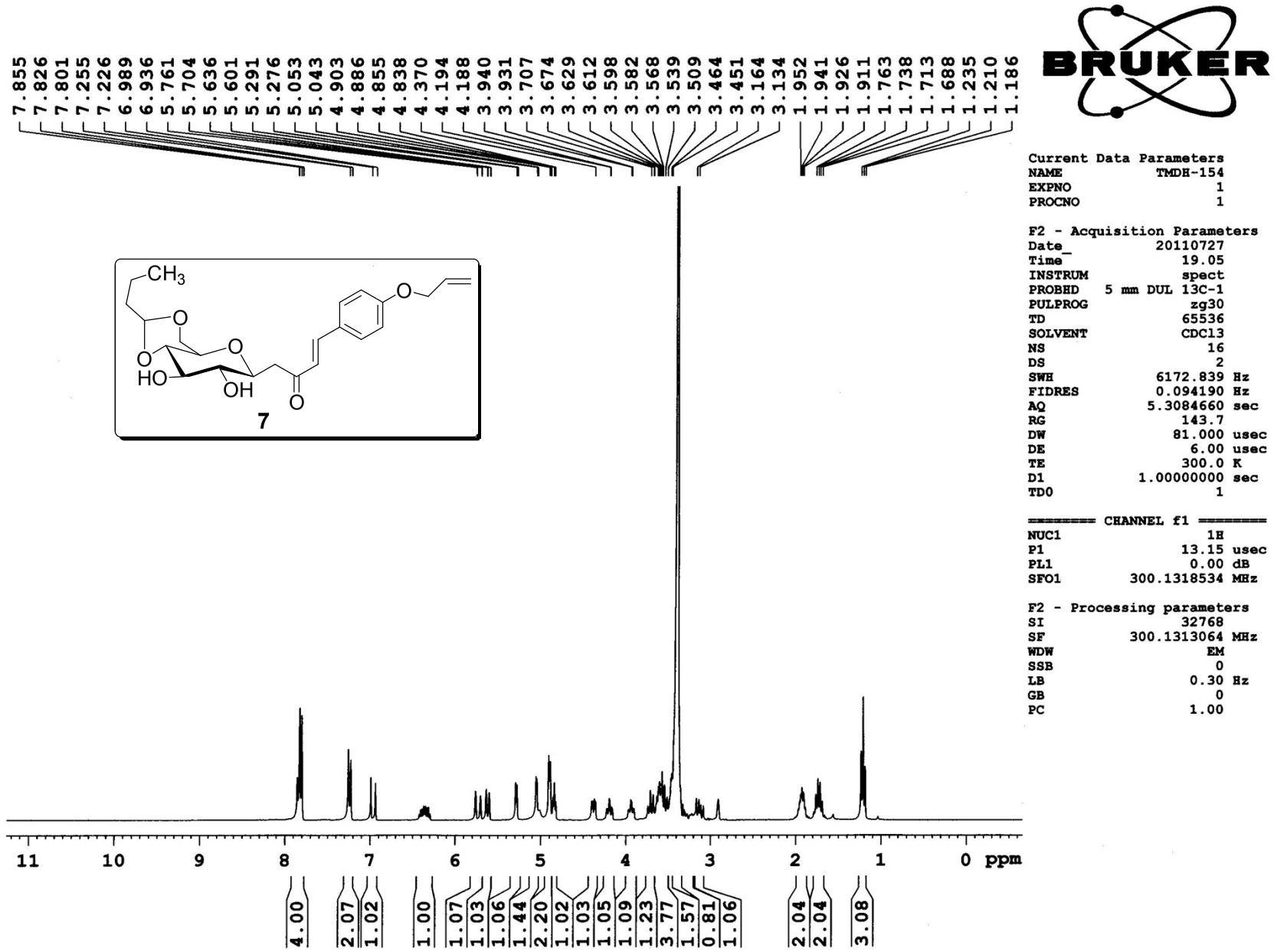
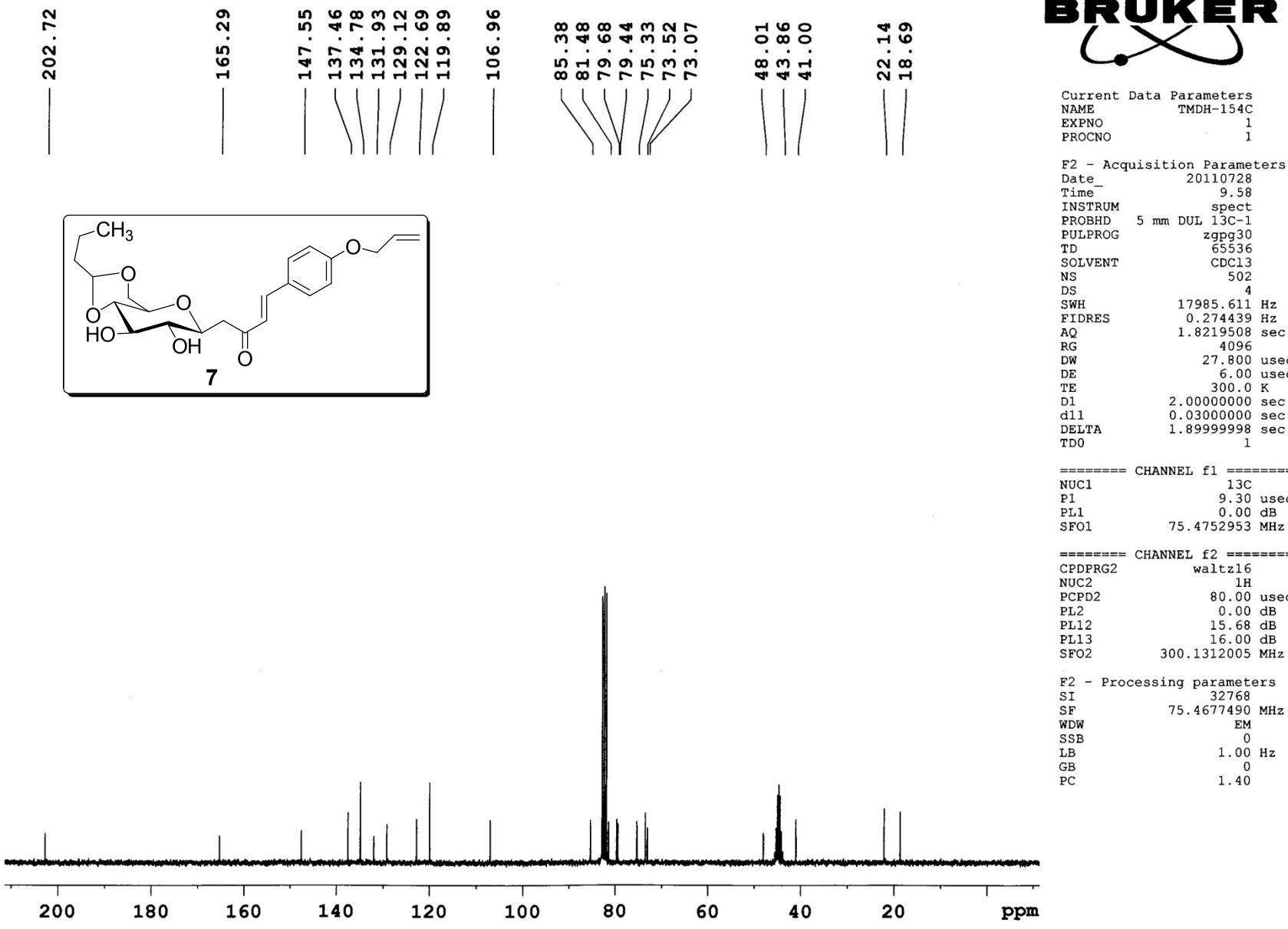


Figure 1 ^{1}H NMR spectrum (300 MHz, $CDCl_3$) of compound, 7.



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PROCNO                       1

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TD                      65536
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RG                         4096
DW                       27.800 usec
DE                        6.00 usec
TE                       300.0 K
D1                 2.00000000 sec
d11                0.03000000 sec
DELTA              1.89999998 sec
TD0                         1

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PL1                       0.00 dB
SFO1               75.4752953 MHz

======== CHANNEL f2 ========
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PCPD2                    80.00 usec
PL2                       0.00 dB
PL12                     15.68 dB
PL13                     16.00 dB
SFO2              300.1312005 MHz

F2 - Processing parameters
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GB                             0
PC                          1.40
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Figure 2 ^{13}C NMR spectrum (75 MHz, $CDCl_3$) of compound, 7.

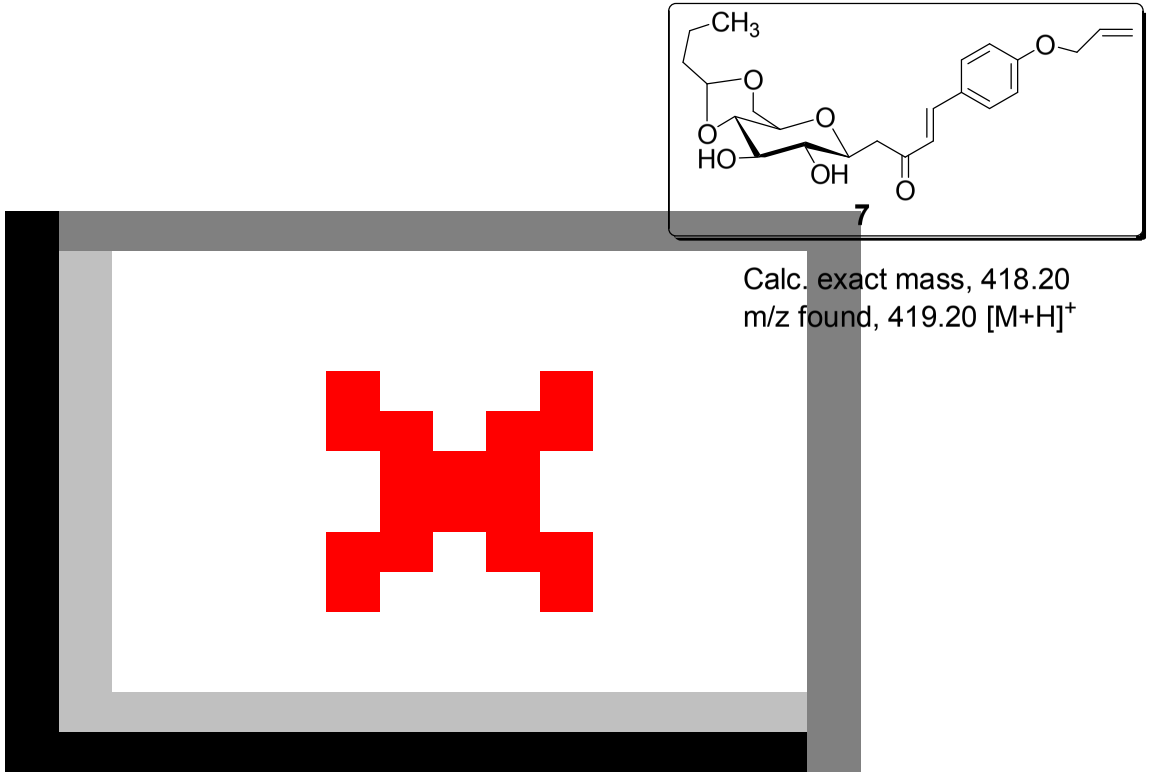


Figure 3 Mass spectrum of compound, 7.

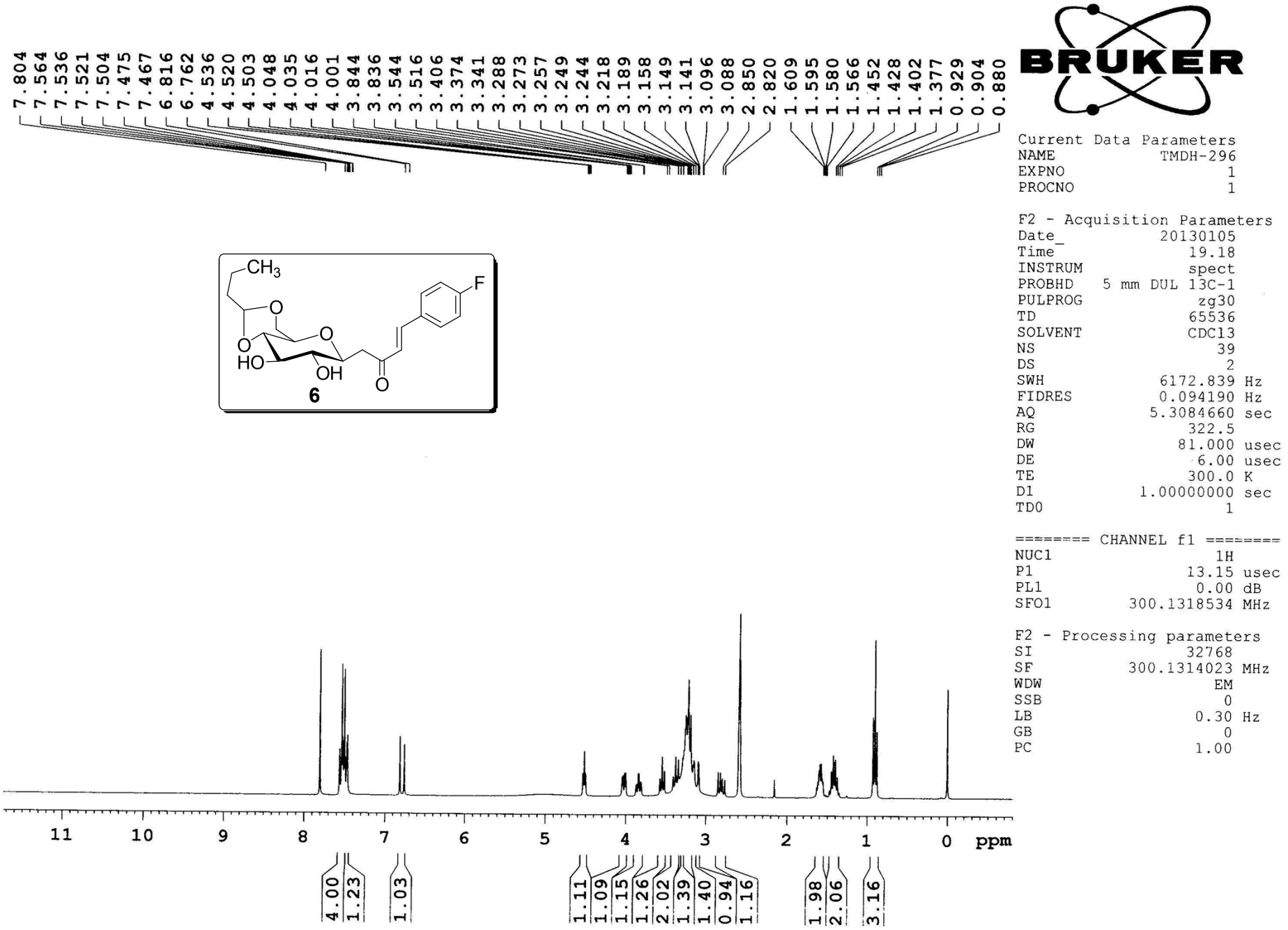
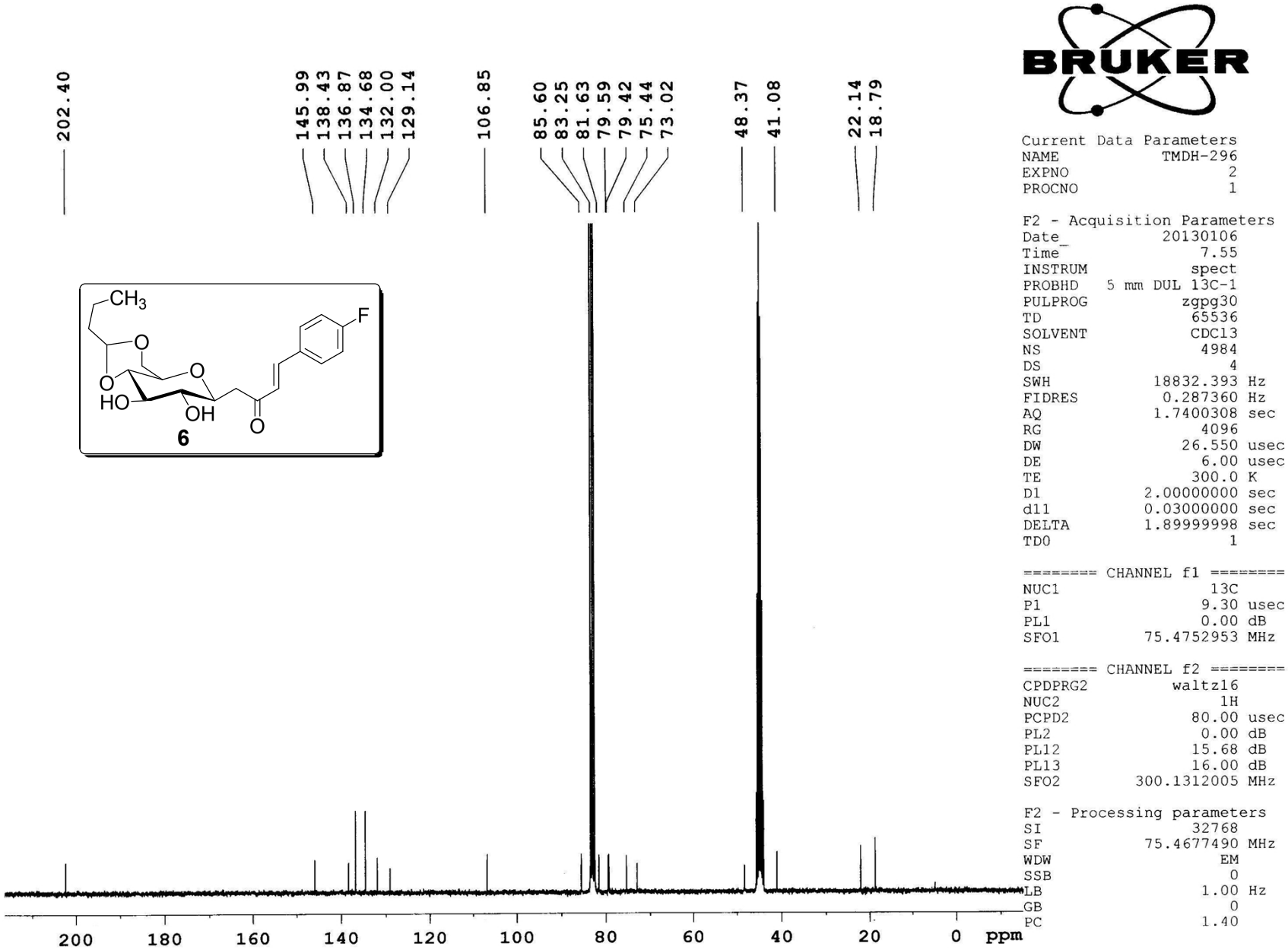


Figure 4 ^{1}H NMR spectrum (300 MHz, $CDCl_3$ + DMSO) of compound, 6.



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PROCNO                       1

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TD                      65536
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DW                     26.550 usec
DE                      6.00 usec
TE                     300.0 K
D1                 2.00000000 sec
d11                0.03000000 sec
DELTA              1.89999998 sec
TD0                          1

======== CHANNEL f1 ========
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P1                        9.30 usec
PL1                       0.00 dB
SFO1               75.4752953 MHz

======== CHANNEL f2 ========
CPDPRG2                waltz16
NUC2                       1H
PCPD2                    80.00 usec
PL2                       0.00 dB
PL12                     15.68 dB
PL13                     16.00 dB
SFO2              300.1312005 MHz

F2 - Processing parameters
SI                       32768
SF                 75.4677490 MHz
WDW                         EM
SSB                          0
LB                        1.00 Hz
GB                           0
PC                        1.40
```

Figure 5 ^{13}C NMR spectrum (75 MHz, $CDCl_3$ + DMSO) of compound, 6.

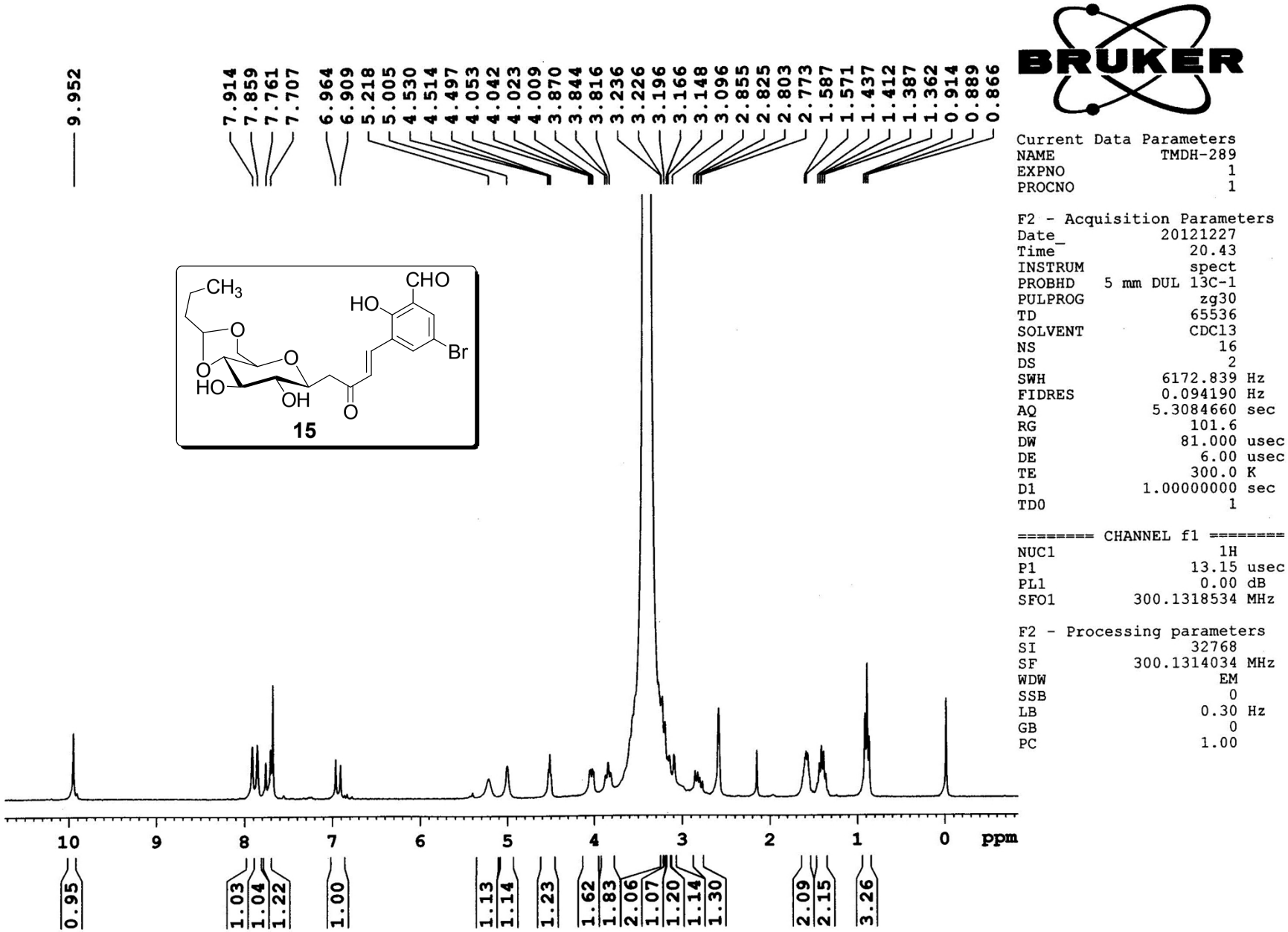
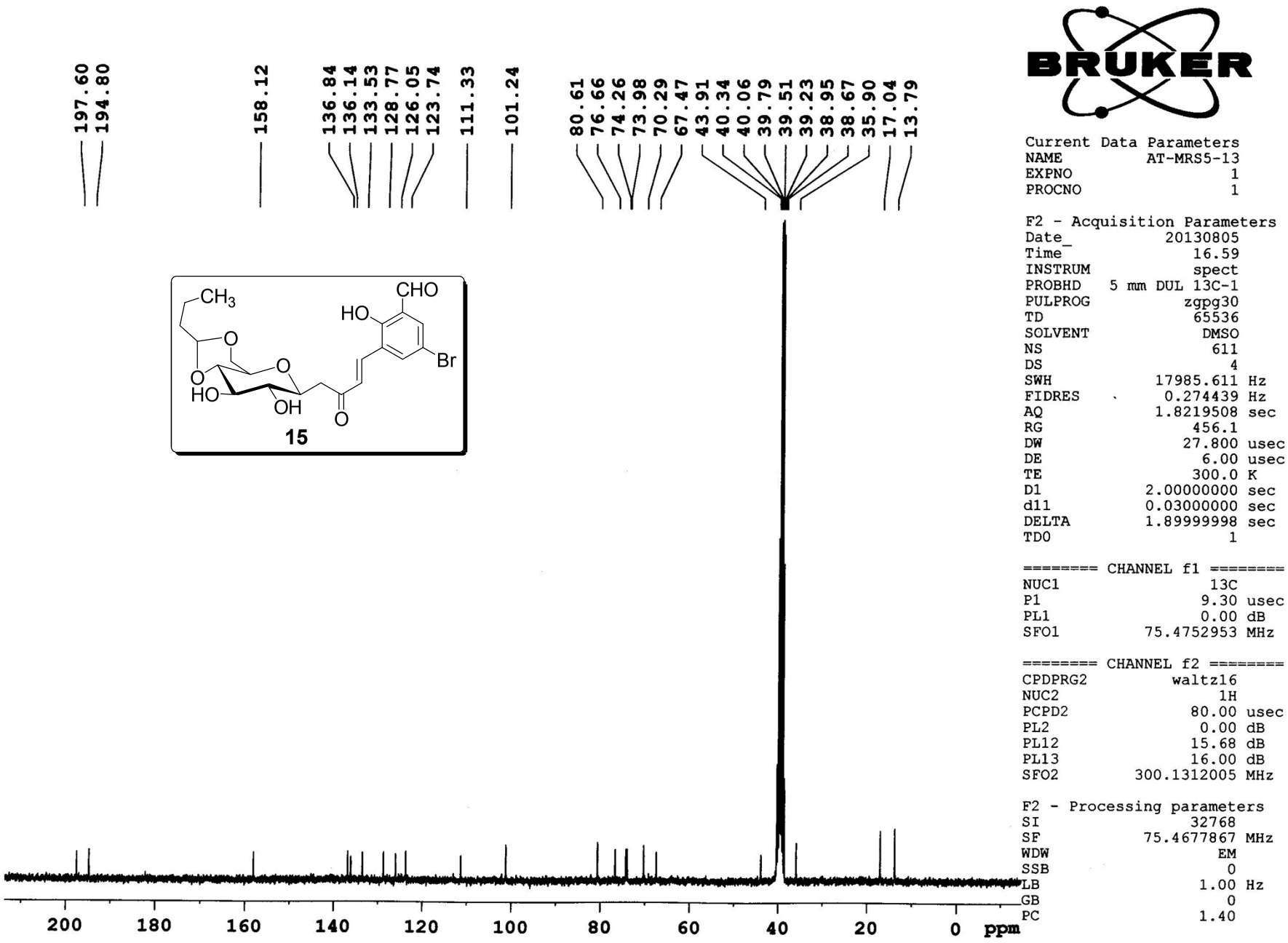


Figure 6 ^{1}H NMR spectrum (300 MHz, DMSO) of compound, 15.



BRUKER

Current Data Parameters
NAME AT-MRS5-13
EXPNO 1
PROCNO 1

F2 - Acquisition Parameters
Date_ 20130805
Time 16.59
INSTRUM spect
PROBHD 5 mm DUL 13C-1
PULPROG zgpg30
TD 65536
SOLVENT DMSO
NS 611
DS 4
SWH 17985.611 Hz
FIDRES 0.274439 Hz
AQ 1.8219508 sec
RG 456.1
DW 27.800 usec
DE 6.00 usec
TE 300.0 K
D1 2.00000000 sec
d11 0.03000000 sec
DELTA 1.89999998 sec
TD0 1

======== CHANNEL f1 ========
NUC1 13C
P1 9.30 usec
PL1 0.00 dB
SFO1 75.4752953 MHz

======== CHANNEL f2 ========
CPDPRG2 waltz16
NUC2 1H
PCPD2 80.00 usec
PL2 0.00 dB
PL12 15.68 dB
PL13 16.00 dB
SFO2 300.1312005 MHz

F2 - Processing parameters
SI 32768
SF 75.4677867 MHz
WDW EM
SSB 0
LB 1.00 Hz
GB 0
PC 1.40

Figure 7 ^{13}C NMR spectrum (75 MHz, DMSO) of compound, 15.

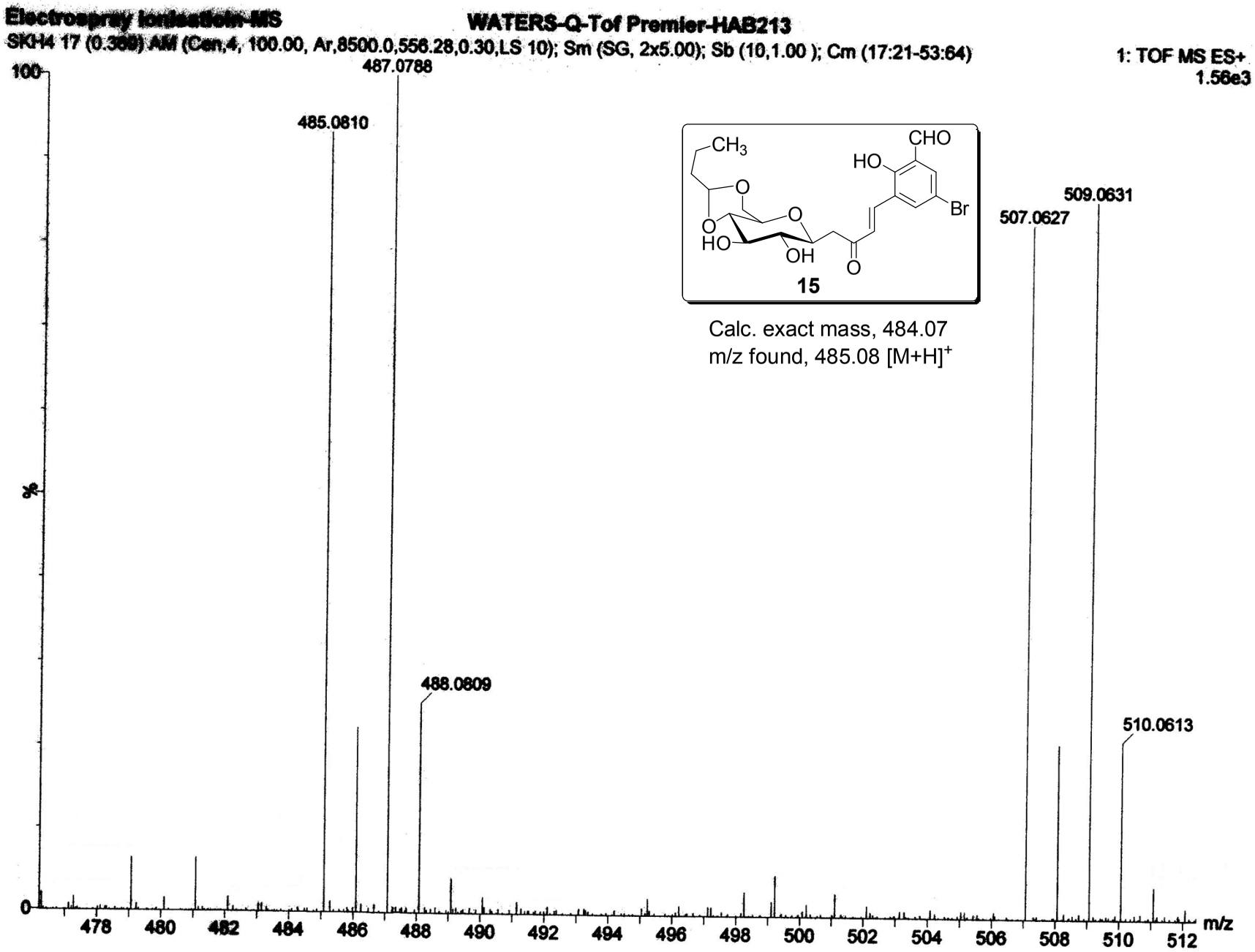


Figure 8 Mass spectrum of compound, 15.

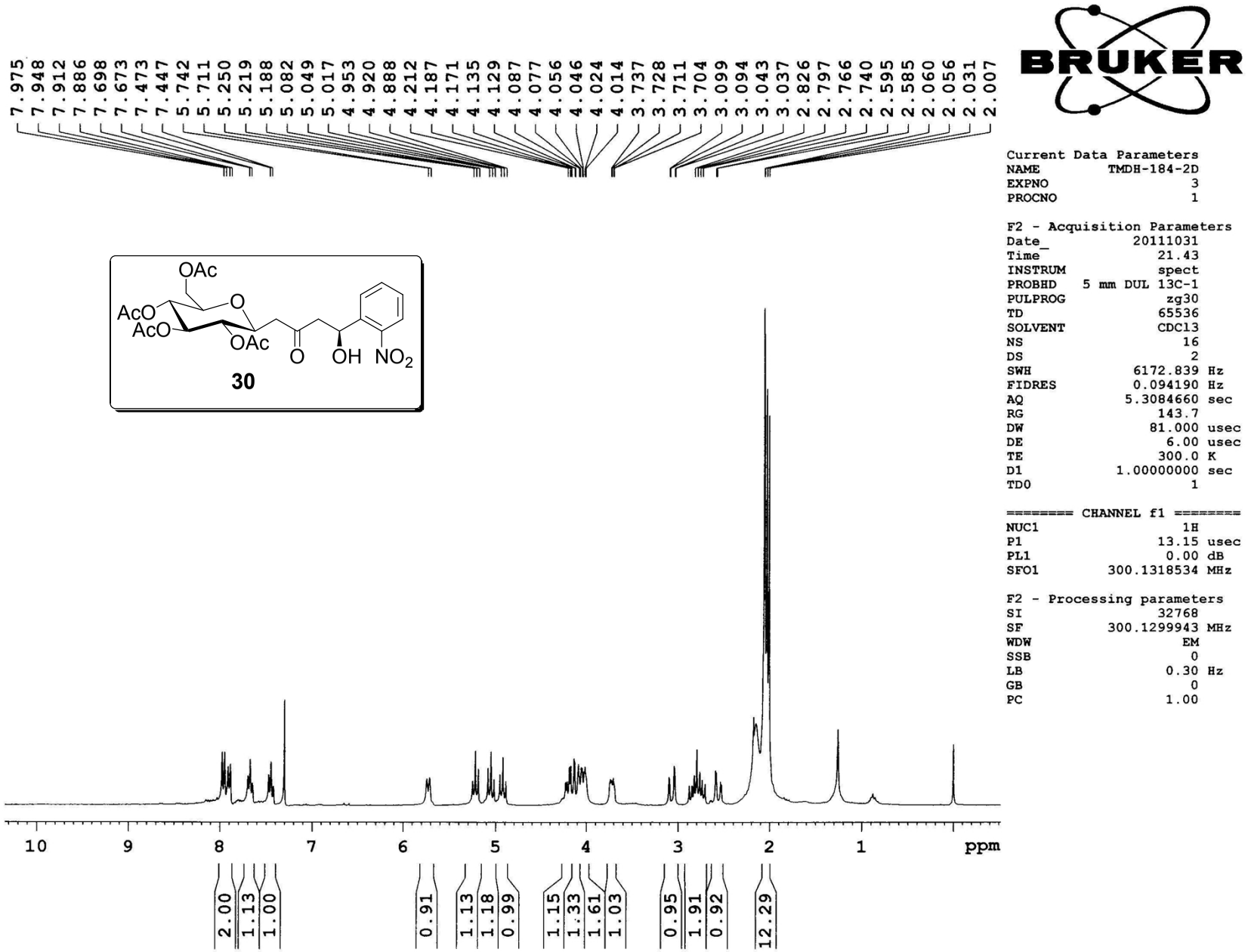
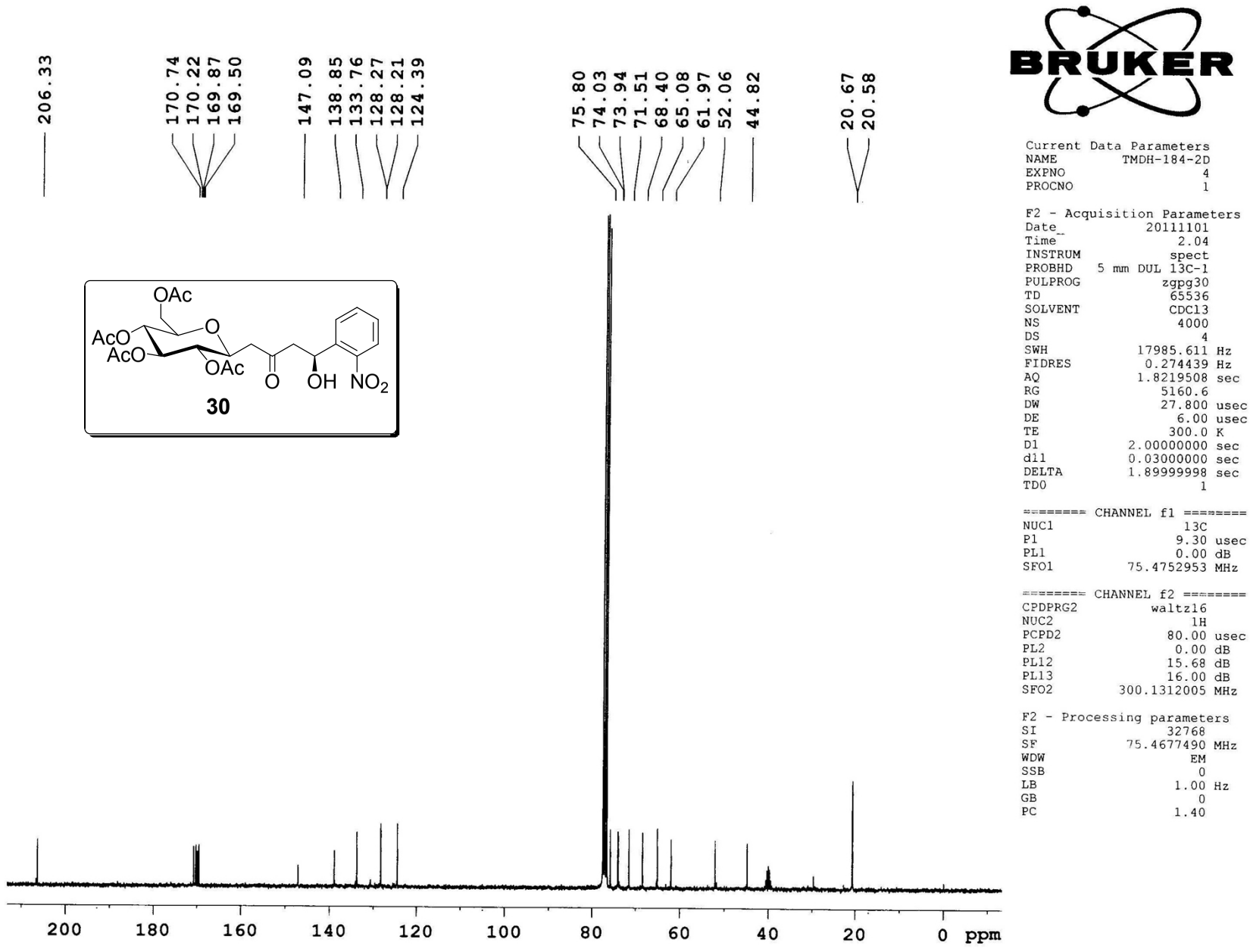


Figure 9 ^{1}H NMR spectrum (300 MHz, $CDCl_3$) of compound, 30.



BRUKER

```
Current Data Parameters
NAME          TMDH-184-2D
EXPNO                   4
PROCNO                  1

F2 - Acquisition Parameters
Date_          20111101
Time              2.04
INSTRUM          spect
PROBHD   5 mm DUL 13C-1
PULPROG         zgpg30
TD              65536
SOLVENT         CDCl3
NS               4000
DS                  4
SWH          17985.611 Hz
FIDRES        0.274439 Hz
AQ            1.8219508 sec
RG               5160.6
DW              27.800 usec
DE               6.00 usec
TE              300.0 K
D1           2.00000000 sec
d11          0.03000000 sec
DELTA        1.89999998 sec
TD0                 1

======== CHANNEL f1 ========
NUC1               13C
P1               9.30 usec
PL1              0.00 dB
SFO1       75.4752953 MHz

======== CHANNEL f2 ========
CPDPRG2        waltz16
NUC2               1H
PCPD2           80.00 usec
PL2              0.00 dB
PL12            15.68 dB
PL13            16.00 dB
SFO2      300.1312005 MHz

F2 - Processing parameters
SI               32768
SF         75.4677490 MHz
WDW                EM
SSB                 0
LB               1.00 Hz
GB                  0
PC               1.40
```

Figure 10 ^{13}C NMR spectrum (75 MHz, $CDCl_3$) of compound, 30.

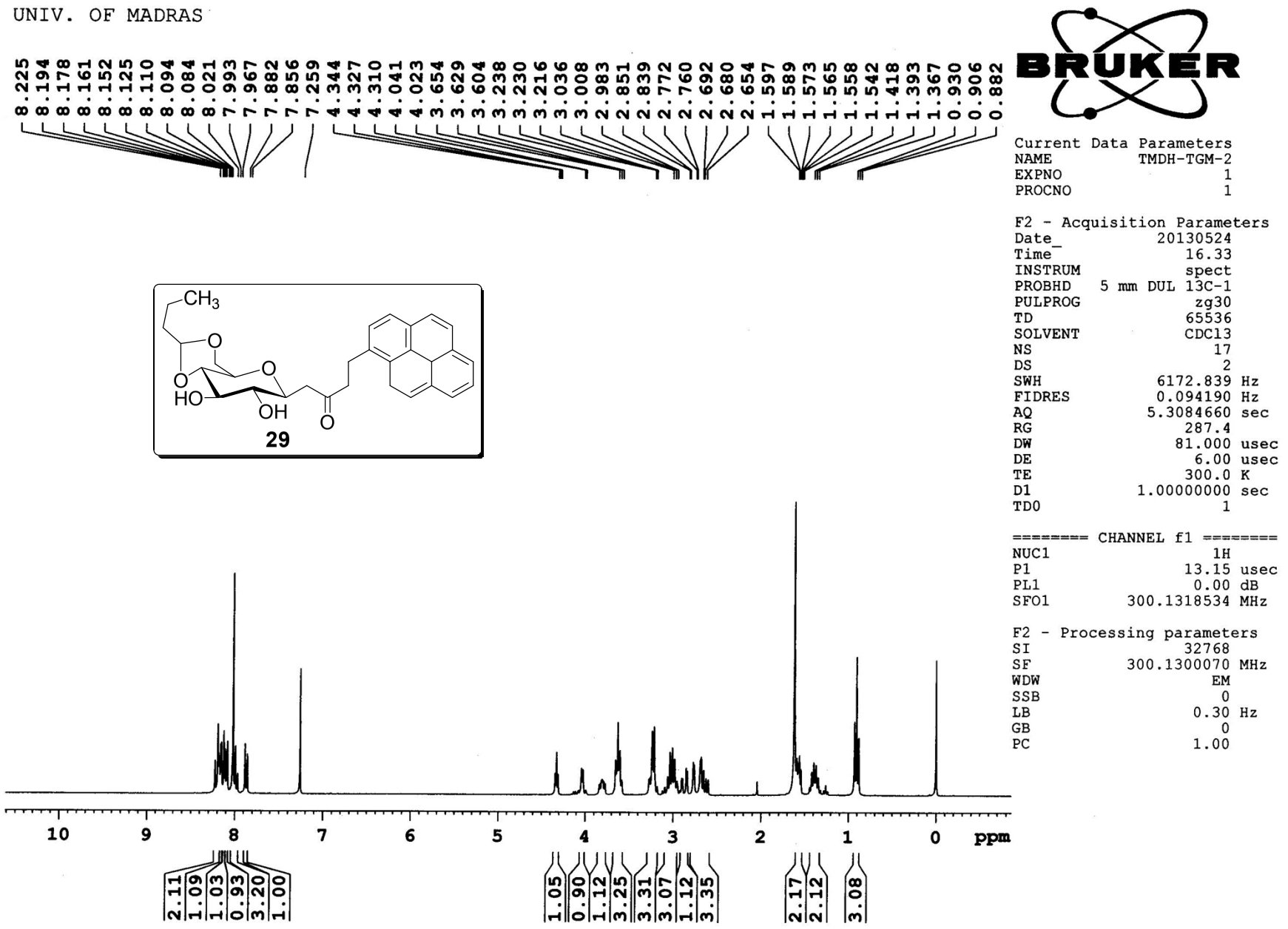
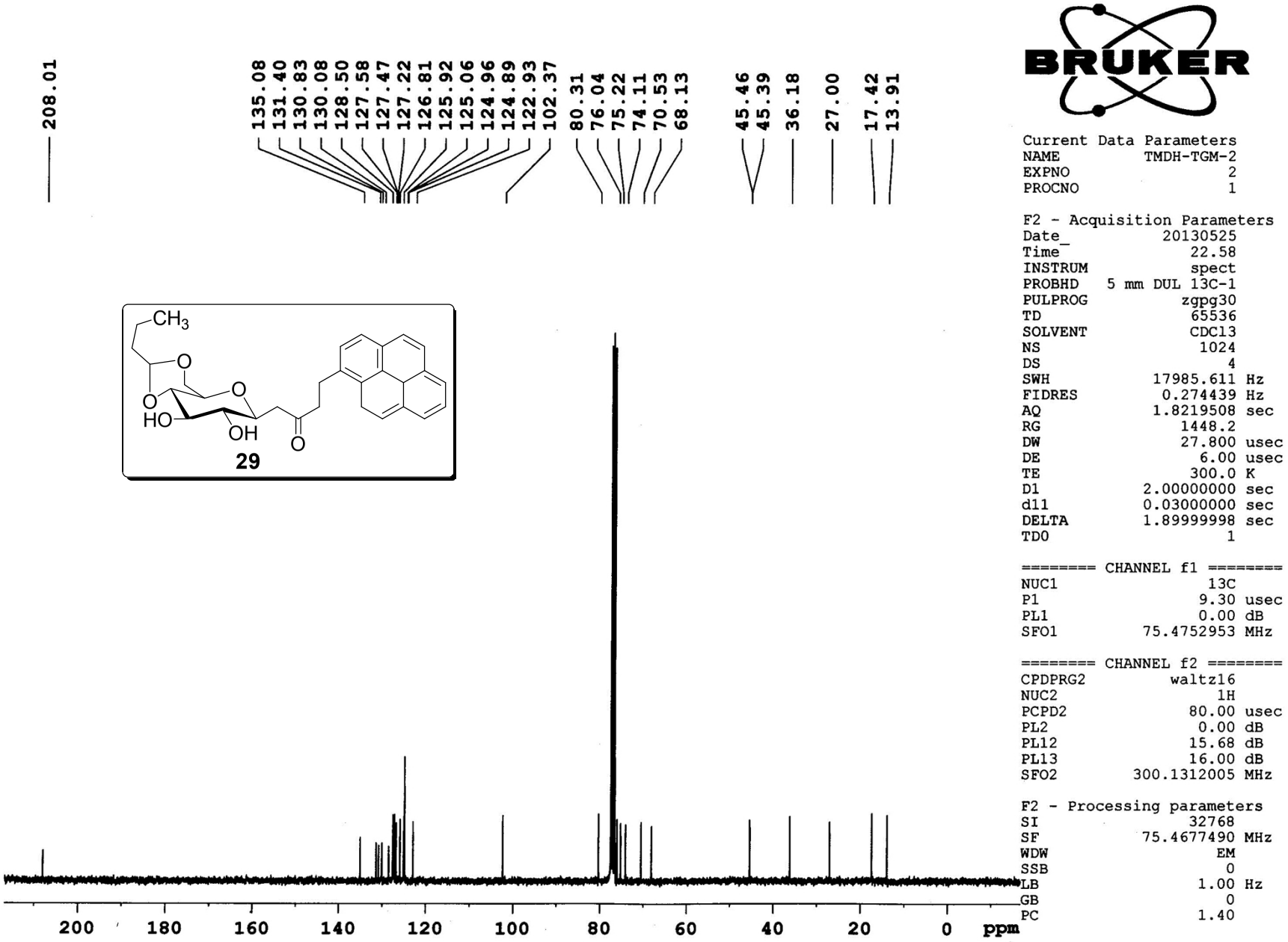


Figure 11 ^{1}H NMR spectrum (300 MHz, $CDCl_3$) of compound, 29.



BRUKER

Current Data Parameters
NAME TMDH-TGM-2
EXPNO 2
PROCNO 1

F2 - Acquisition Parameters
Date_ 20130525
Time 22.58
INSTRUM spect
PROBHD 5 mm DUL 13C-1
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 1024
DS 4
SWH 17985.611 Hz
FIDRES 0.274439 Hz
AQ 1.8219508 sec
RG 1448.2
DW 27.800 usec
DE 6.00 usec
TE 300.0 K
D1 2.00000000 sec
d11 0.03000000 sec
DELTA 1.89999998 sec
TD0 1

======== CHANNEL f1 ========
NUC1 13C
P1 9.30 usec
PL1 0.00 dB
SFO1 75.4752953 MHz

======== CHANNEL f2 ========
CPDPRG2 waltz16
NUC2 1H
PCPD2 80.00 usec
PL2 0.00 dB
PL12 15.68 dB
PL13 16.00 dB
SFO2 300.1312005 MHz

F2 - Processing parameters
SI 32768
SF 75.4677490 MHz
WDW EM
SSB 0
LB 1.00 Hz
GB 0
PC 1.40

Figure 12 ^{13}C NMR spectrum (75 MHz, $CDCl_3$) of compound, 29.

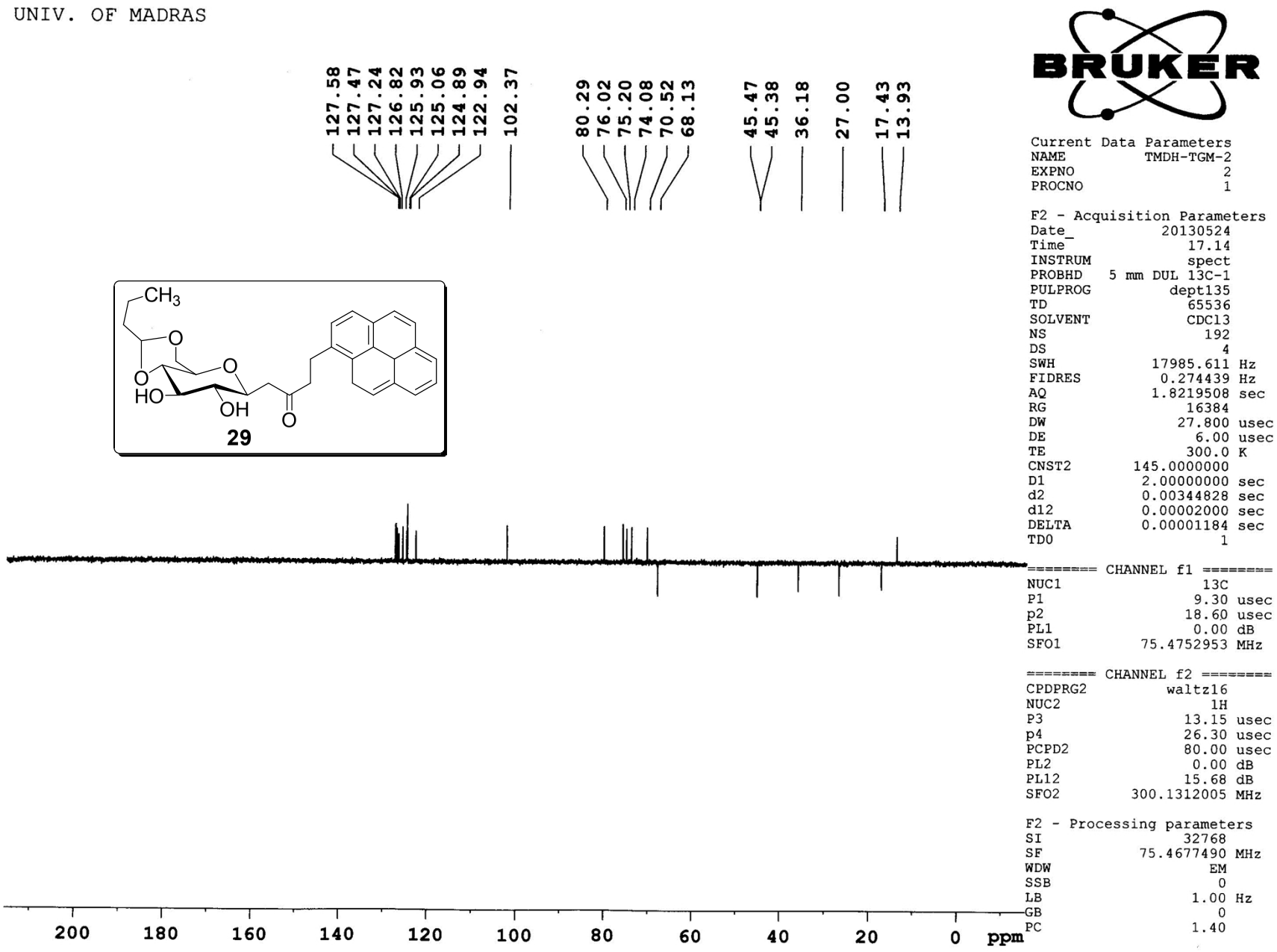


Figure 13 DEPT-135 spectrum (75 MHz, $CDCl_3$) of compound, 29.

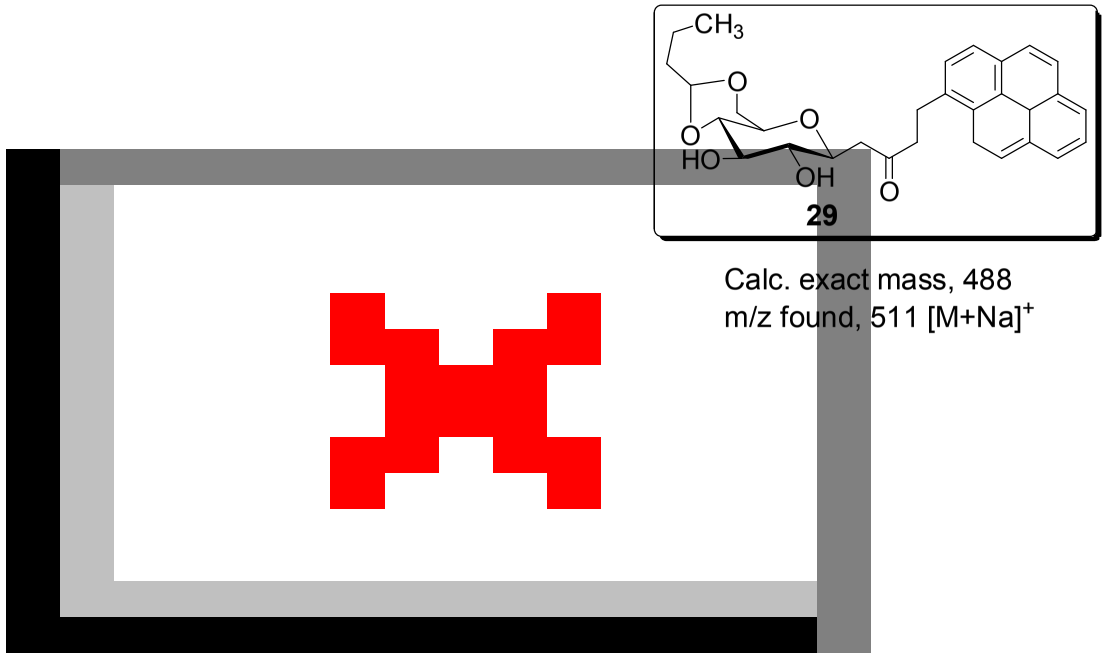


Figure 14 Mass spectrum of compound, 29.

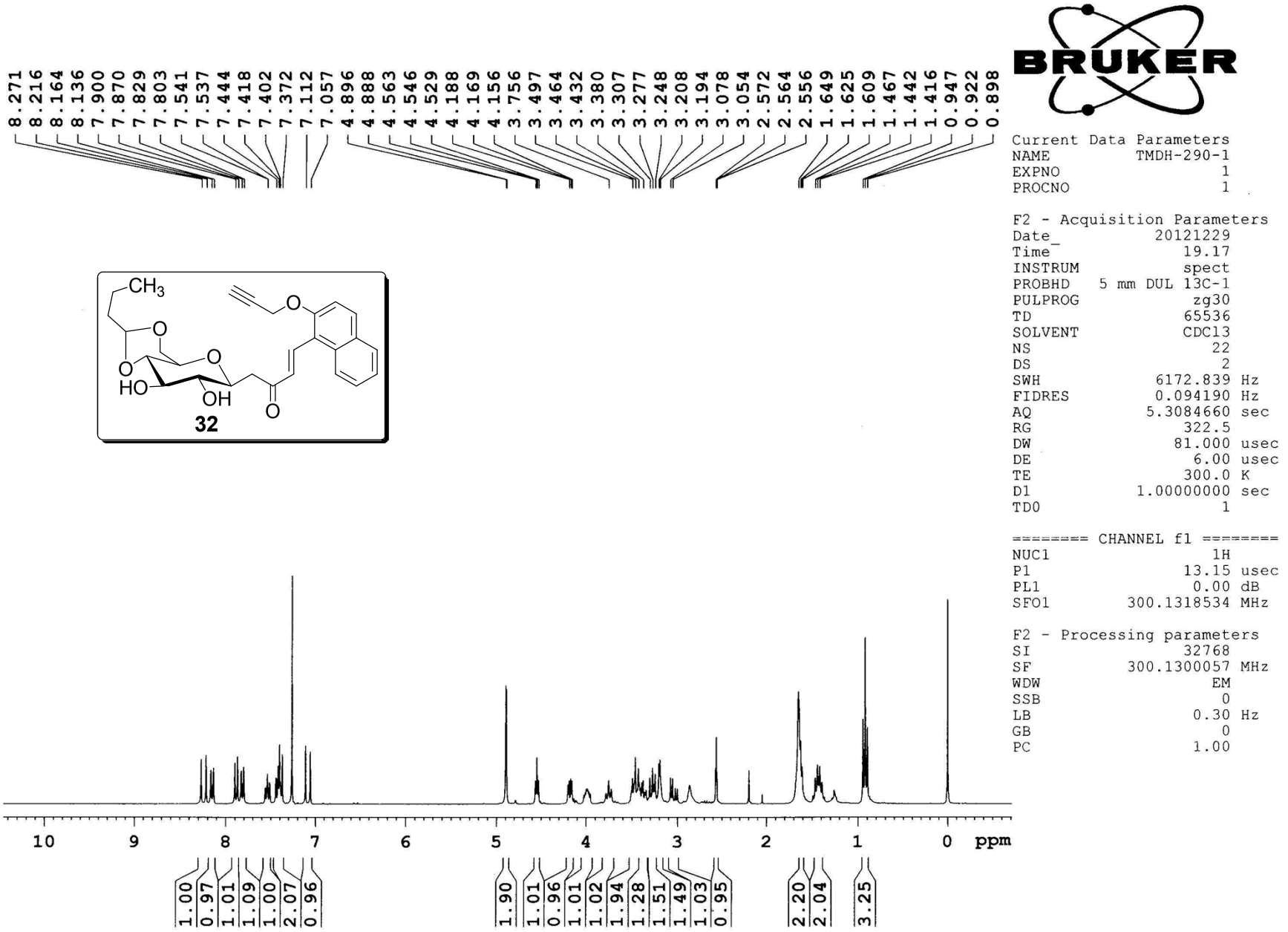
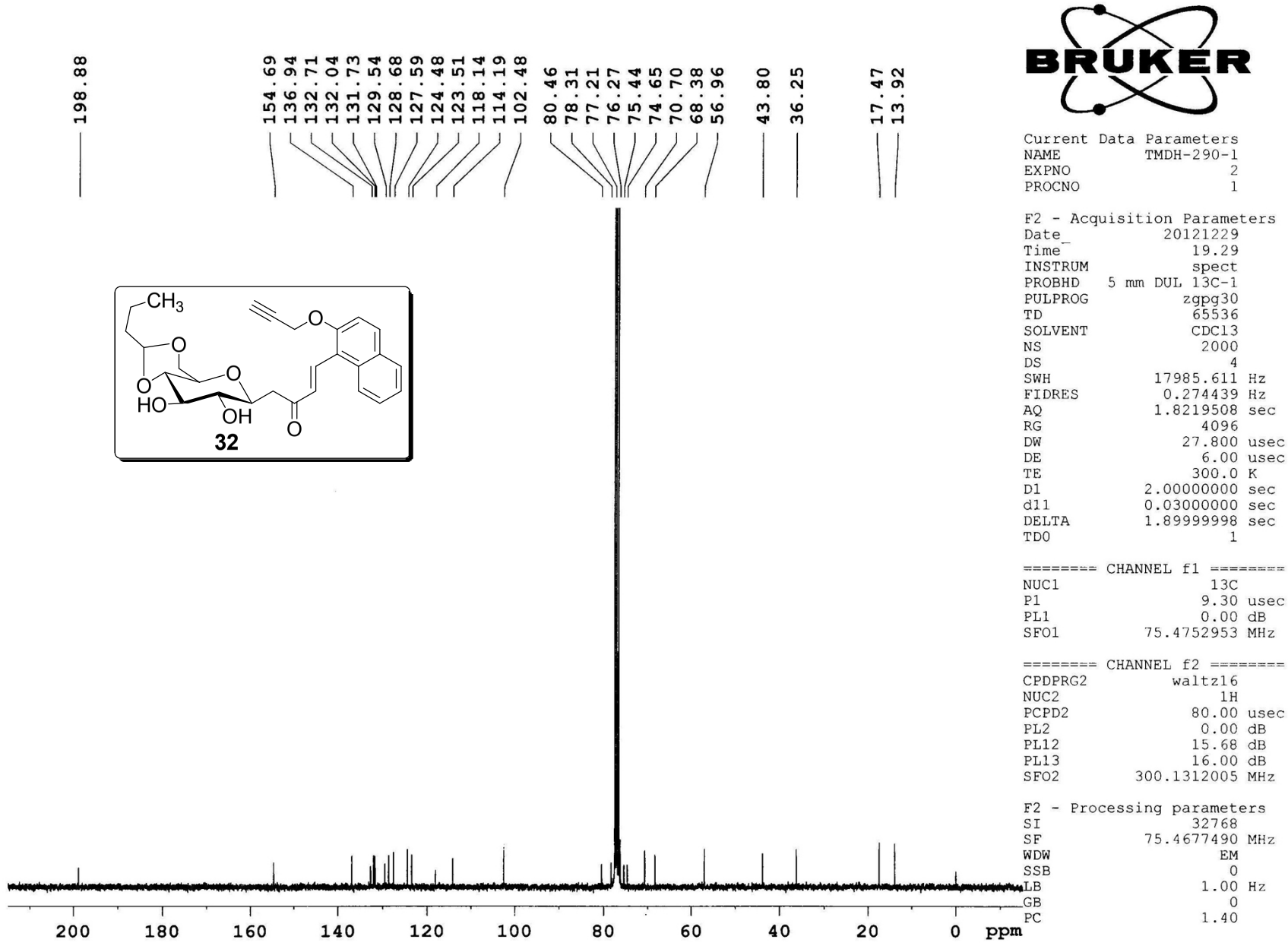


Figure 15 ^{1}H NMR spectrum (300 MHz, $CDCl_3$) of compound, 32.



BRUKER

Current Data Parameters
NAME TMDH-290-1
EXPNO 2
PROCNO 1

F2 - Acquisition Parameters
Date_ 20121229
Time 19.29
INSTRUM spect
PROBHD 5 mm DUL 13C-1
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 2000
DS 4
SWH 17985.611 Hz
FIDRES 0.274439 Hz
AQ 1.8219508 sec
RG 4096
DW 27.800 usec
DE 6.00 usec
TE 300.0 K
D1 2.00000000 sec
d11 0.03000000 sec
DELTA 1.89999998 sec
TD0 1

======== CHANNEL f1 ========
NUC1 13C
P1 9.30 usec
PL1 0.00 dB
SFO1 75.4752953 MHz

======== CHANNEL f2 ========
CPDPRG2 waltz16
NUC2 1H
PCPD2 80.00 usec
PL2 0.00 dB
PL12 15.68 dB
PL13 16.00 dB
SFO2 300.1312005 MHz

F2 - Processing parameters
SI 32768
SF 75.4677490 MHz
WDW EM
SSB 0
LB 1.00 Hz
GB 0
PC 1.40

Figure 16 ^{13}C NMR spectrum (75 MHz, $CDCl_3$) of compound, 32.

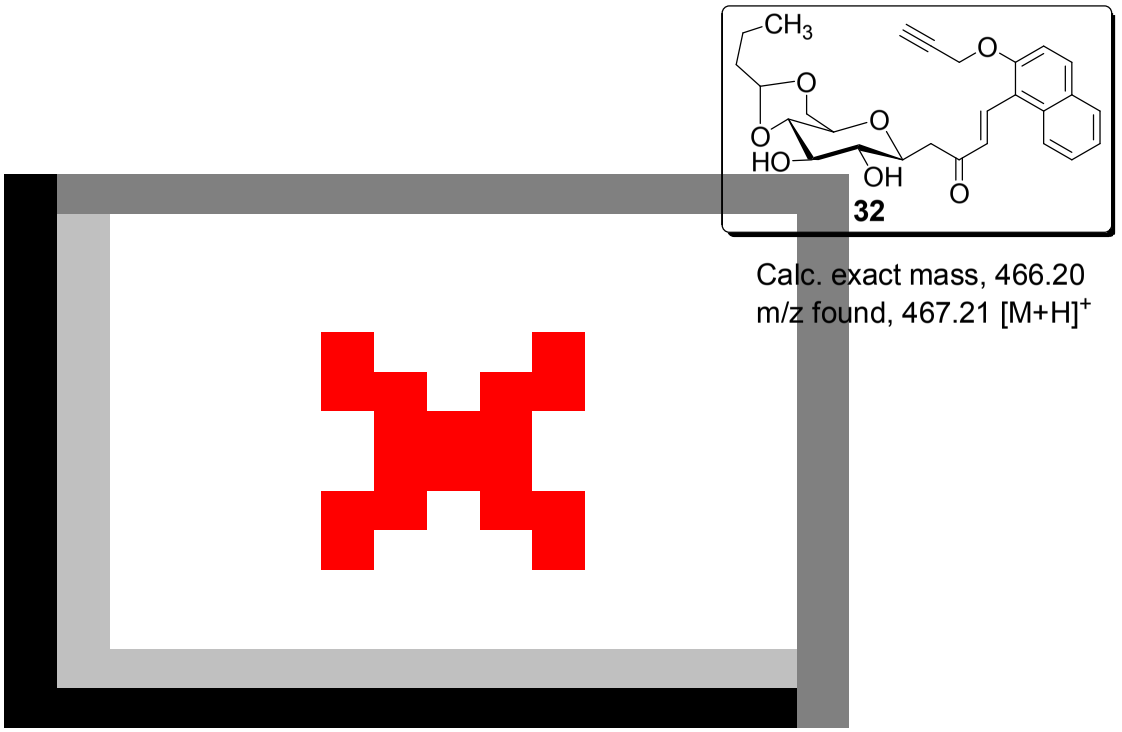


Figure 17 Mass spectrum of compound, 32.

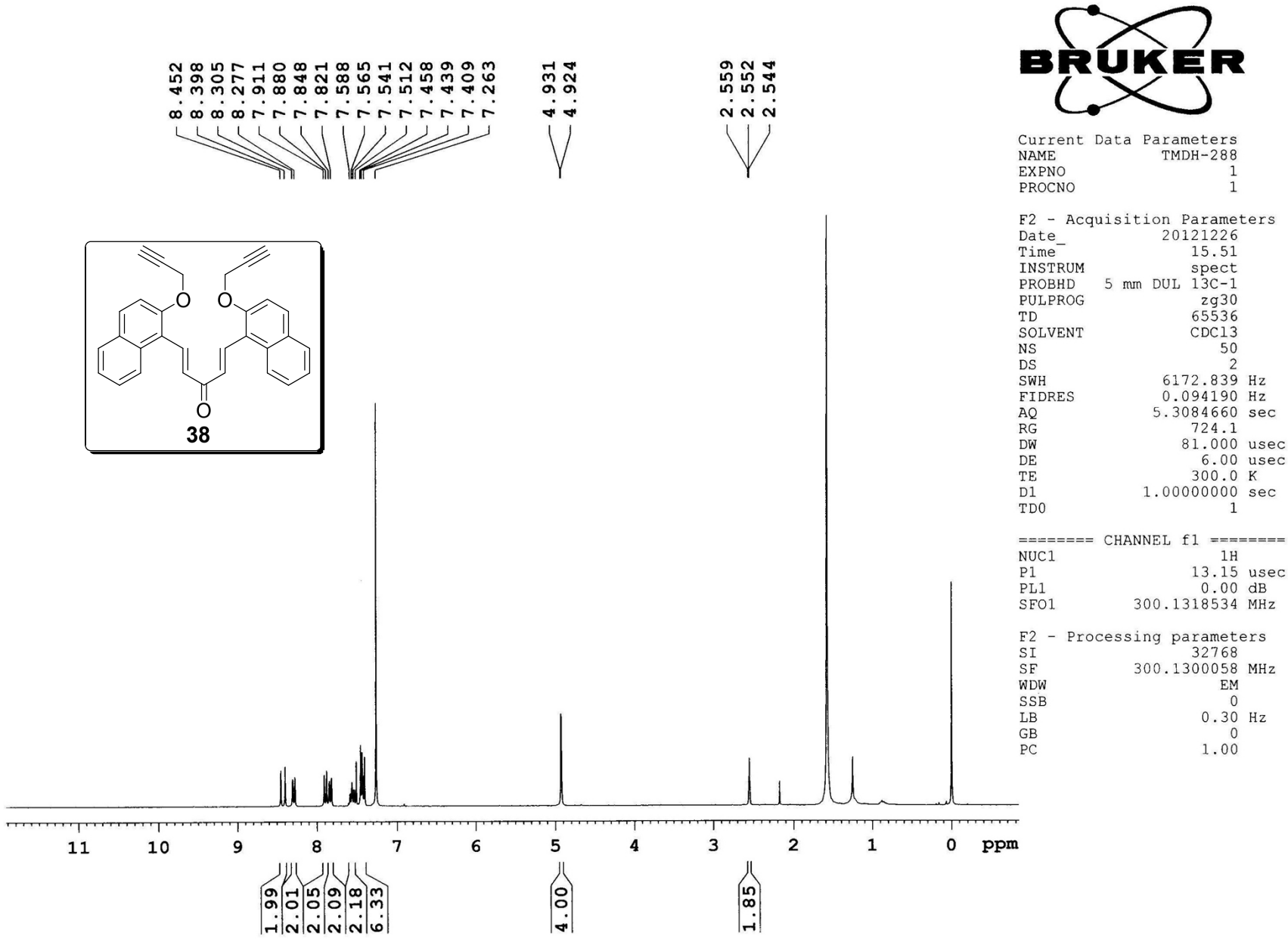
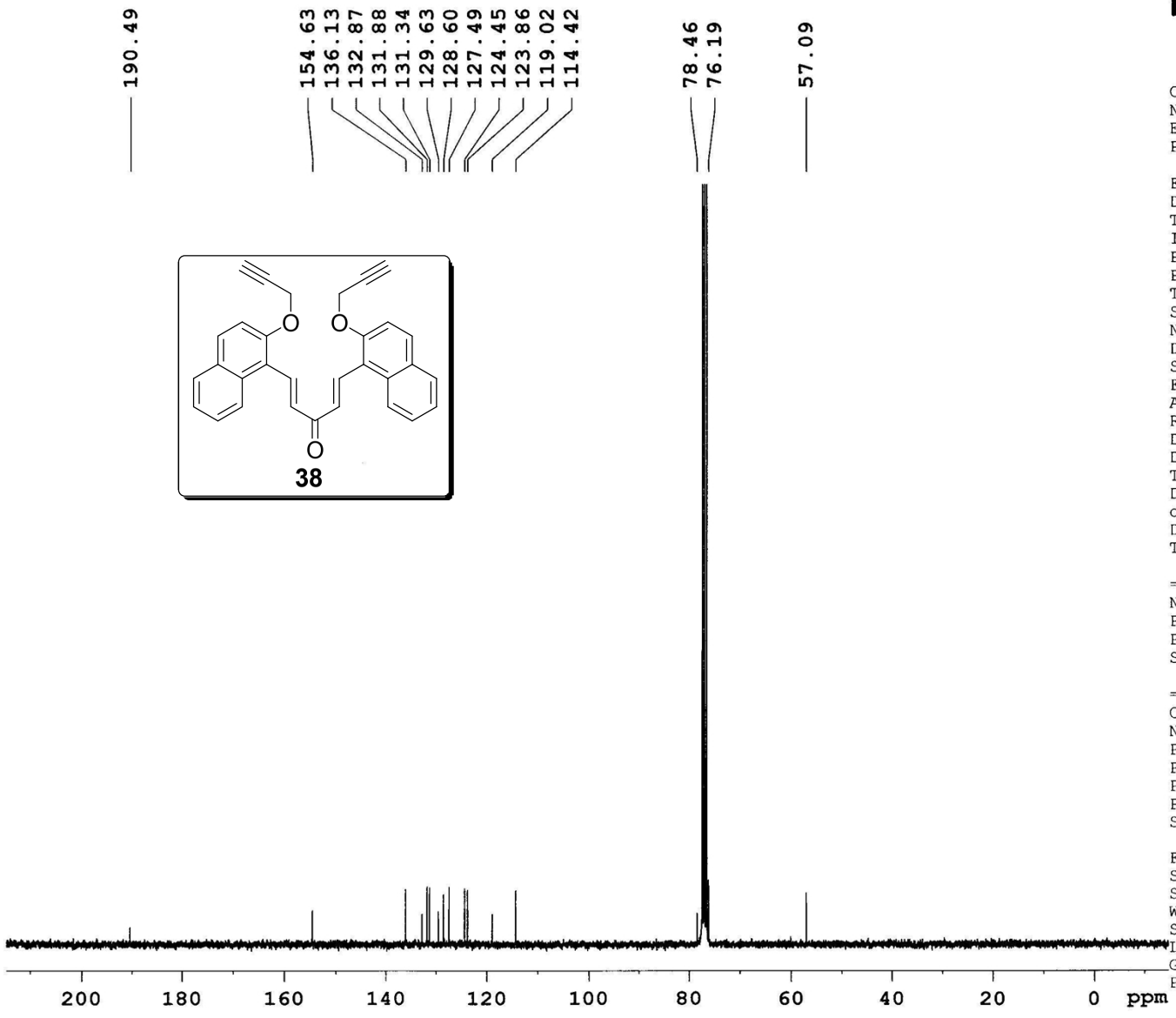


Figure 18 ^{1}H NMR spectrum (300 MHz, $CDCl_3$) of compound, 38.



BRUKER

```
Current Data Parameters
NAME        TMDH-288-C13
EXPNO                  1
PROCNO                 1

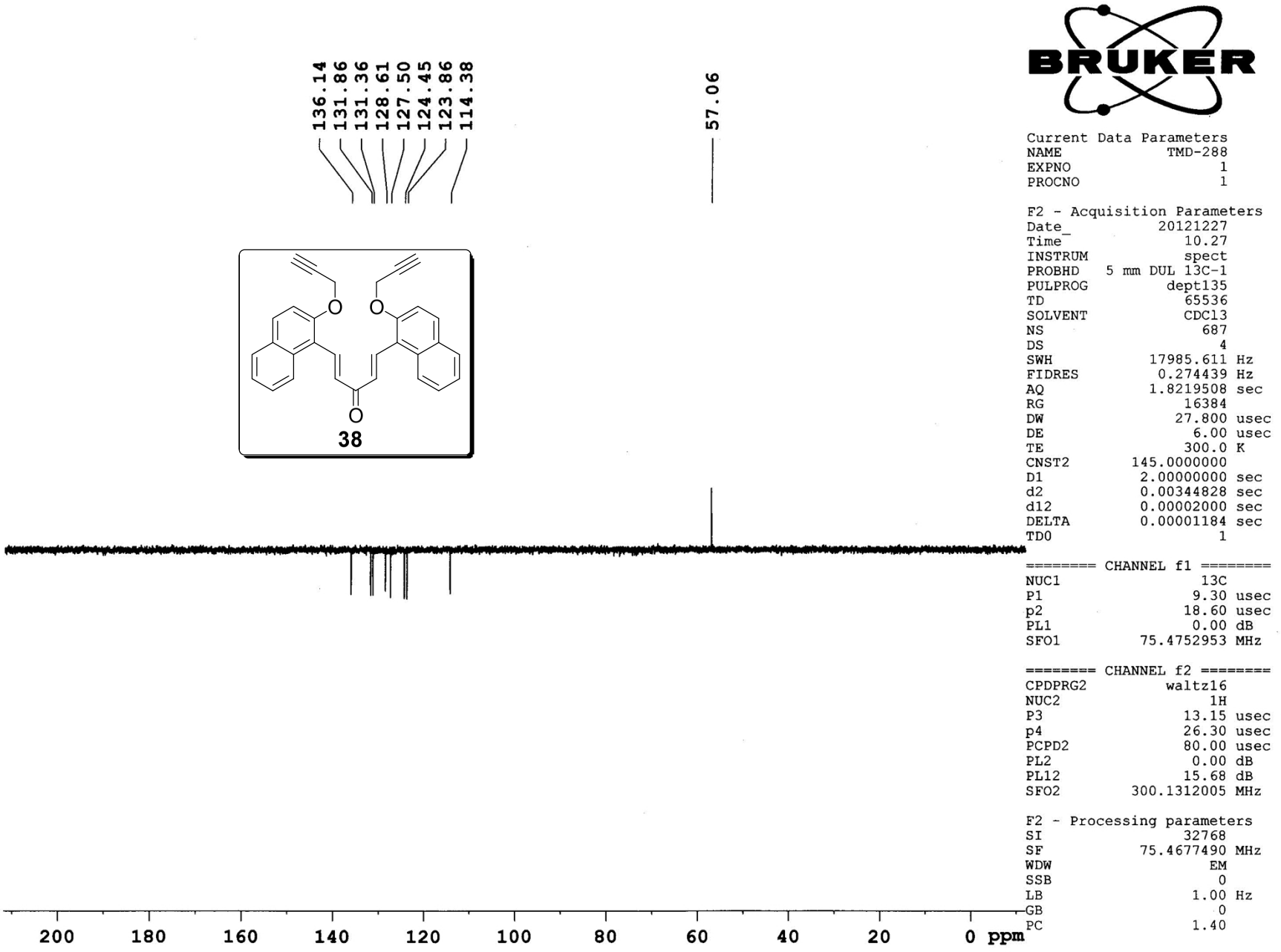
F2 - Acquisition Parameters
Date_           20121226
Time              16.08
INSTRUM           spect
PROBHD   5 mm DUL 13C-1
PULPROG          zgpg30
TD                65536
SOLVENT           CDCl3
NS                 1833
DS                    4
SWH           17985.611 Hz
FIDRES         0.274439 Hz
AQ             1.8219508 sec
RG                574.7
DW               27.800 usec
DE                6.00 usec
TE               300.0 K
D1            2.00000000 sec
d11           0.03000000 sec
DELTA         1.89999998 sec
TD0                   1

======== CHANNEL f1 ========
NUC1                 13C
P1                 9.30 usec
PL1                0.00 dB
SFO1         75.4752953 MHz

======== CHANNEL f2 ========
CPDPRG2          waltz16
NUC2                 1H
PCPD2             80.00 usec
PL2                0.00 dB
PL12              15.68 dB
PL13              16.00 dB
SFO2        300.1312005 MHz

F2 - Processing parameters
SI                32768
SF           75.4677490 MHz
WDW                  EM
SSB                   0
LB                 1.00 Hz
GB                    0
PC                 1.40
```

Figure 19 ^{13}C NMR spectrum (75 MHz, $CDCl_3$) of compound, 38.




```
Current Data Parameters
NAME                 TMD-288
EXPNO                      1
PROCNO                     1

F2 - Acquisition Parameters
Date_              20121227
Time                  10.27
INSTRUM               spect
PROBHD    5 mm DUL 13C-1
PULPROG            dept135
TD                    65536
SOLVENT               CDCl3
NS                      687
DS                        4
SWH               17985.611 Hz
FIDRES             0.274439 Hz
AQ                 1.8219508 sec
RG                    16384
DW                   27.800 usec
DE                    6.00 usec
TE                   300.0 K
CNST2            145.0000000
D1                2.00000000 sec
d2                0.00344828 sec
d12               0.00002000 sec
DELTA             0.00001184 sec
TD0                       1

======== CHANNEL f1 ========
NUC1                    13C
P1                    9.30 usec
p2                   18.60 usec
PL1                   0.00 dB
SFO1             75.4752953 MHz

======== CHANNEL f2 ========
CPDPRG2              waltz16
NUC2                    1H
P3                   13.15 usec
p4                   26.30 usec
PCPD2                80.00 usec
PL2                   0.00 dB
PL12                 15.68 dB
SFO2            300.1312005 MHz

F2 - Processing parameters
SI                    32768
SF               75.4677490 MHz
WDW                      EM
SSB                       0
LB                     1.00 Hz
GB                        0
PC                     1.40
```

Figure 20 DEPT-135 spectrum (75 MHz, $CDCl_3$) of compound, 38.

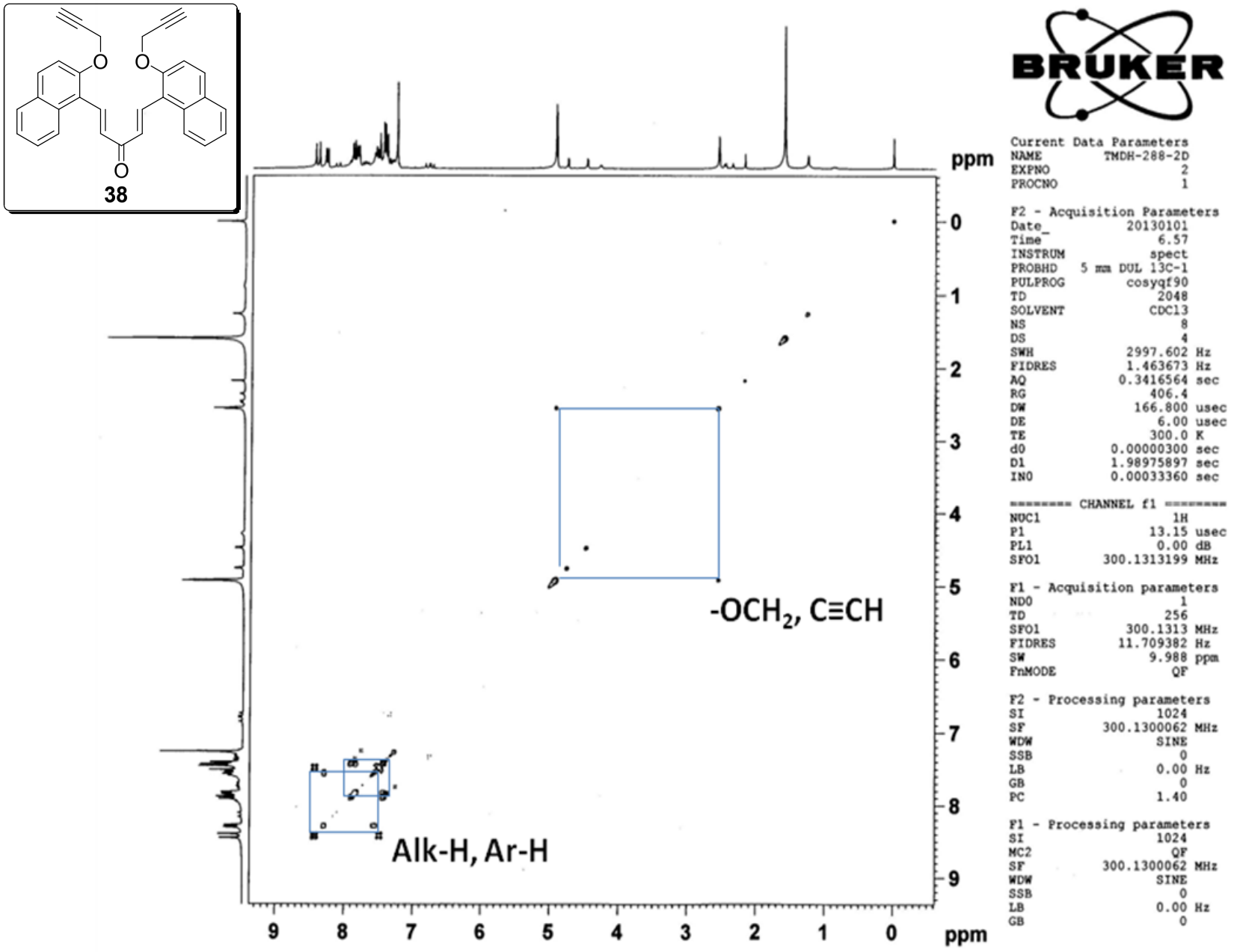
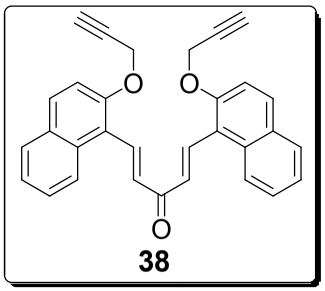
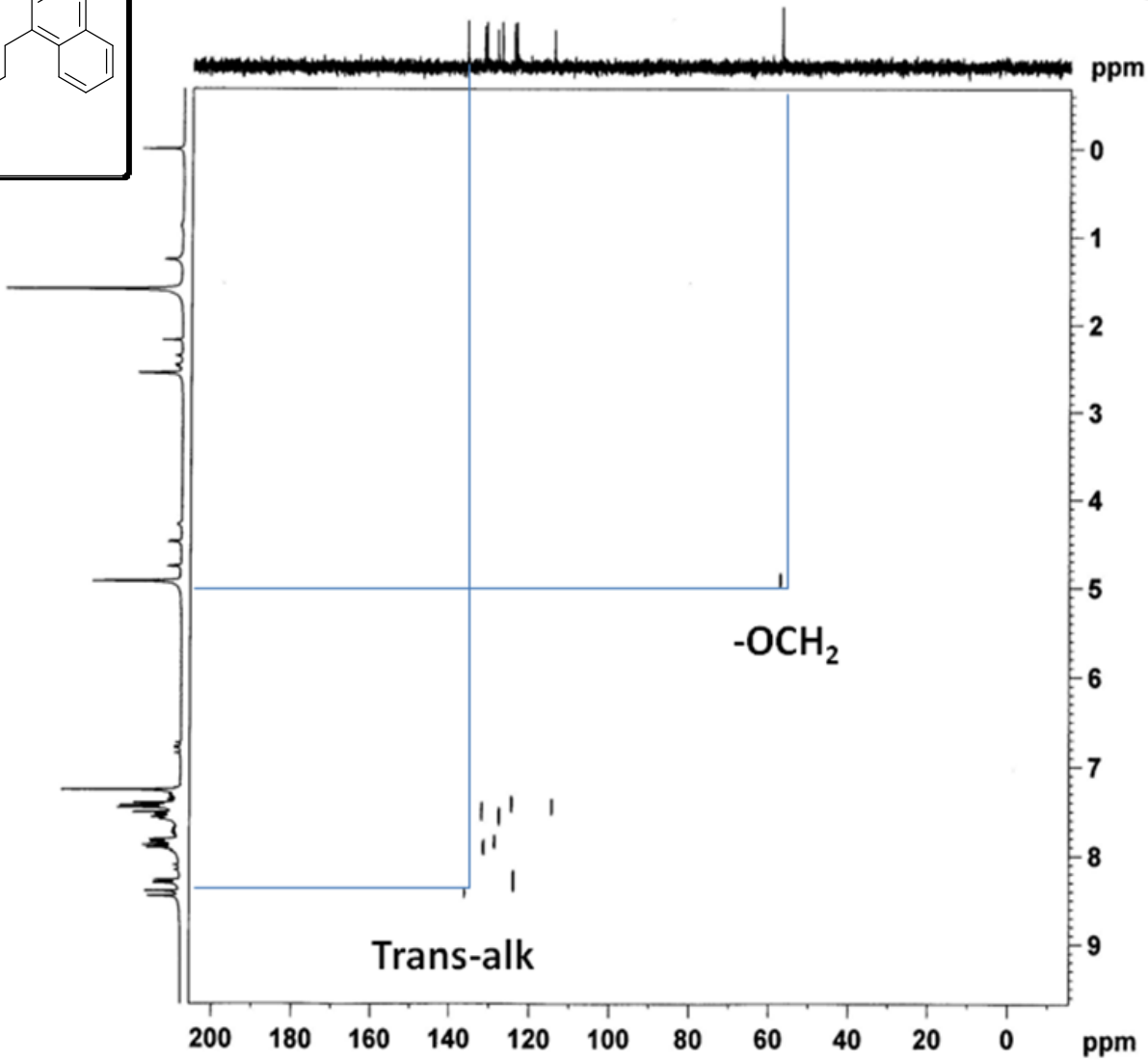


Figure 21 ^{1}H-^{1}H [COSY] spectrum (300 MHz, $CDCl_3$) of compound, 38.






```
Current Data Parameters
NAME          TMDH-288-2D
EXPNO                   4
PROCNO                  1

F2 - Acquisition Parameters
Date_           20130101
Time               8.52
INSTRUM           spect
PROBHD   5 mm DUL 13C-1
PULPROG          hxcoqf
TD                 4096
SOLVENT           CDCl3
NS                   16
DS                    4
SWH           16666.666 Hz
FIDRES         4.069010 Hz
AQ             0.1229300 sec
RG                 16384
DW                30.000 usec
DE                 6.00 usec
TE                300.0 K
CNST2         145.0000000
CNST11          3.0000000
d0             0.00000300 sec
D1             2.04423189 sec
d2             0.00344828 sec
d3             0.00229885 sec
d11            0.03000000 sec
d12            0.00002000 sec
IN0            0.00016080 sec

======== CHANNEL f1 ========
NUC1                13C
P1                 9.30 usec
p2                18.60 usec
PL1                0.00 dB
SFO1          75.4749263 MHz

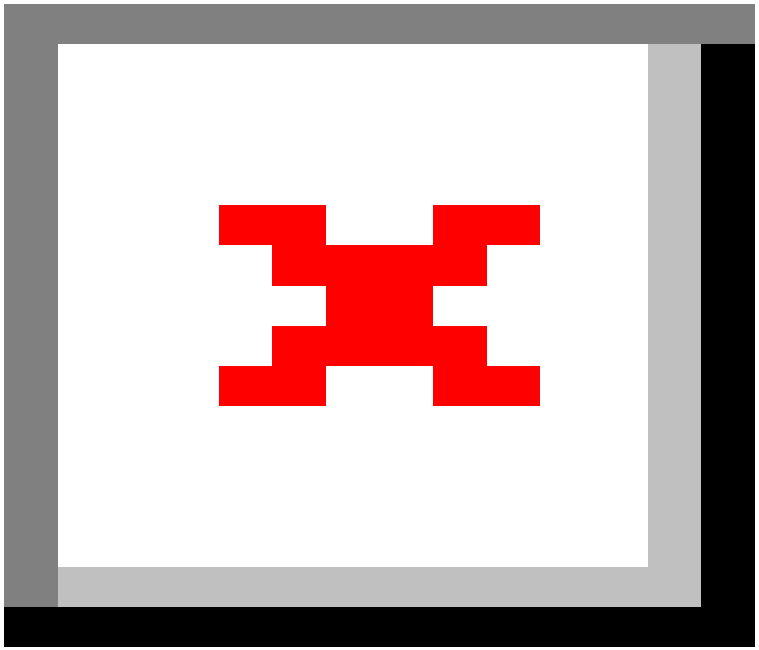
======== CHANNEL f2 ========
CPDPRG2          waltz16
NUC2                1H
P3                13.15 usec
PCPD2             80.00 usec
PL2                0.00 dB
PL12              15.68 dB
SFO2         300.1313555 MHz

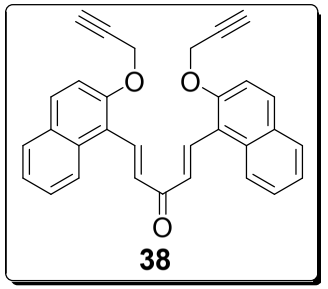
F1 - Acquisition parameters
ND0                    2
TD                   110
SFO1           300.1314 MHz
FIDRES        28.267752 Hz
SW                10.360 ppm
FnMODE                QF

F2 - Processing parameters
SI                  2048
SF            75.4677490 MHz
WDW                QSINE
SSB                    2
LB                 0.00 Hz
GB                     0
PC                  1.40

F1 - Processing parameters
SI                  1024
MC2                   QF
SF           300.1300061 MHz
WDW                QSINE
SSB                    2
LB                 0.00 Hz
GB                     0
```

Figure 22 ^{1}H-^{13}C [COSY] spectrum (300 MHz, 75 MHz, $CDCl_3$) of compound, 38.





Calc. exact mass, 422.16
m/z found, 423.16 $[M+H]^+$

Figure 23 Mass spectrum of compound, 38.

Table 1: Gelation studies of sugar chalcone derivatives

Solvents /Solvent mixture	Compounds																									
	5	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
																			(Compounds in section 2.s to 2.z in ESI)							
Hexane	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
EtOAc	P	P	I	PG	PG	P	P	P	P	P	I	P	P	S	S	S	S	S	S	S	S	S	S	S	S	I
$CHCl_3$	P	P	I	G	S	P	P	P	P	P	I	P	P	S	S	S	S	S	S	S	S	S	S	S	S	I
$CHCl_2$	P	P	I	S	S	P	P	P	P	P	I	P	P	S	S	S	S	S	S	S	S	S	S	S	S	I
MeOH	P	P	I	S	S	P	P	P	P	P	I	S	S	P	S	S	S	S	S	S	S	S	S	S	S	S
EtOH	P	P	I	S	S	P	P	P	P	P	I	S	S	P	S	S	S	S	S	S	S	S	S	S	S	I
CH_3CN	P	P	S	S	S	P	P	P	S	P	I	S	S	P	S	S	S	S	S	S	S	P	P	P	P	I
DMSO	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
H_2O	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
DMSO+ H_2O	P	P	G	P	P	P	P	S	S	P	P	P	P	P	P	P	PG	P	P	P	G	P	P	P	P	I
$CHCl_{3+}$ MeOH	S	S	S	G	G	S	S	P	P	P	I	S	S	S	S	S	S	S	S	S	S	S	S	S	S	I
Hex+ethylacetate	S	S	P	P	P	S	S	P	P	P	I	S	S	S	S	S	P	S	S	S	P	S	S	S	S	I
Hex+chloroform	S	S	P	P	P	S	S	P	P	P	I	S	S	S	S	S	P	S	S	S	P	S	S	S	S	I

Note: G = Gel; PG = Partial gel; S = Soluble; P = Precipitation; I = Insoluble.

Table 2: Gelation studies of propargylated sugar chalcone derivatives

Solvents	Compounds					
	31	**32**	**33**	**34**	**35**	**36**
Hexane	I	I	I	I	I	I
EtOAc	S	PG	S	S	G	S
$CHCl_3$	S	S	PG	P	S	S
$CHCl_2$	S	S	S	S	S	S
MeOH	S	P	S	S	S	S
EtOH	S	S	S	S	S	S
CH_3CN	P	P	S	S	S	S
DMSO	S	S	S	S	S	S
H_2O	I	I	I	I	I	I
DMSO+H_2O	P	P	P	P	P	P
$CHCl_3$+MeOH	S	S	PG	S	G	S
Hex+EtOAc	S	P	S	S	P	S
Hex+$CHCl_3$	S	P	G	S	P	S

Note: G = Gel; PG = Partial gel; S = Soluble; P = Precipitation; I = Insoluble.

Table 3: Gelation test for aldol product, sugar ketone and dimer derivatives.

Solvents	Compounds													
	30	**30'**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**37**	**38**	**39**	**40**	**41**
Hexane	I	I	I	I	I	I	I	I	I	S	S	S	S	S
EtOAc	S	S	S	S	S	S	S	S	S	S	S	S	S	S
$CHCl_3$	S	S	S	S	S	S	S	S	P	S	S	S	S	S
$CHCl_2$	S	S	S	S	S	S	S	S	S	S	S	S	S	S
MeOH	S	S	P	P	P	P	P	S	S	S	S	S	S	S
EtOH	S	S	P	P	P	P	P	S	S	S	S	S	S	S
CH_3CN	P	P	S	S	S	S	S	S	S	S	S	S	S	S
DMSO	S	S	S	S	S	S	S	S	S	S	S	S	S	S
H_2O	I	I	I	I	I	I	I	I	I	I	I	I	I	I

DMSO+H_2O	S	S	P	P	P	P	P	P	P	P	P	P	P	P
$CHCl_3$+MeOH	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Hex+EtOAc	S	S	S	S	S	S	S	S	P	S	S	S	S	S
Hex+$CHCl_3$	S	S	S	S	S	S	S	S	P	S	S	S	S	S

Note: G = Gel; PG = Partial gel; S = Soluble; P = Precipitation; I = Insoluble.