

Electronic Supporting Information

Combinatorial synthesis of galactosyl-1,3,5-triazines as novel nucleoside analogues

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Materials and General Methods

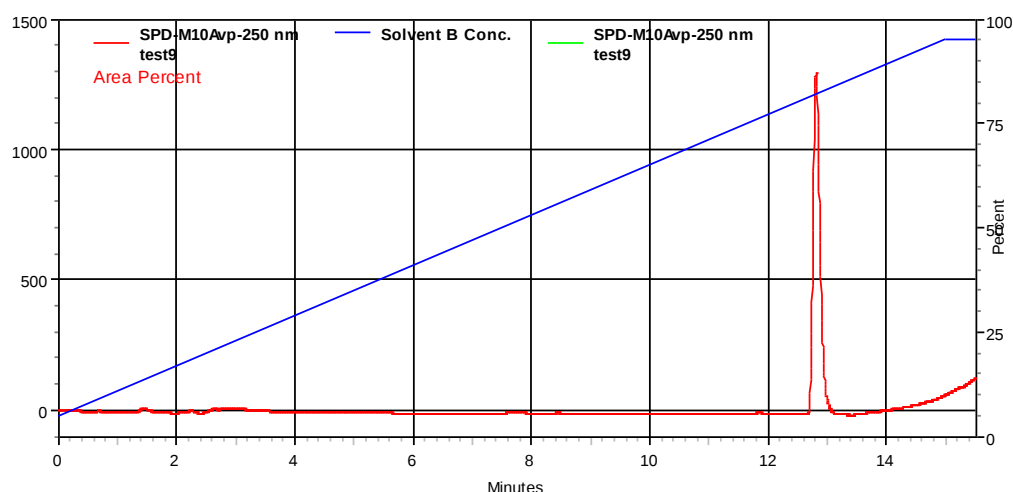
Unless otherwise noted, all reagents and solvents were purchased from Acros or Aldrich and were used as received. PAL aldehyde (4-formyl-3,5-dimethoxyphenoxymethyl) resin was product of Midwest Bio-Tech (loading level 1.10 mmol/g). Solid phase reactions were performed in 4 ml glass vials on a VWR Orbital Shaker or in a VWR dry block heater. Resin filtrations were carried out using 70 μ PE frit cartridges from Applied Separations.

Compounds in the library were identified by LC-MS (Agilent Technology, HP1100) with a C18 column (20 x 4.0 mm) using a gradient of 5-95% CH₃CN-H₂O (containing 0.1% acetic acid) over 4 min. ¹H-NMR and ¹³C-NMR were recorded on a Varian Innova 400-MHz NMR spectrometer. Analytical characterization for the representative 10 compounds (**A7**, **A8**, **B5**, **B10**, **C1**, **D2**, **E3**, **F9**, **G4**, and **H6**) was performed on a HPLC-MS with a DAD detector and a single quadrupole mass spectrometer (Agilent 6130 series) with an ESI probe. Analytical method, unless indicated: eluents: A: H₂O (0.1%, HCOOH), B: ACN (0.1% HCOOH), gradient from 5 to 95% B in 10 min; C₁₈ (2) Luna column (4.6 x 50 mm², 5 μ m particle size). ¹H-NMR (300 MHz) and ¹³C-NMR (75 MHz) spectra were recorded on Bruker Advance NMR spectrometers, and chemical shifts are expressed in parts per million (ppm). UV absorption was recorded on Genesys 10 UV (Thermo Electron Corporation). High resolution mass spectrometry (HRMS) data was recorded on a Micromass VG 7035 (Mass Spectrometry Laboratory at National University of Singapore (NUS)).

2-(1',2':3',4'-di-O-isopropylidene-D-galactopyranose-6-O-yl)-4,6-dichloro-[1,3,5]triazine(2)

To a stirred solution of 2,4,6-trichloro-1,3,5-triazine (**1**, 1.9 g, 10.3 mmol) and crushed sodium hydroxide (0.5 g, 12.5 mmol) in anhydrous benzene (20 mL), was added 1,2:3,4-di-O-isopropylidene-D-galactopyranose (2.6 g, 10.0 mmol) in benzene (10 mL) over 1hr. The reaction was allowed to stir at room temperature overnight. After reaction, the solvent was evaporated under reduced pressure and the residue was dissolved in DCM and filtered. The filtrate was concentrated and subjected to column chromatography (ethyl acetate : hexanes = 1:4) to yield 3.8g title compound as a clear oil (95.5% yields). Other reaction conditions with different bases (Et₃N, DIPEA, DBU, K₂CO₃, NaH) in different solvents (THF, DCM, DMF, Pyridine) were also tested, yielding either no product or only trace amount of product. ¹H-NMR (400MHz, CDCl₃): δ = 5.54(d, 1H, J= 5.2 Hz), 4.67 (m, 1H), 4.64(d, 1H, J= 7.2 Hz), 4.58(m, 1H), 4.36(m, 1H), 4.33(m, 1H), 4.22(m, 1H), 1.52(s, 3H), 1.47(s, 3H), 1.34(d, 6H). ¹³C-NMR (100MHz) δ = 172.8, 171.1, 110.0, 109.1, 96.4, 70.8, 70.6, 68.7, 65.5, 26.3, 26.2, 25.1, 24.7. HRMS (m/z): [M+H]⁺ calcd. for C₁₅H₂₀Cl₂N₃O₆: 408.0729, found 408.0762.

HPLC chromatogram of **2** (5-95% CH₃CN-H₂O) over 15 min.



R₁-amines on solid support (4)

To a suspension of PAL-aldehyde resin (100 mg, 0.11 mmol) in anhydrous THF (3 mL, with 2% acetic acid), was added the desired R₁ amine (0.55 mmol, 5 equiv). After shaking at room temperature for 1 hr, sodium triacetoxyborohydride (160 mg, 0.75 mmol, 7 equiv) was added. The reaction mixture was shaken at room temperature for 12 hrs and filtered. The resin was washed with DMF (5 times), alternatively with dichloromethane and methanol (5 times), and finally dichloromethane (5 times), before dried in vacuum.

2-amino-4-(1',2':3',4'-di-O-isopropylidene-D-galactopyranose-6-O-yl)-6-chloro-[1,3,5]triazine on solid support (5)

To a suspension of R₁-amine resin **4** (0.11 mmol) in DIPEA (0.6 mL, 6.25 mmol) and anhydrous THF (3 mL) was added compound **2** (225 mg, 0.55 mmol) at room temperature. The reaction mixture was then heated at 65 °C for 3 hrs and filtered. The resin was washed with DMF (5 times), alternatively with dichloromethane and methanol (5 times), and finally dichloromethane (5 times), before dried in vacuum.

2-amino-4-amino-6-(1',2':3',4'-di-O-isopropylidene-D-galactopyranose-6-O-yl)-[1,3,5]triazine on solid support (6)

To the suspension of resin **5** (10 mg, ~0.01mmol) in DIPEA (30 μ L, 0.3mmol) and N-Methyl-2-pyrrolidone(2 ml) was added the desired R₂ amine (0.05 mmol, 5 equiv) at room temperature. The reaction mixture was then heated at 125 °C for 3 hrs and filtered. The resin was washed with DMF (5 times), alternatively with dichloromethane and methanol (5 times), and finally dichloromethane (5 times), before dried in vacuum.

General procedure for cleavage final product from the resin (7)

To the resin **6** in a frit cartridge was added 10% TFA in dichloromethane (1 mL). The reaction was allowed for 5 mins at room temperature and filtered. The resin was washed with dichloromethane (0.5 mL) and the combined filtrate was dried on Speed-Vac immediately.

Table S1. Compound purity in the 1,3,5-triazine galactose library (%). ^{[a], [b]}

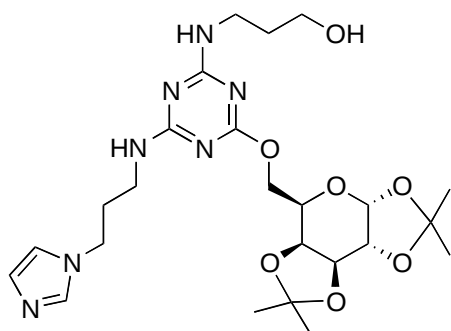
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B	99	94	92	95	95	89	92	97	94	96
C	95	96	95	96	98	98	86	93	90	81
D	90	95	94	95	95	95	89	96	90	91
E	89	96	92	94	94	83	94	97	87	93
F	93	96	95	97	89	90	90	97	90	92
G	86	93	92	93	94	92	96	96	82	90
H	90	87	82	90	95	93	82	92	75	84

[a] The rows and columns indicate the R₁ and R₂ amine building blocks.

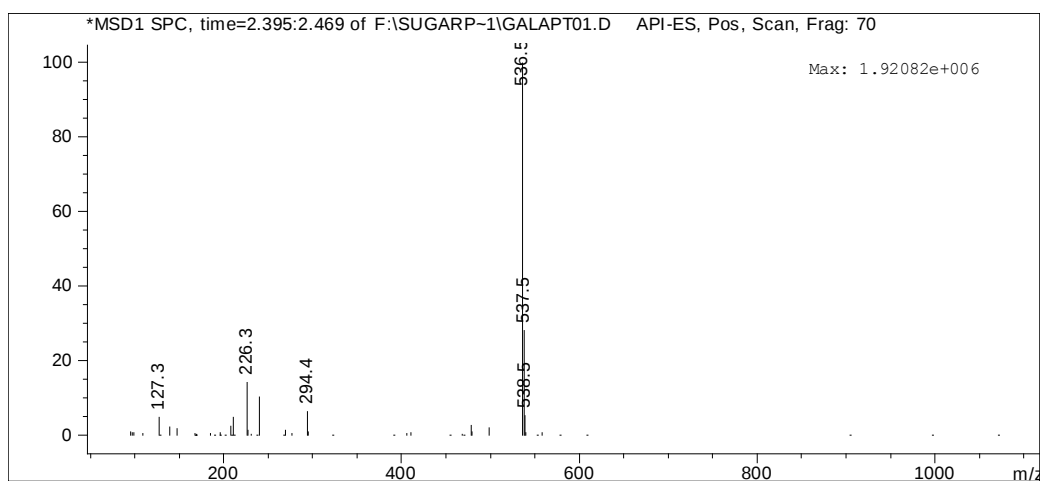
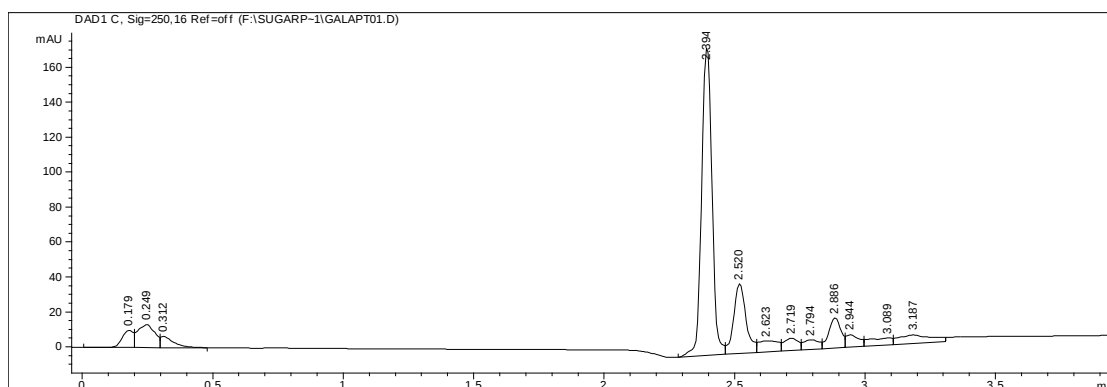
[b] Purities were determined by integration of HPLC absorbance peaks at 250 nm.

LC-MS spectra of the 80 final products in the library

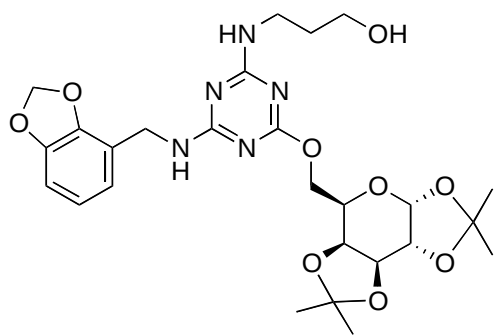
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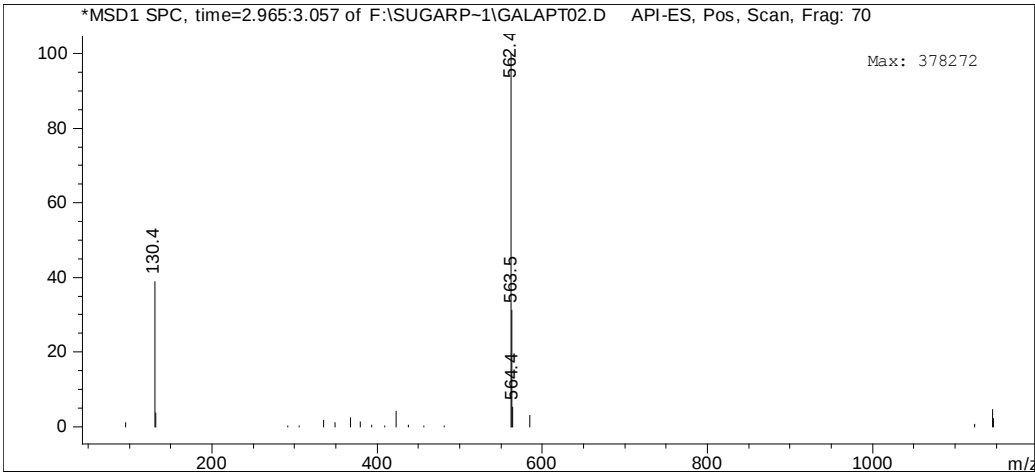
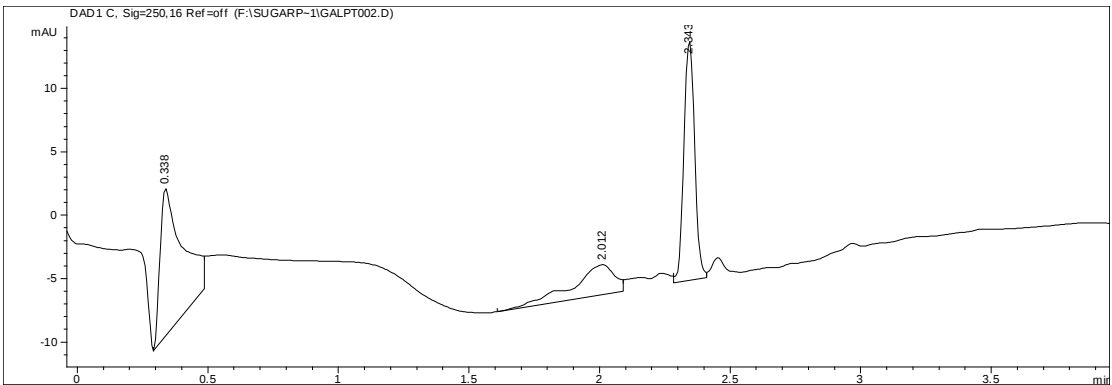
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Exact Mass: 535.28



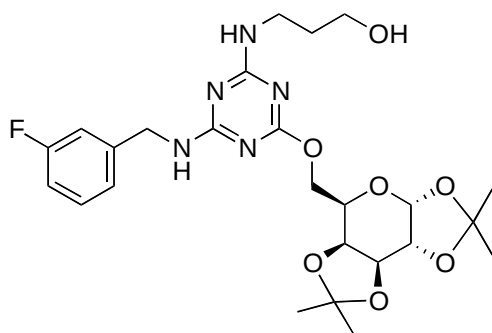
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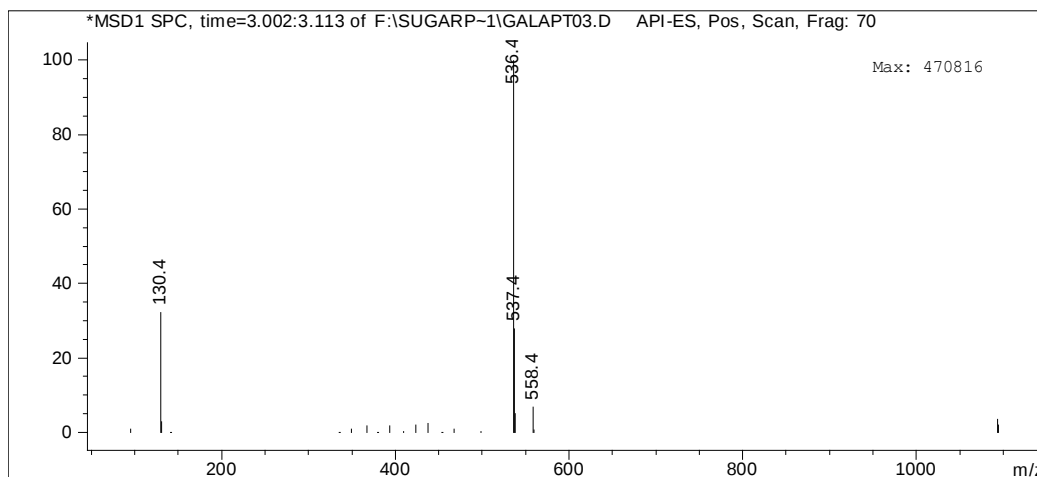
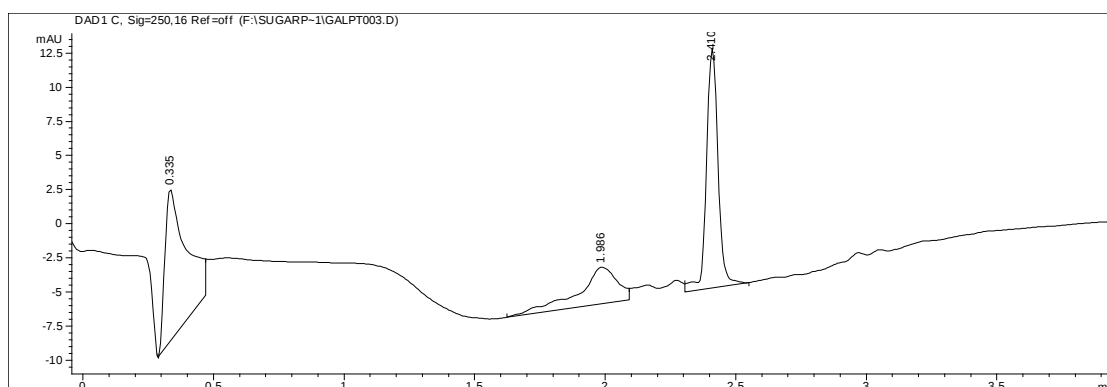
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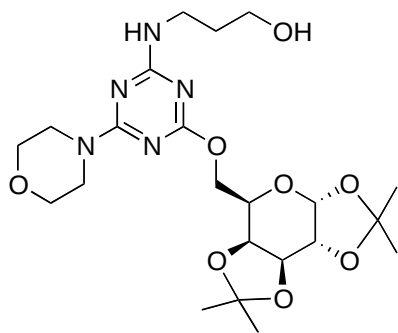
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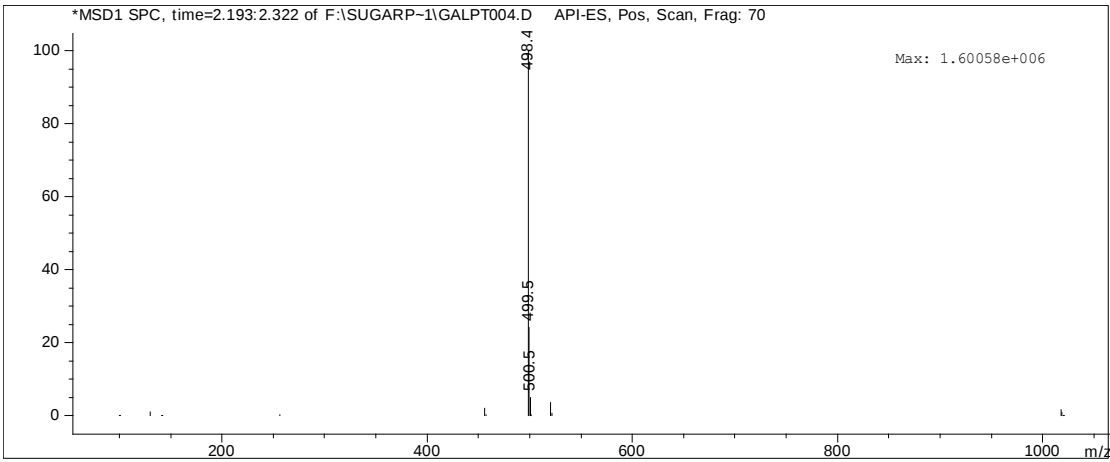
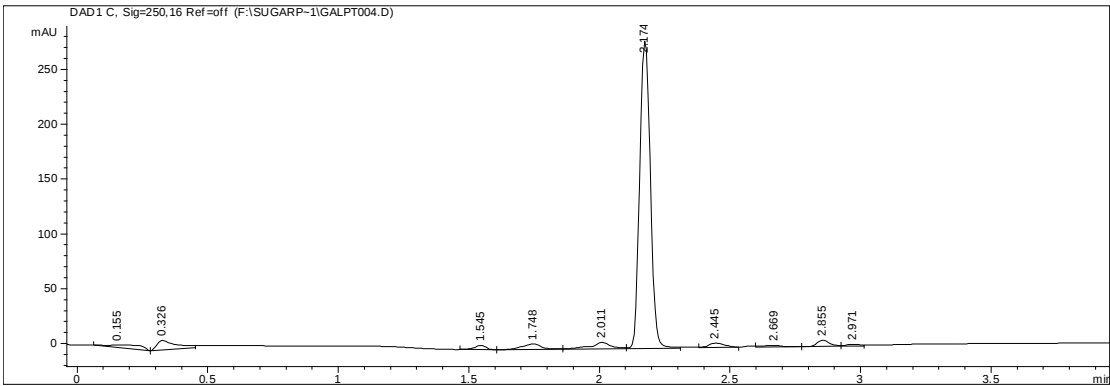
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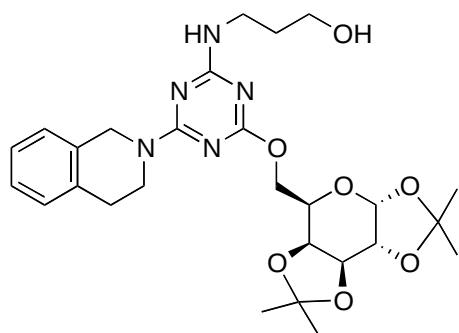
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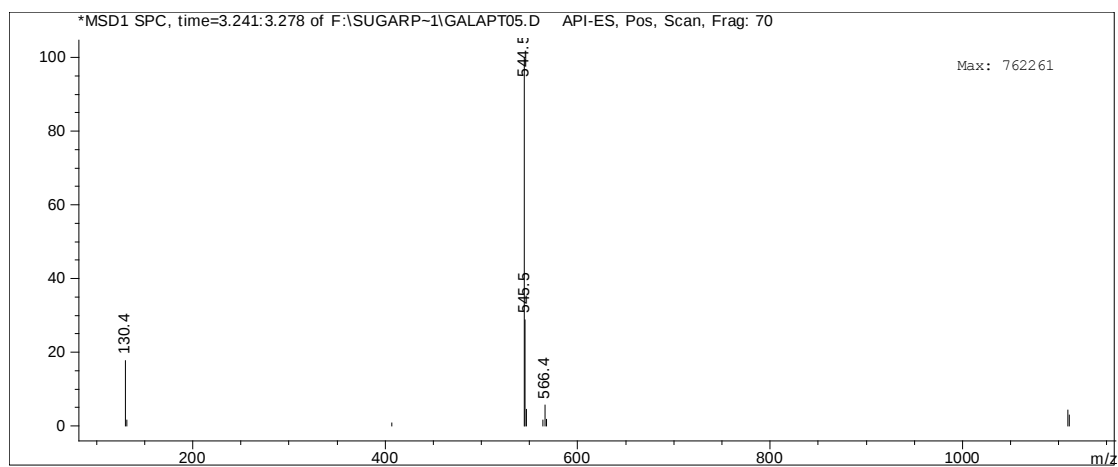
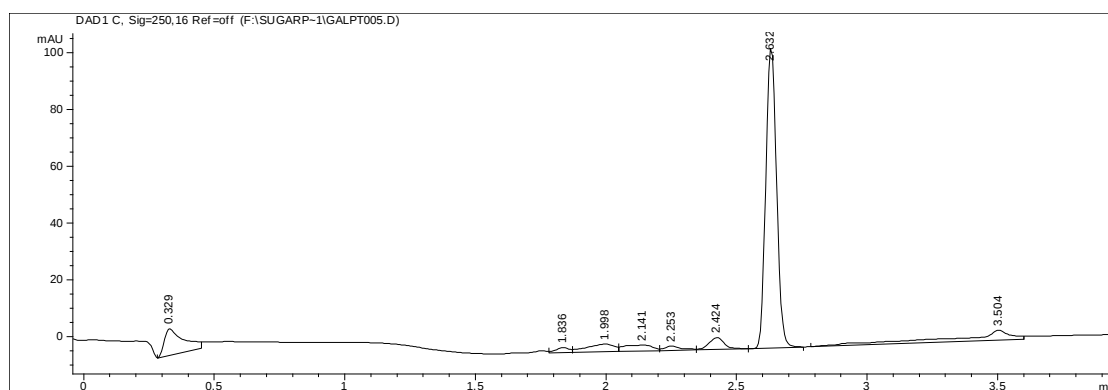
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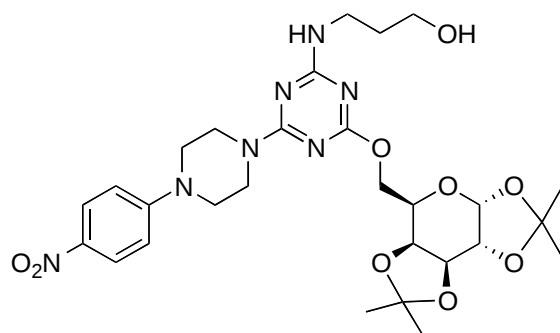
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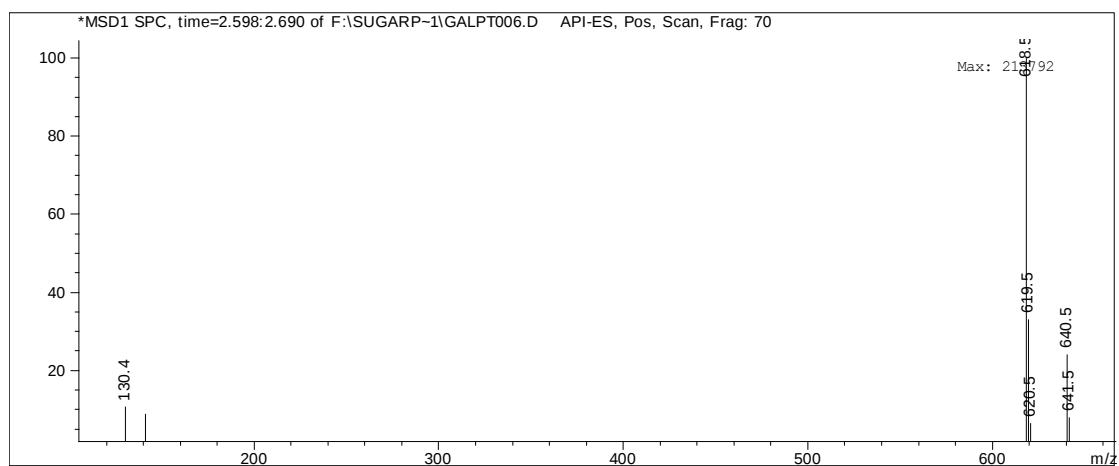
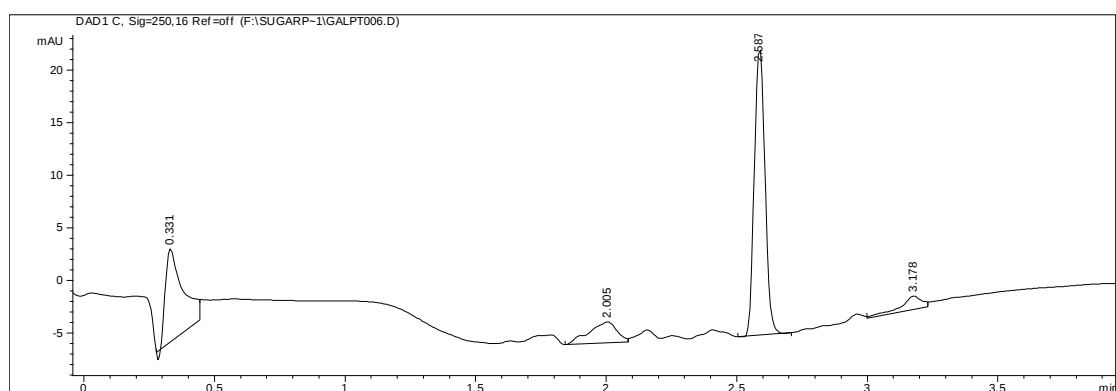
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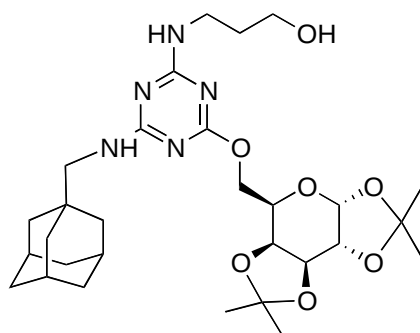
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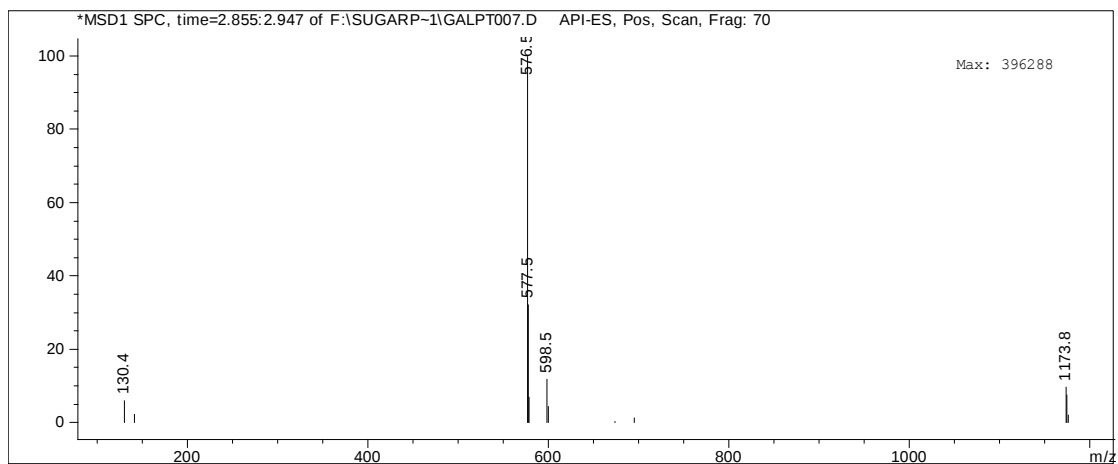
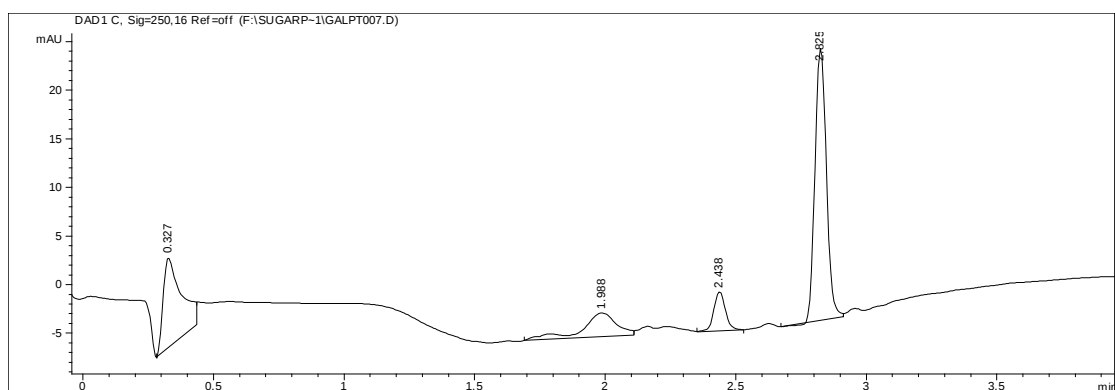
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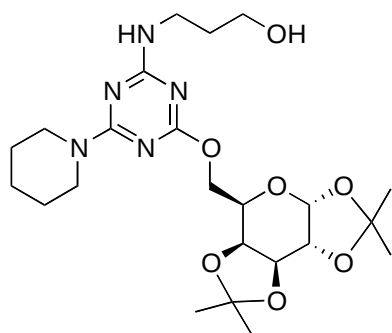
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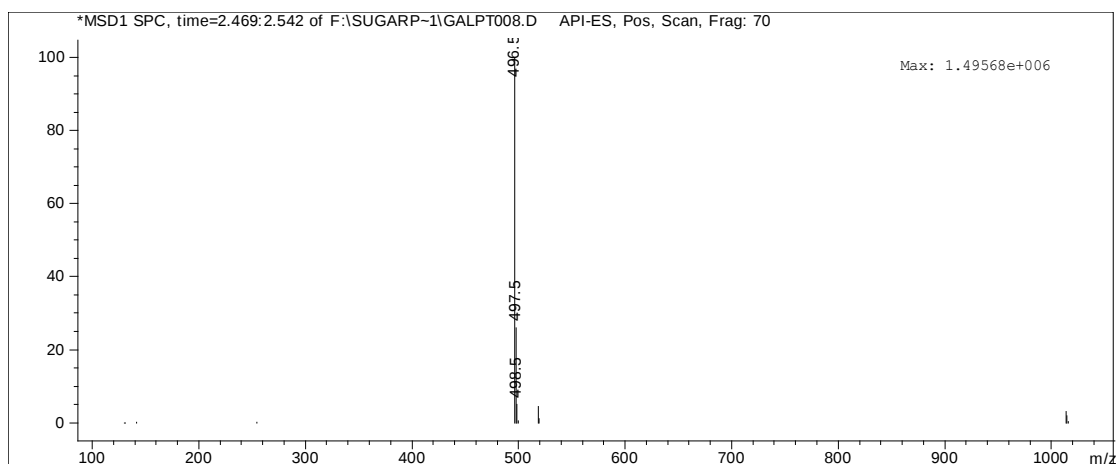
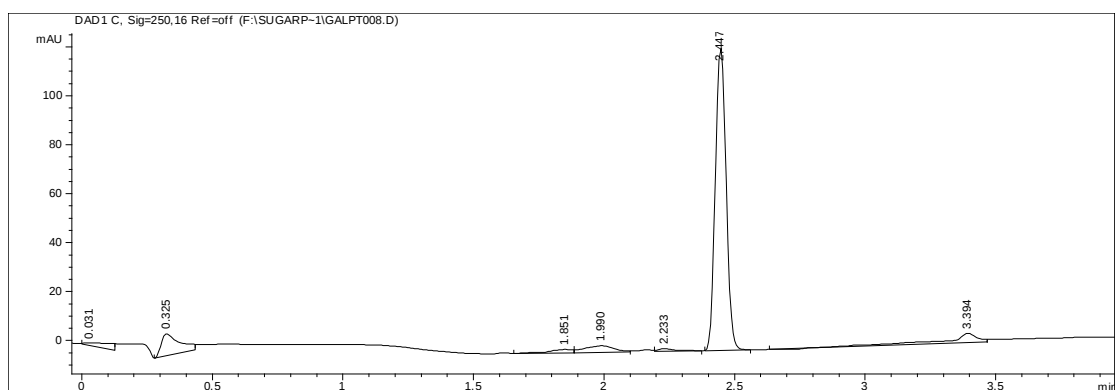
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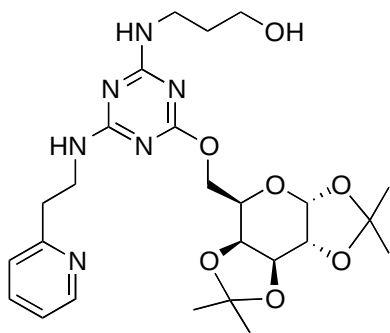
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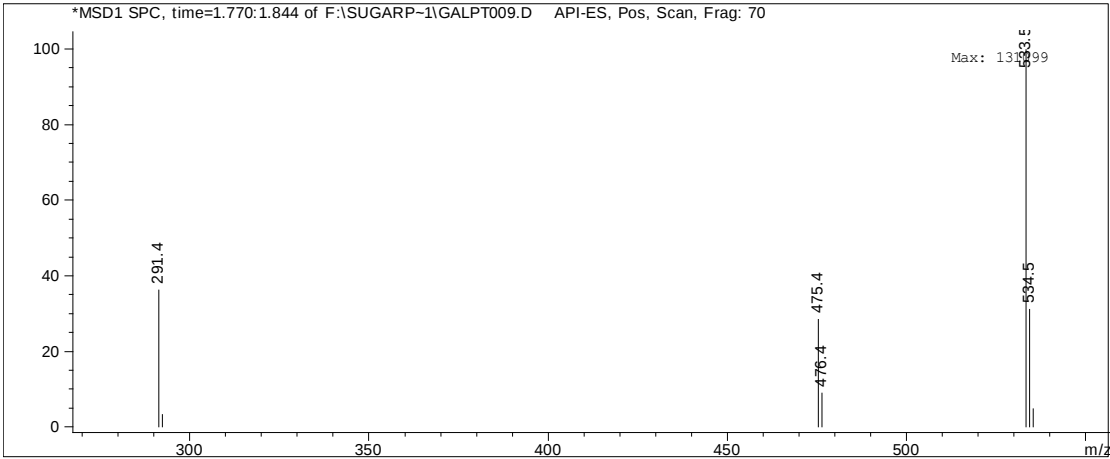
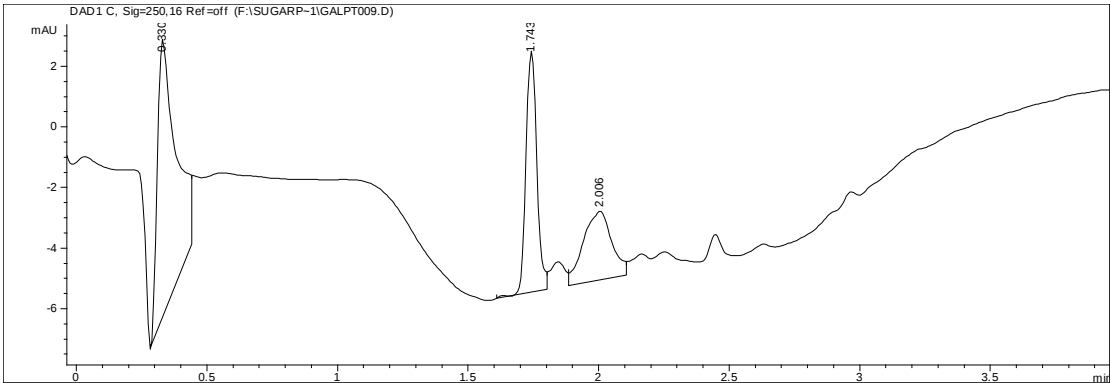
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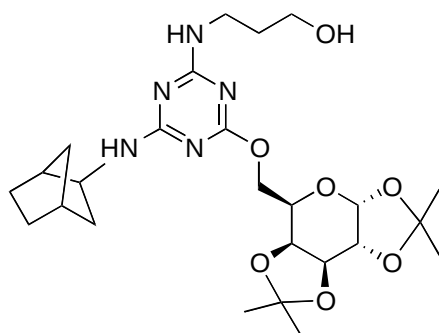
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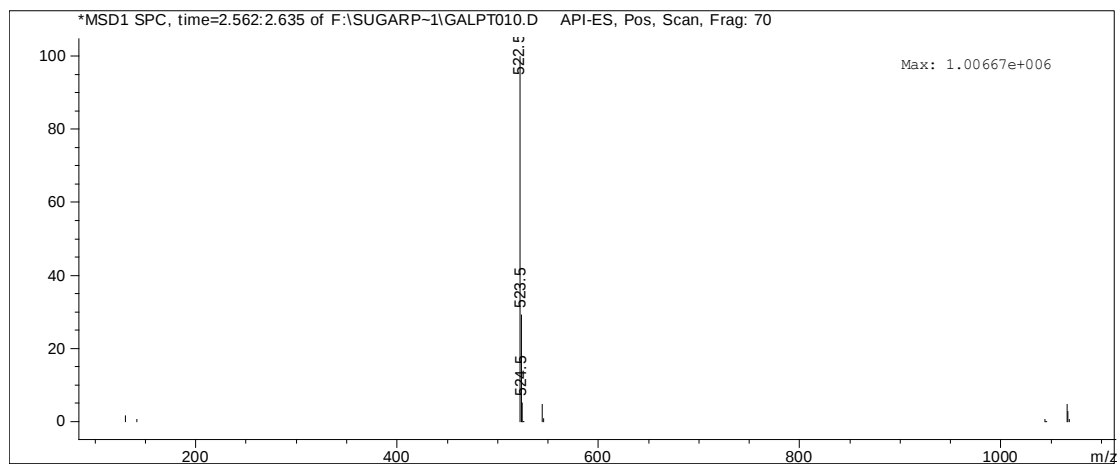
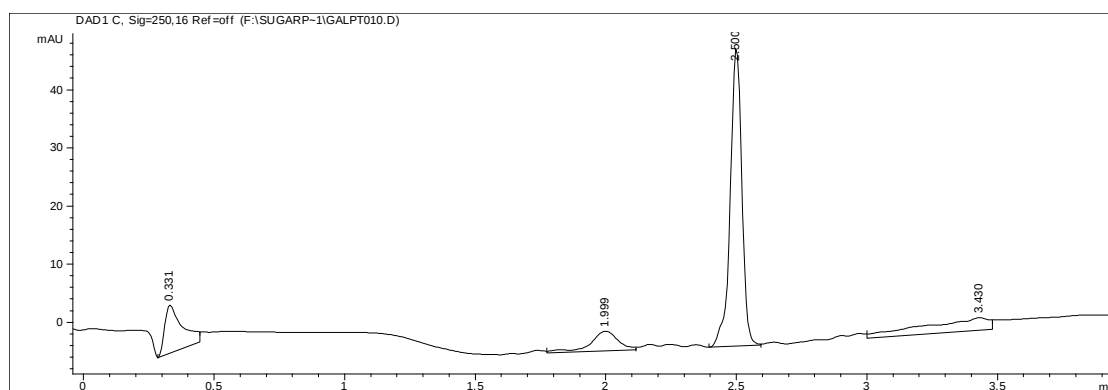
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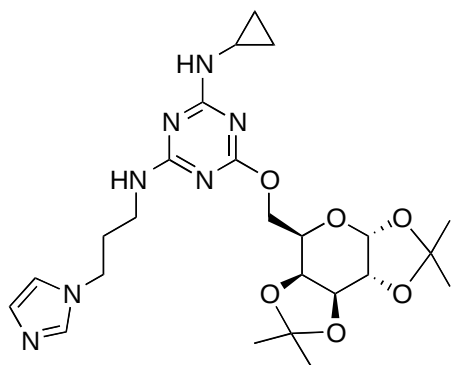
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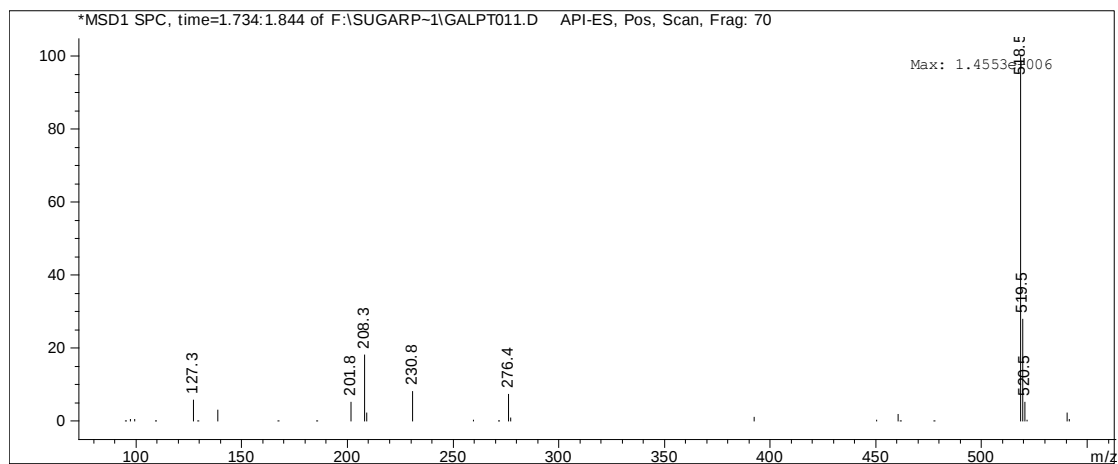
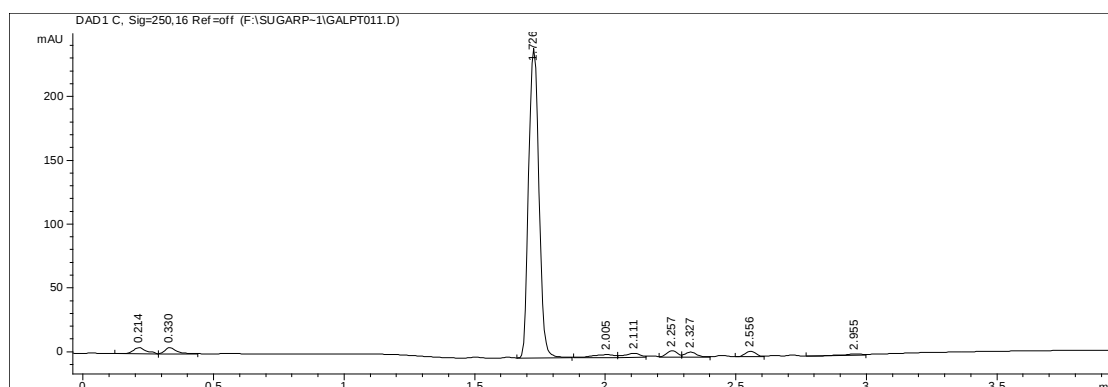
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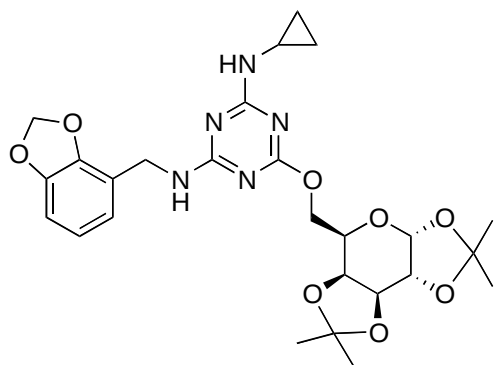
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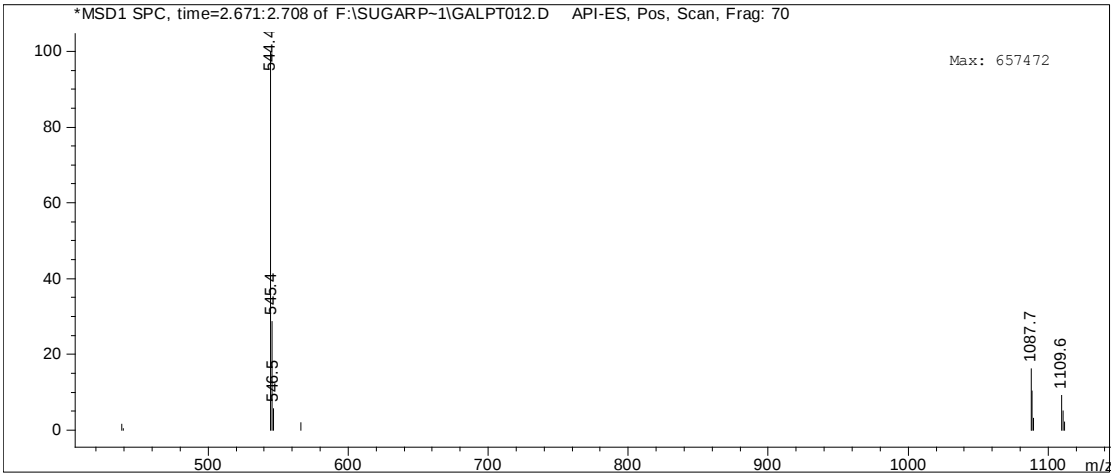
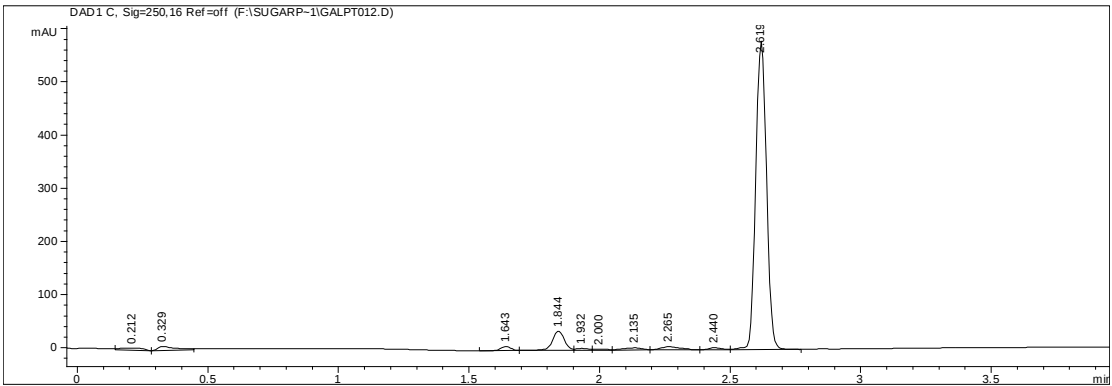
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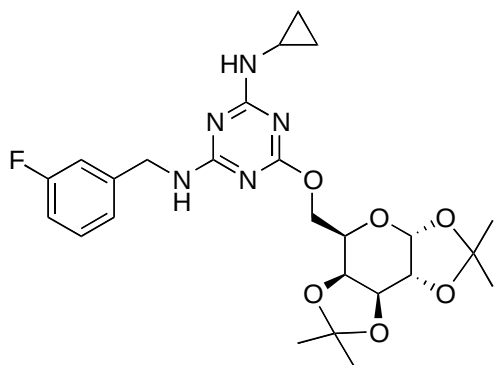
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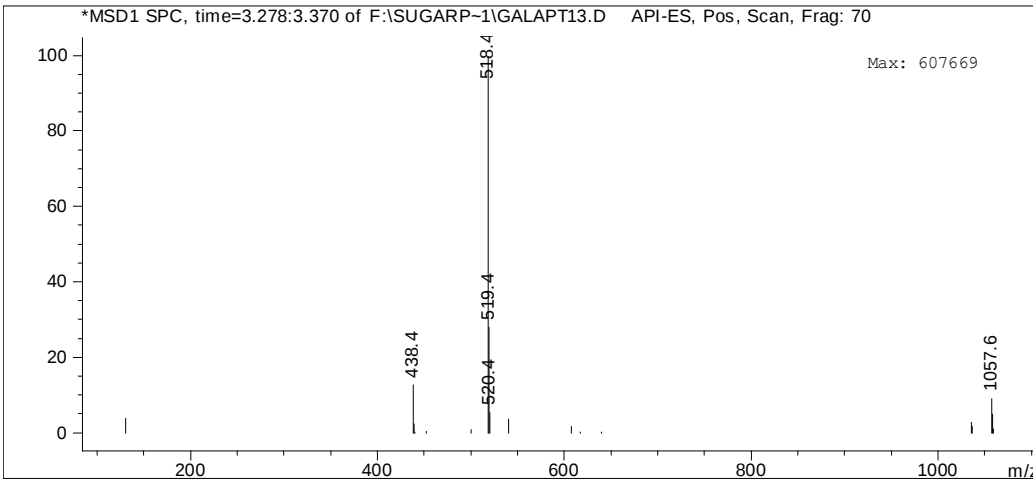
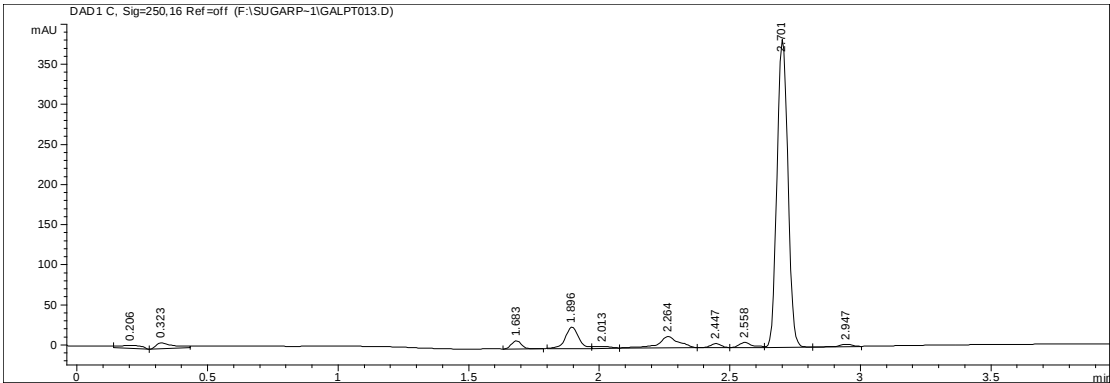
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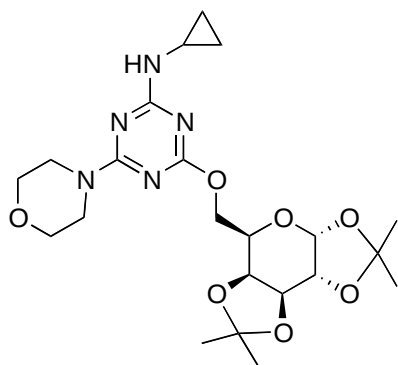
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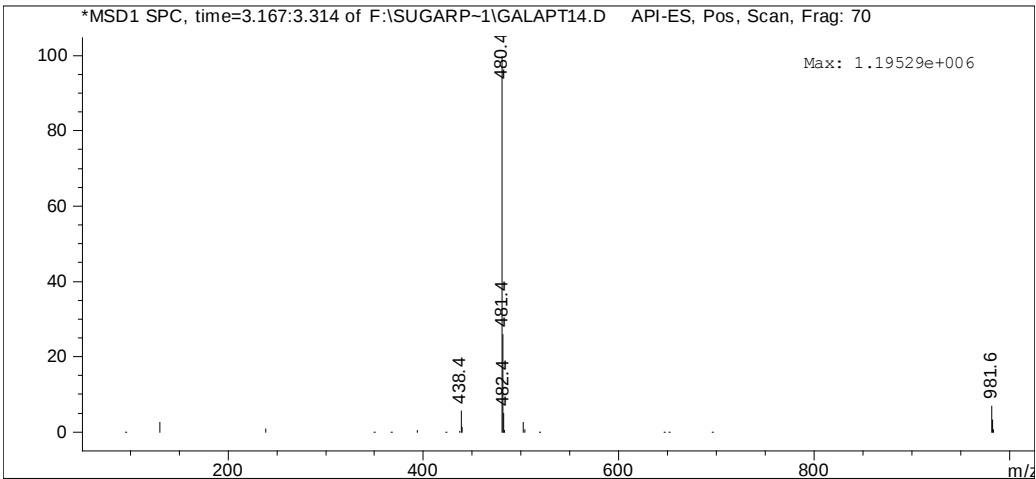
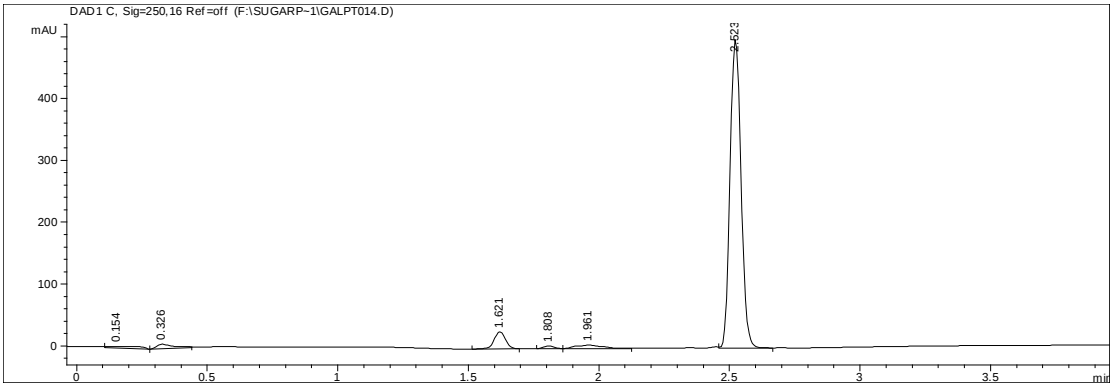
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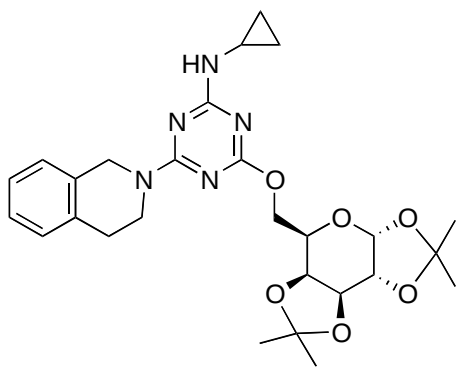
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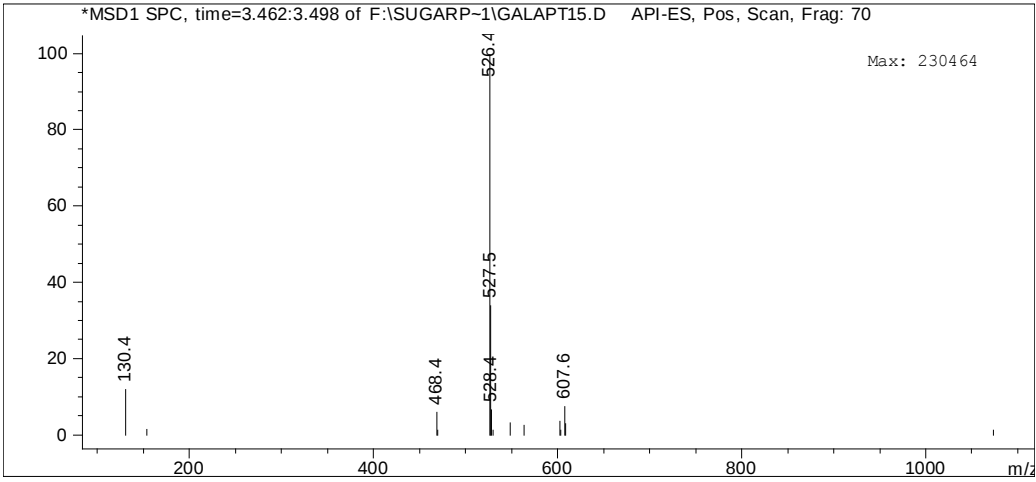
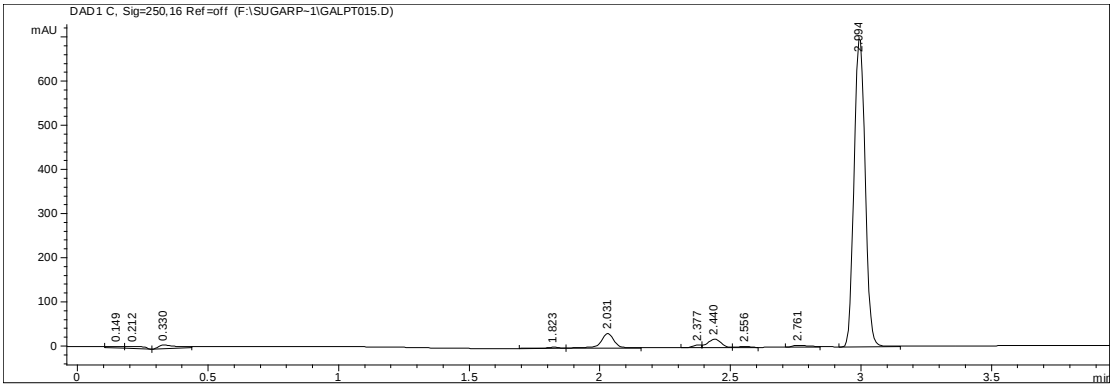
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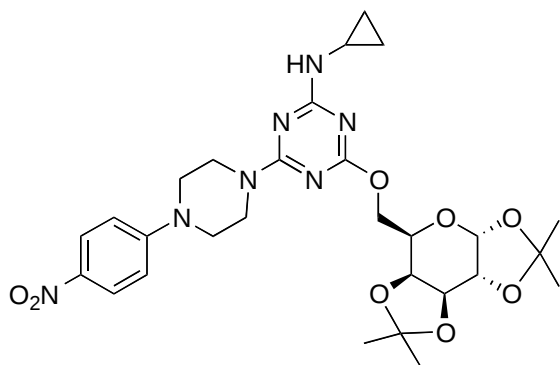
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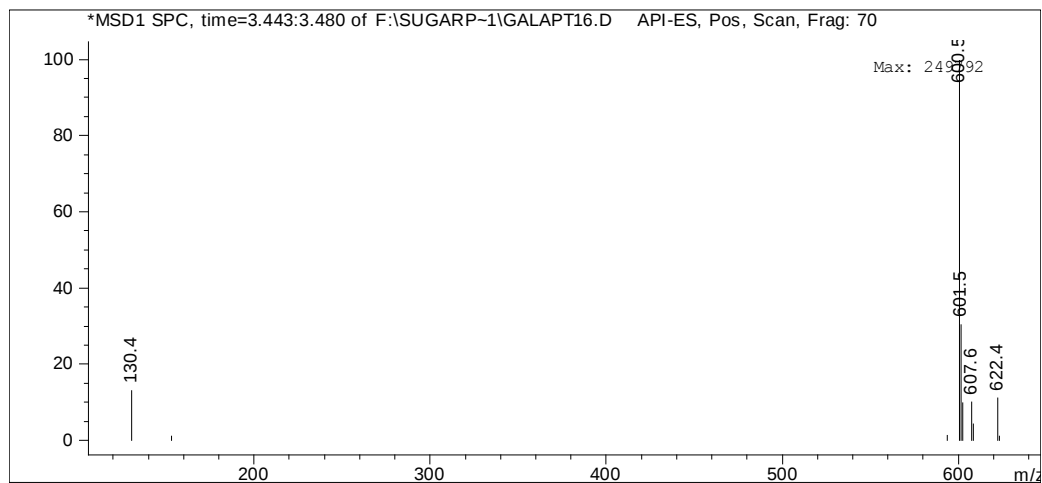
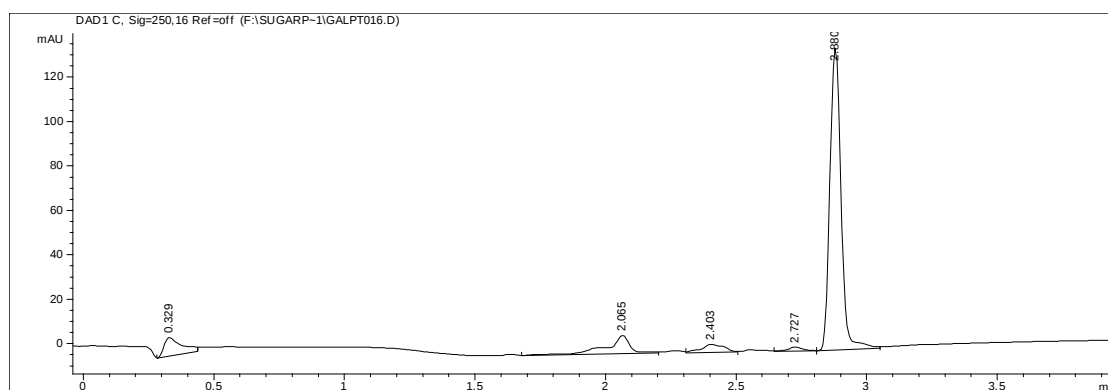
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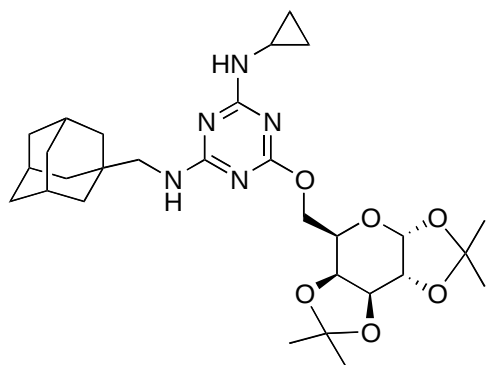
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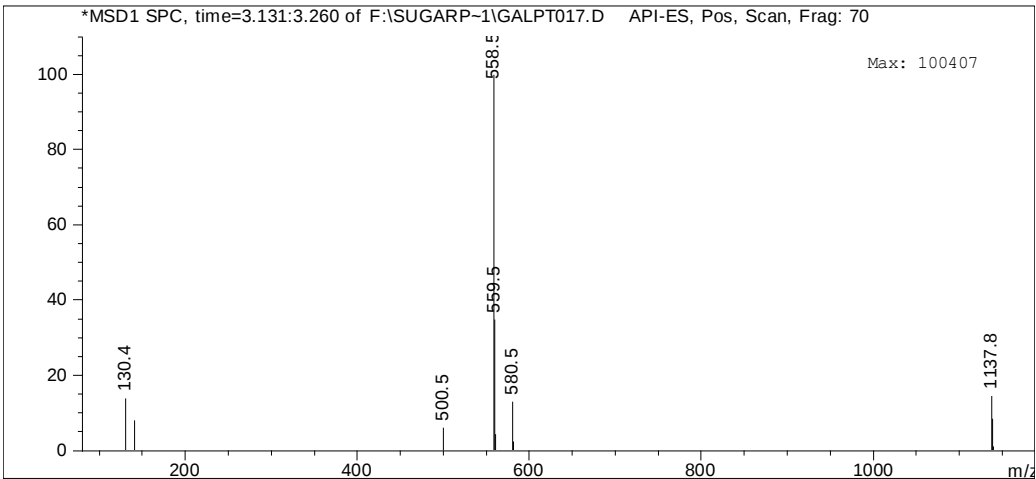
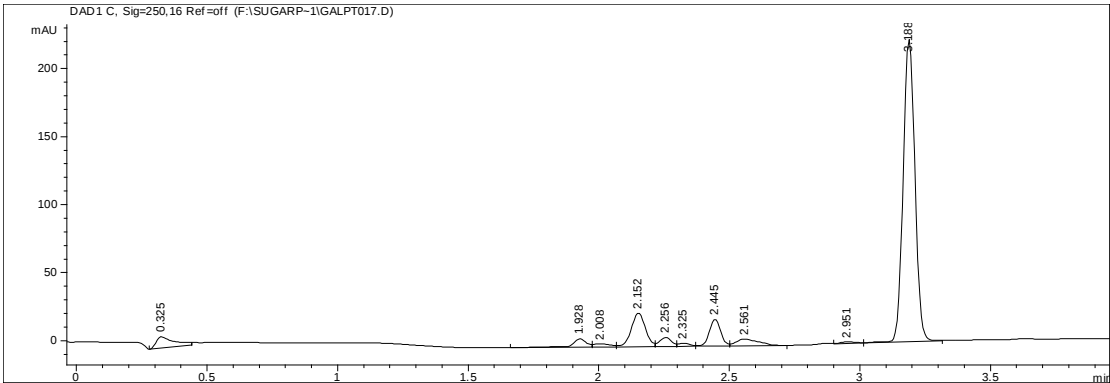
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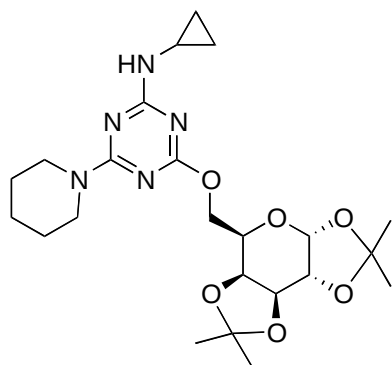
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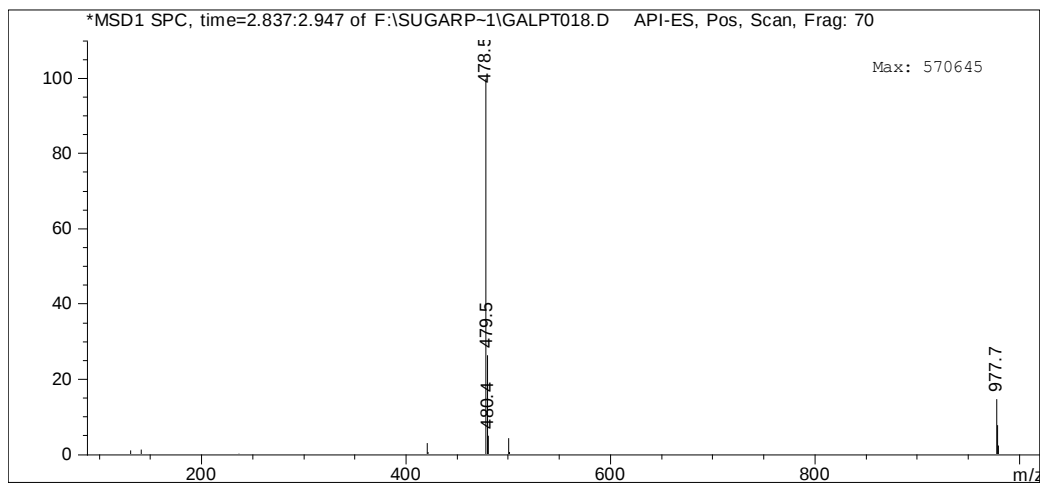
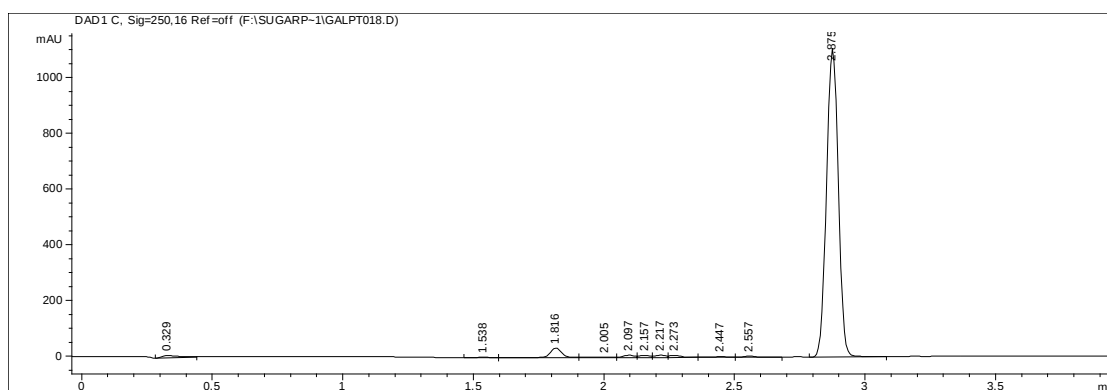
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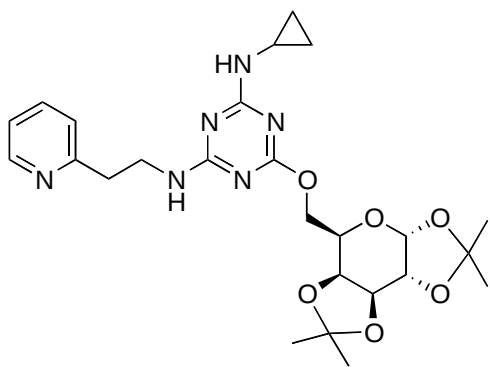
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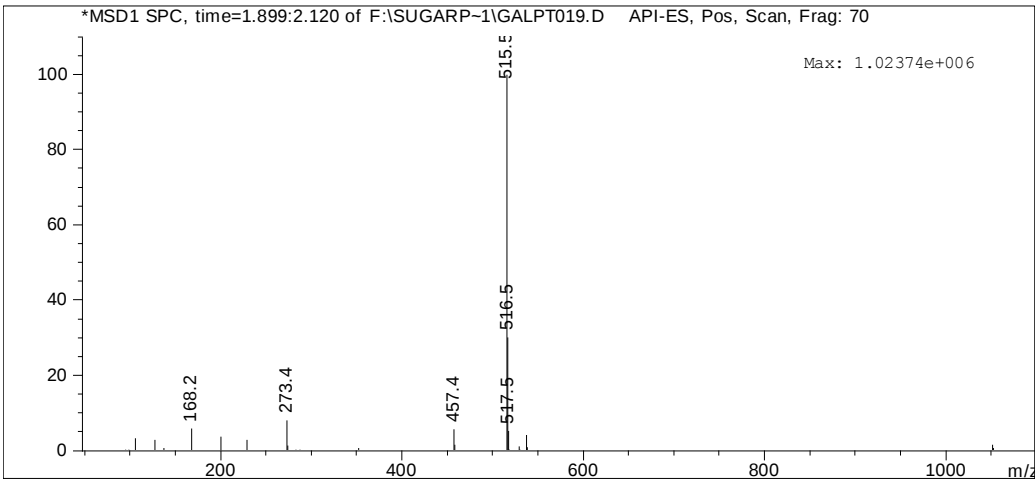
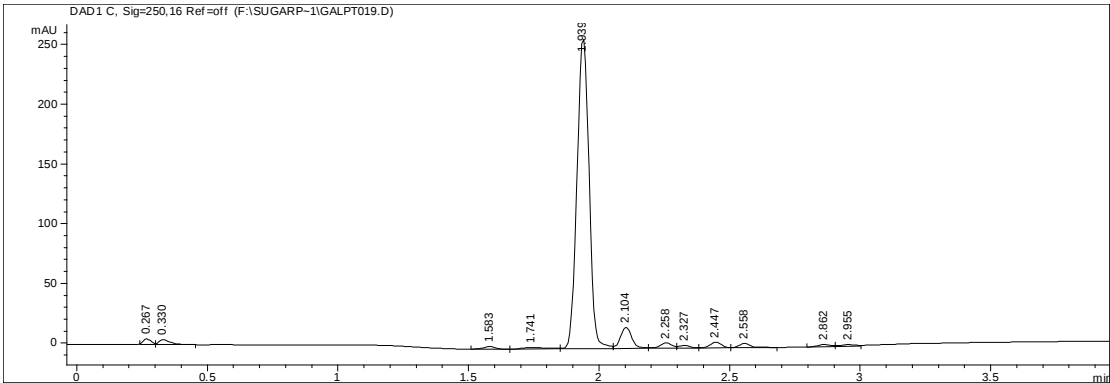
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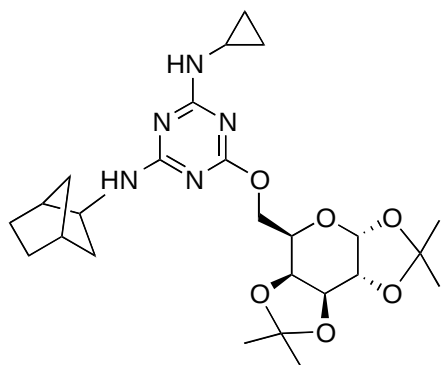
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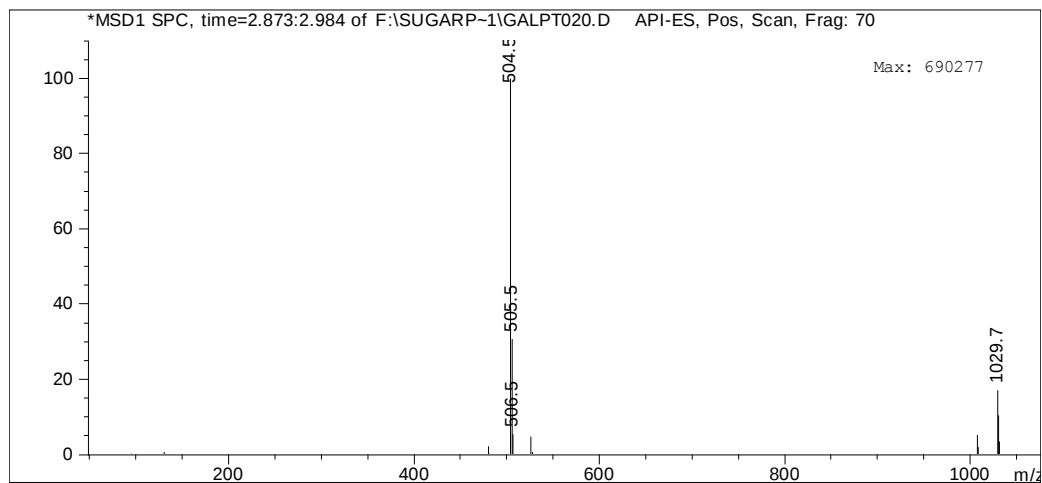
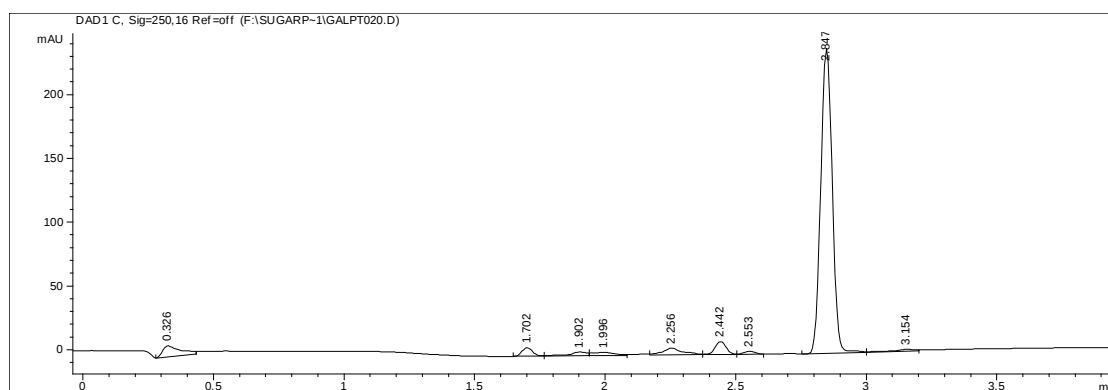
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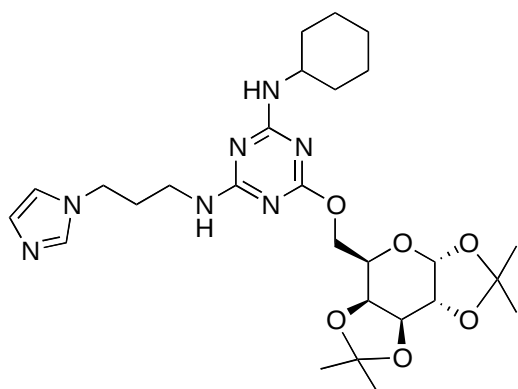
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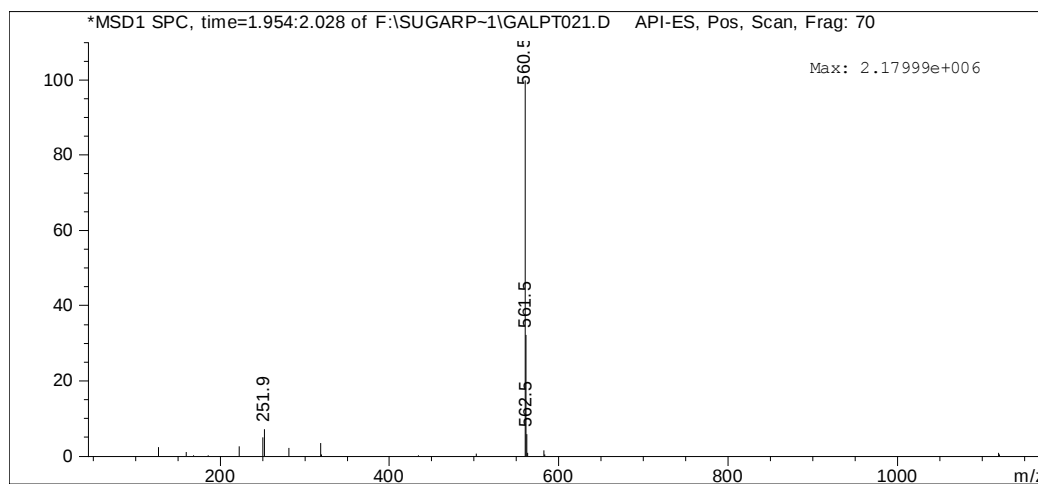
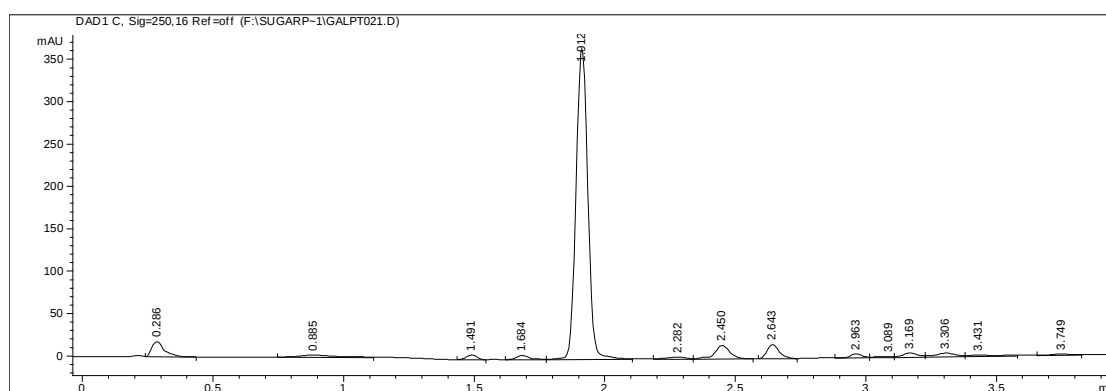
Chemical Formula: $C_{25}H_{37}N_5O_6$
Exact Mass: 503.27



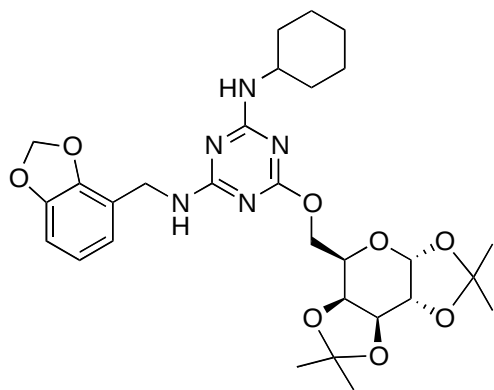
C1



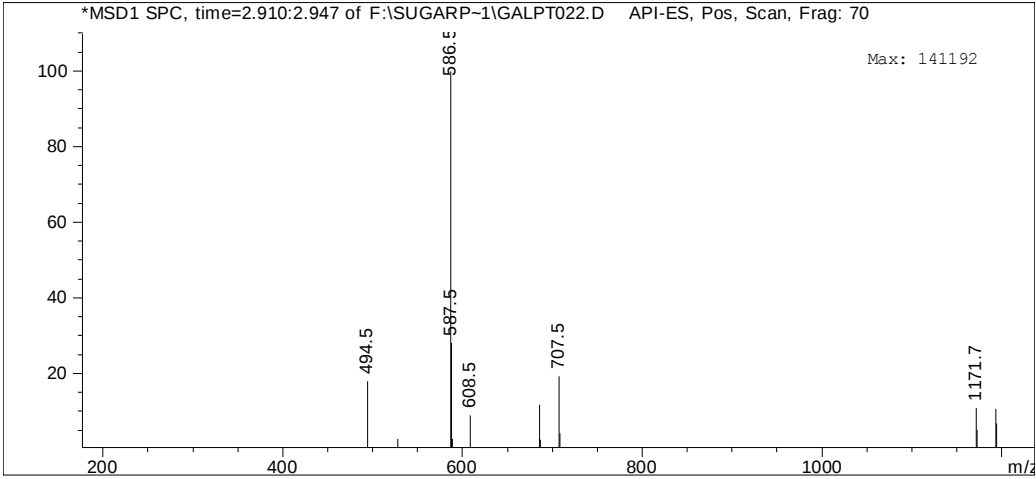
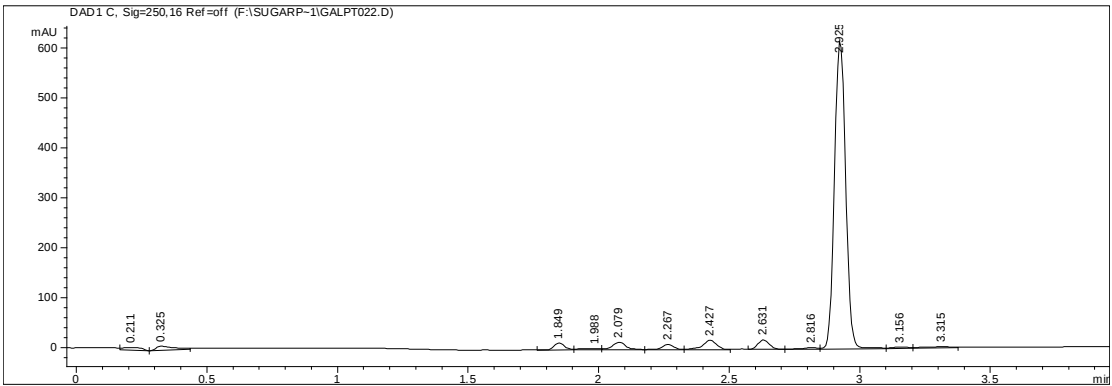
Chemical Formula: $C_{27}H_{41}N_7O_6$
Exact Mass: 559.31



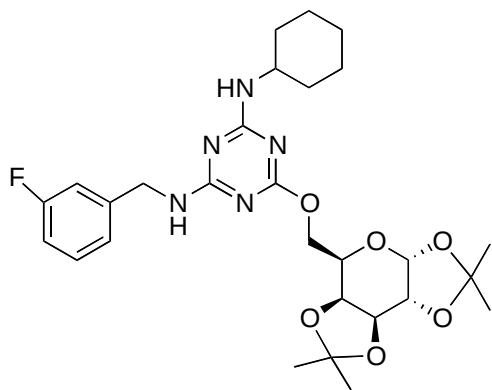
C2



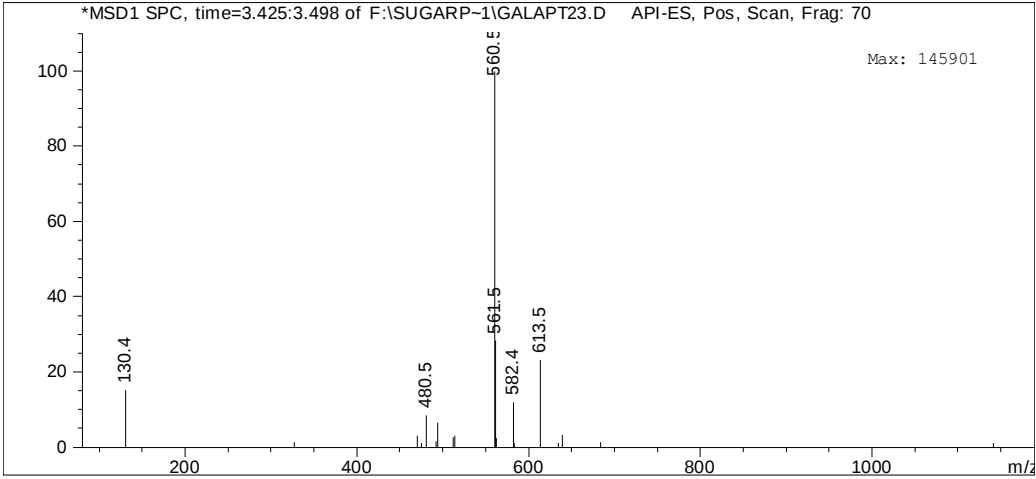
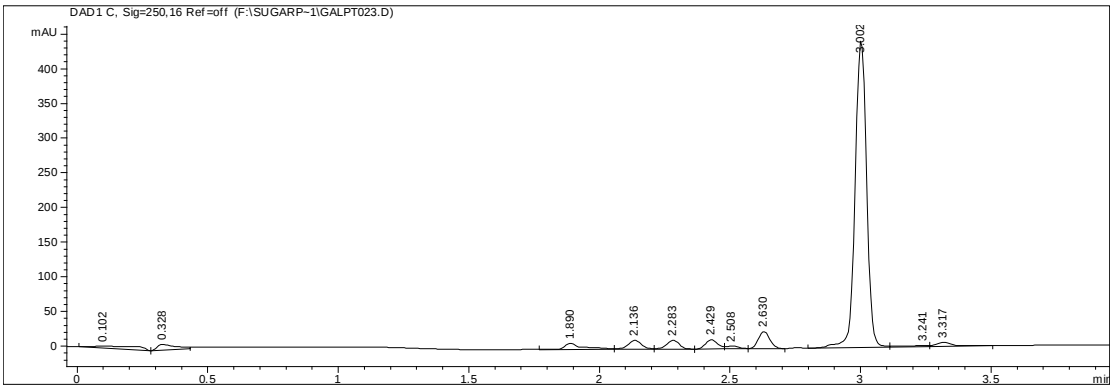
Chemical Formula: C₂₉H₃₉N₅O₈
Exact Mass: 585.28



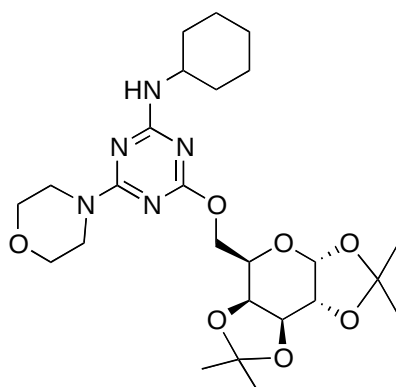
C3



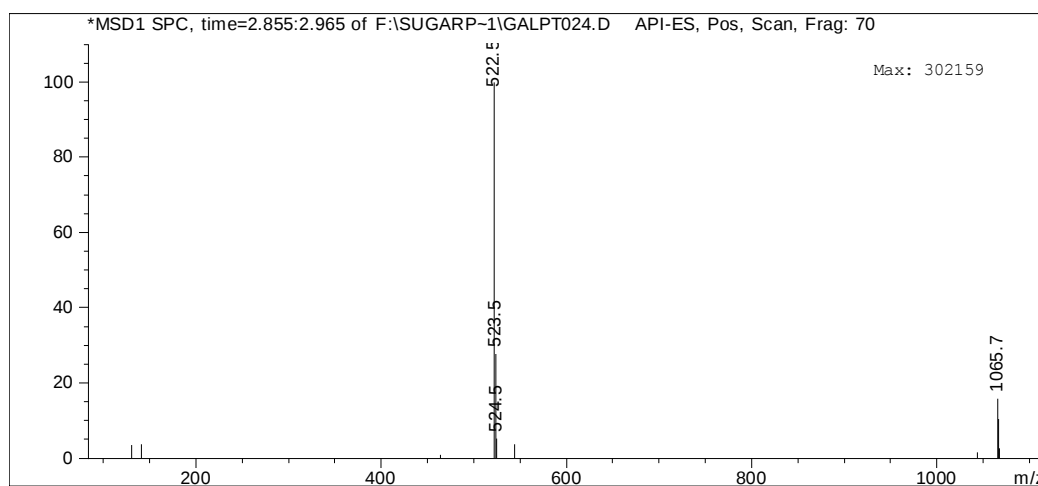
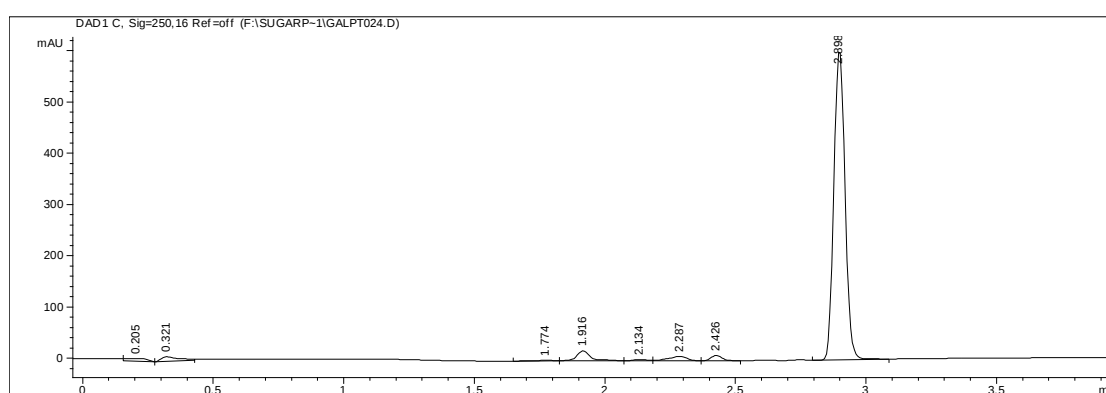
Chemical Formula: C₂₈H₃₈FN₅O₆
Exact Mass: 559.28



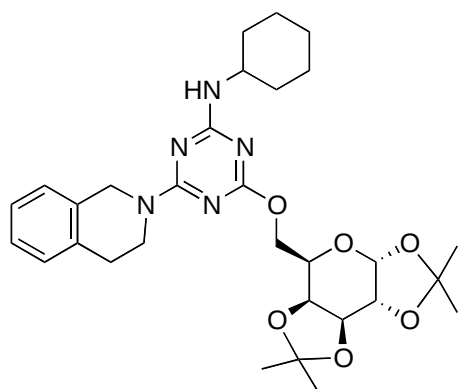
C4



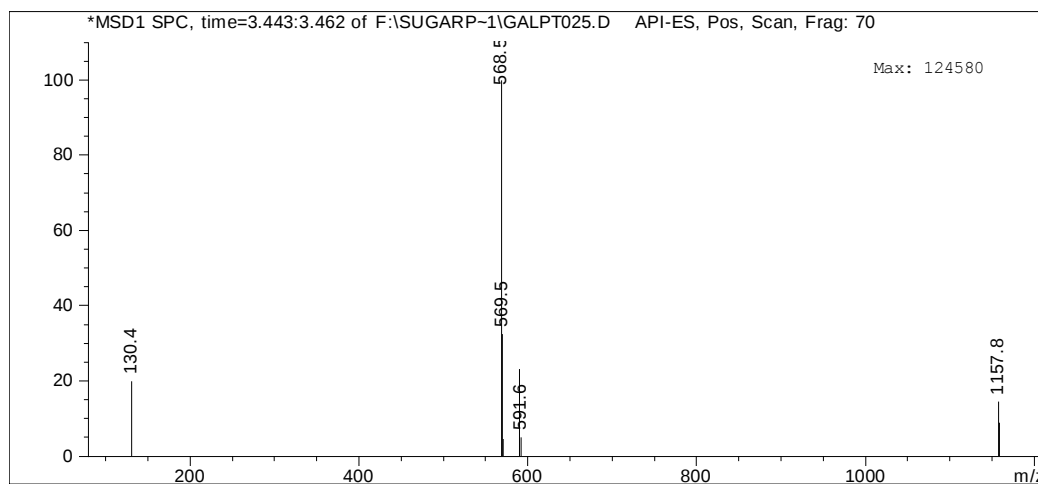
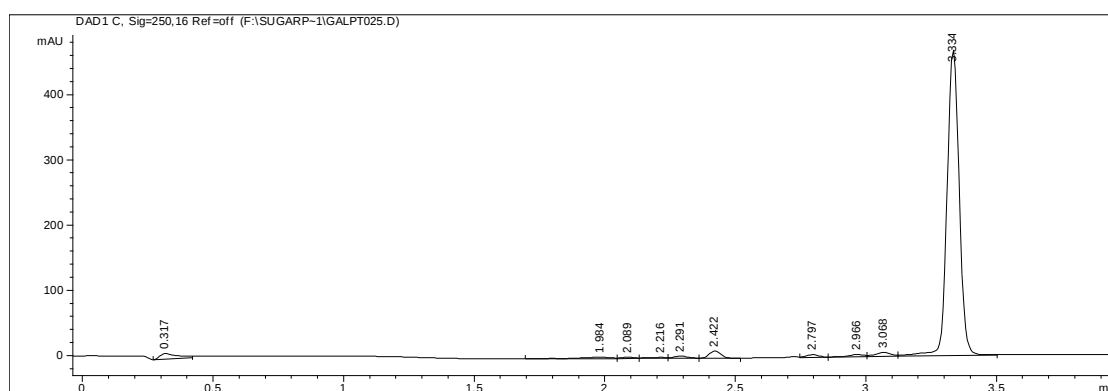
Chemical Formula: $C_{25}H_{39}N_5O_7$
Exact Mass: 521.28



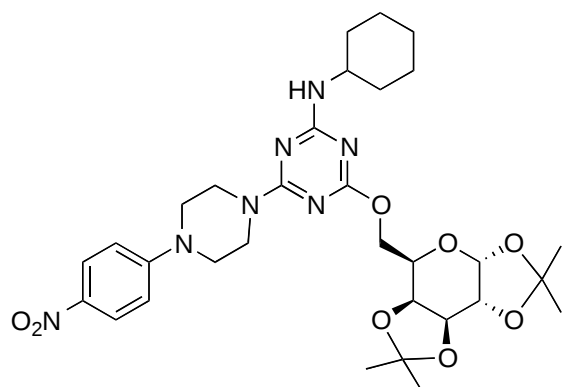
C5



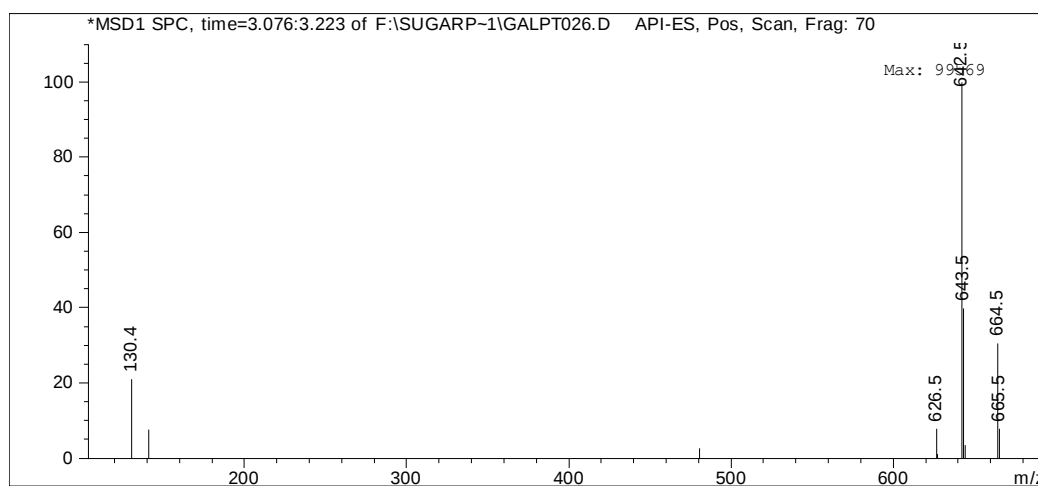
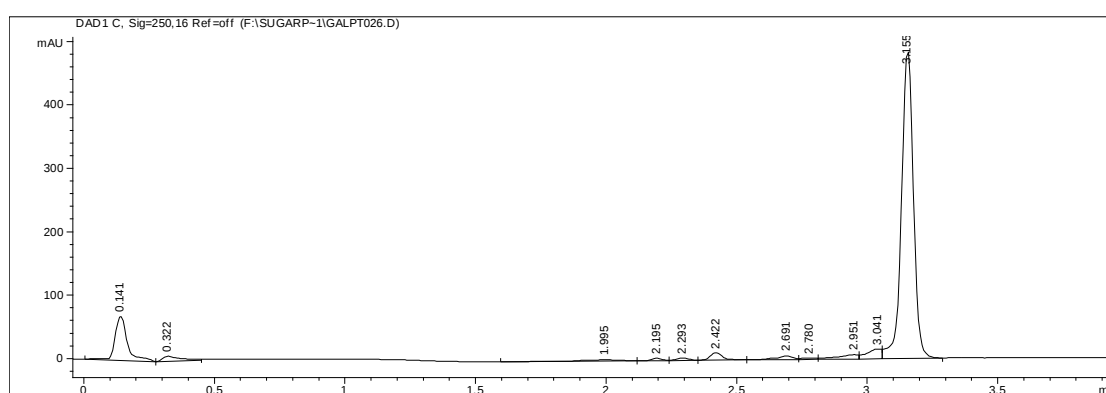
Chemical Formula: $C_{30}H_{41}N_5O_6$
Exact Mass: 567.31



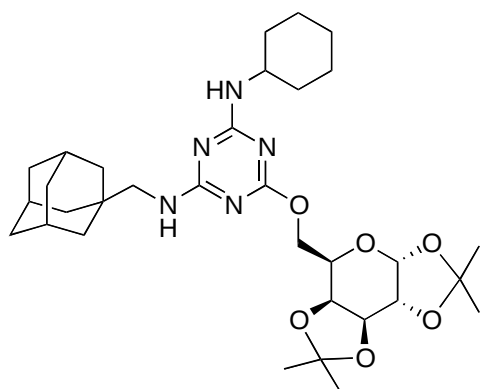
C6



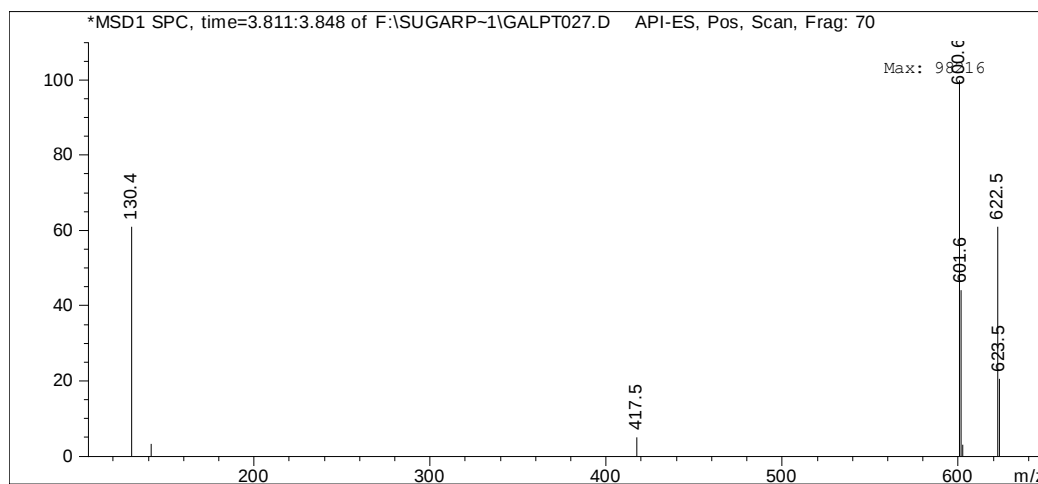
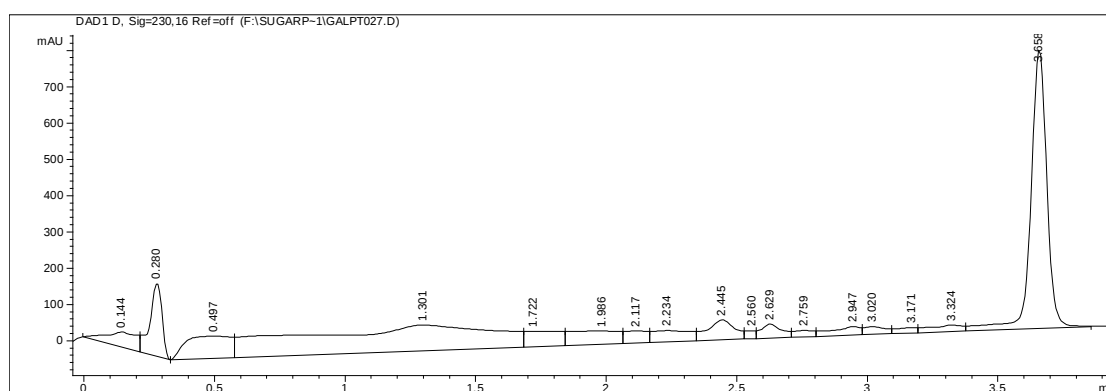
Chemical Formula: $C_{31}H_{43}N_7O_8$
Exact Mass: 641.32



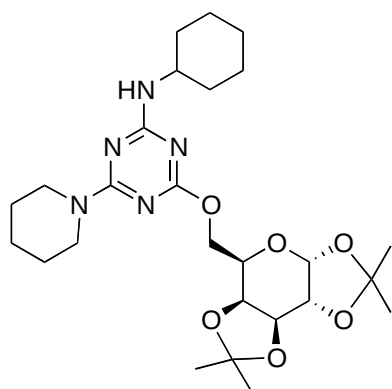
C7



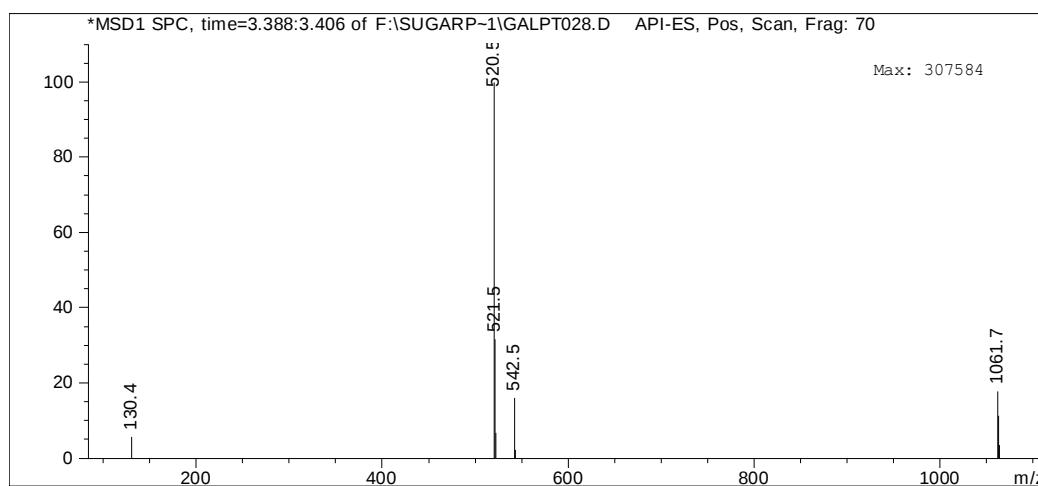
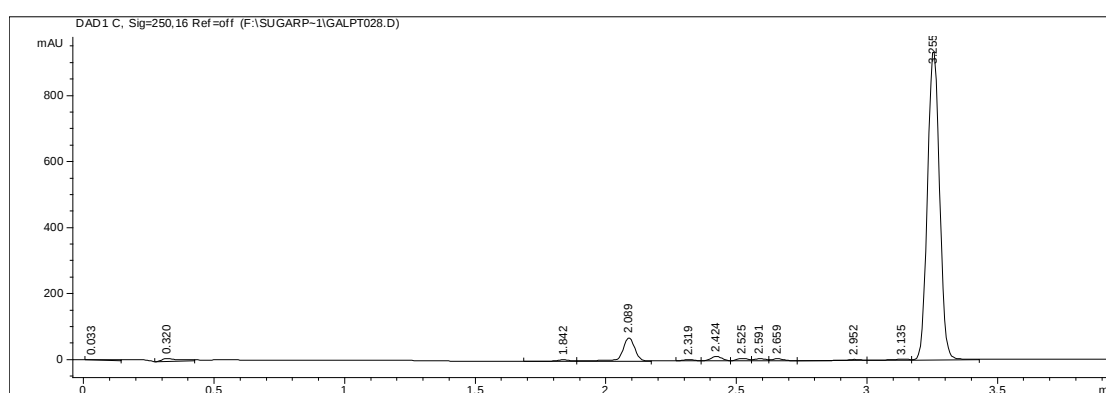
Chemical Formula: $C_{32}H_{49}N_5O_6$
Exact Mass: 599.37



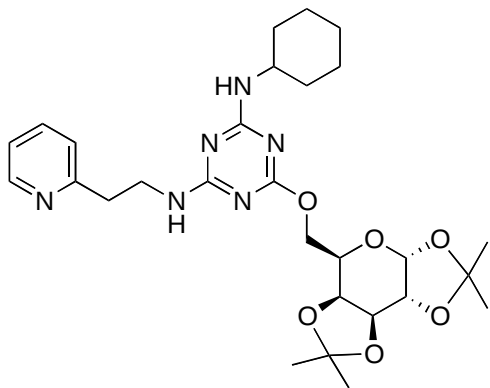
C8



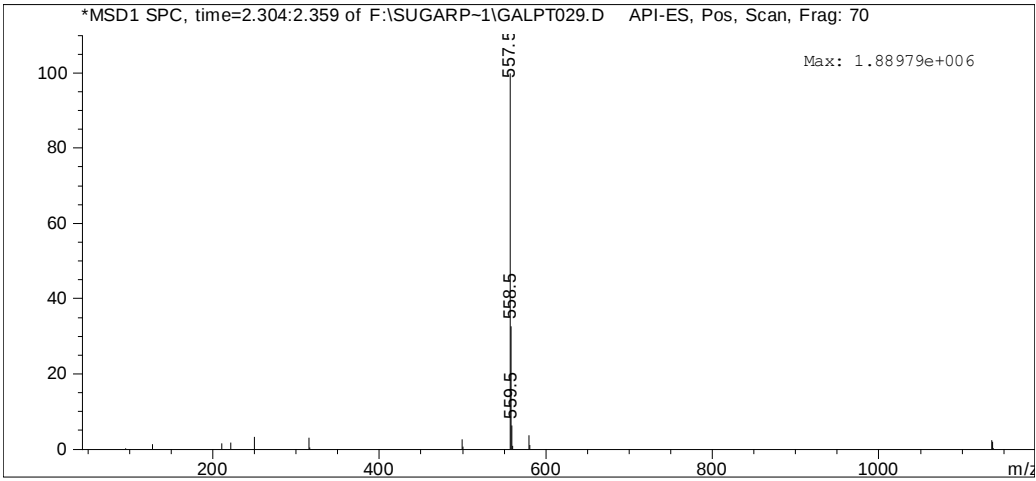
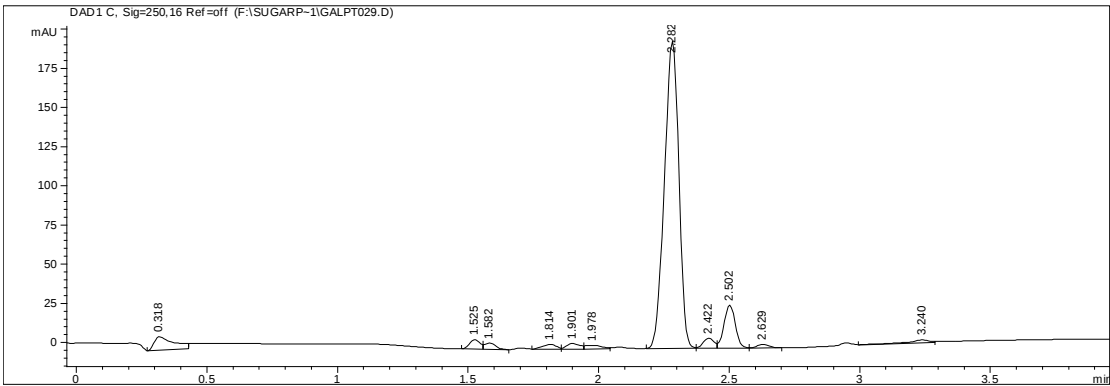
Chemical Formula: $C_{26}H_{41}N_5O_6$
Exact Mass: 519.31



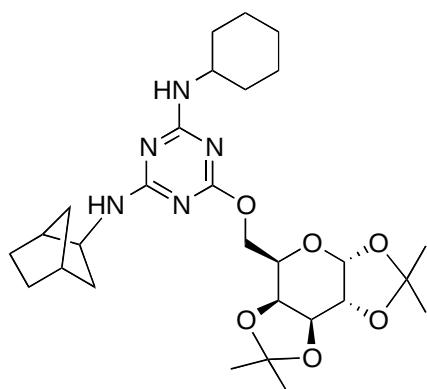
C9



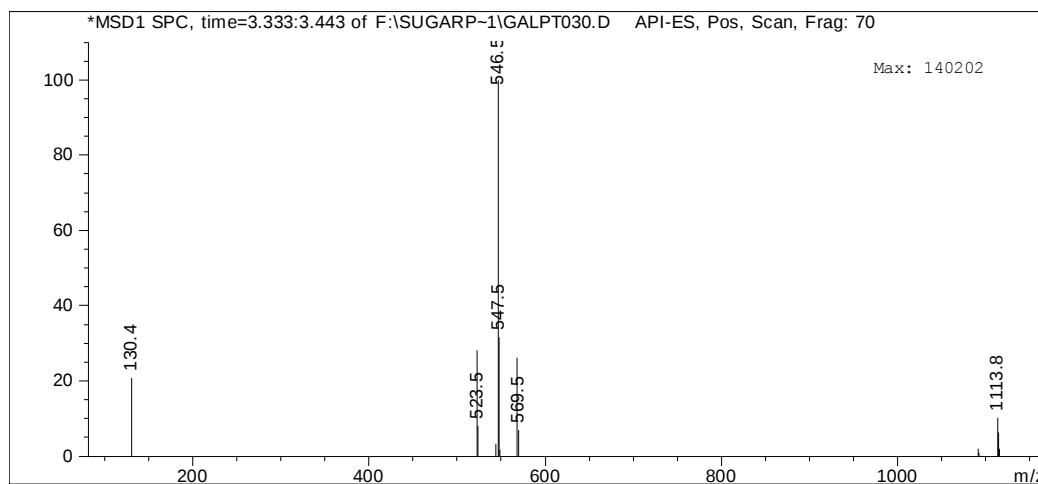
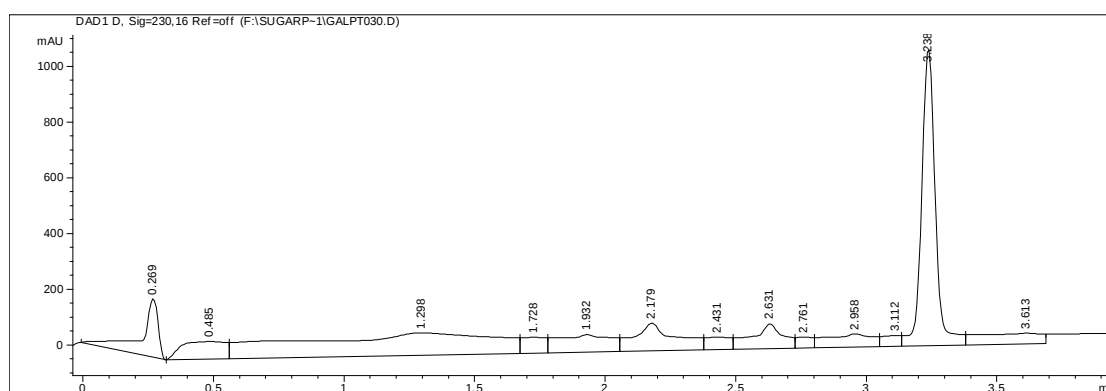
Chemical Formula: C₂₈H₄₀N₆O₆
Exact Mass: 556.30



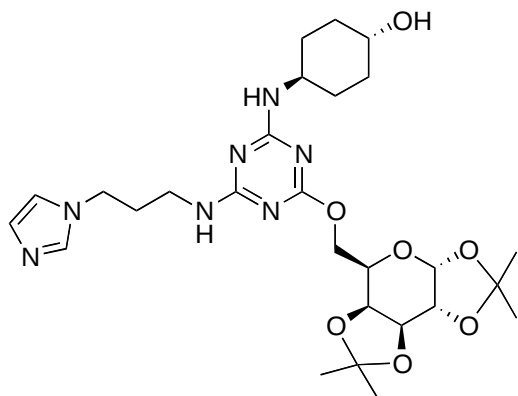
C10



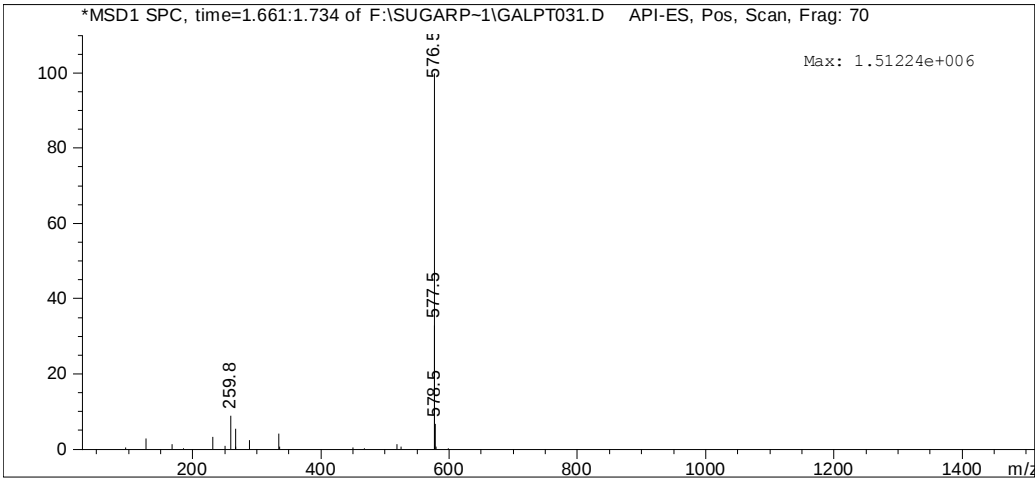
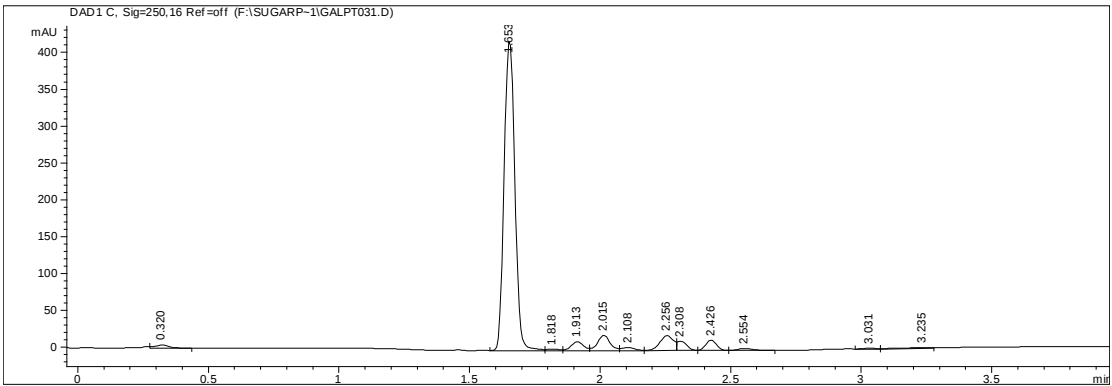
Chemical Formula: $C_{28}H_{43}N_5O_6$
Exact Mass: 545.32



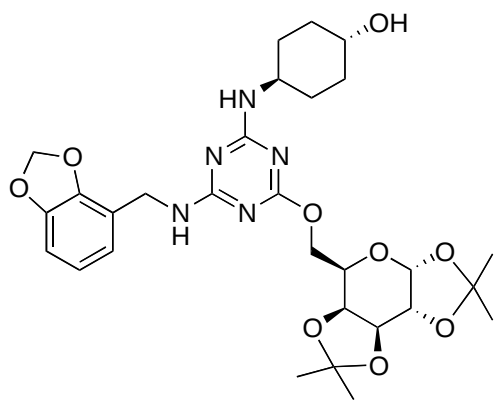
D1



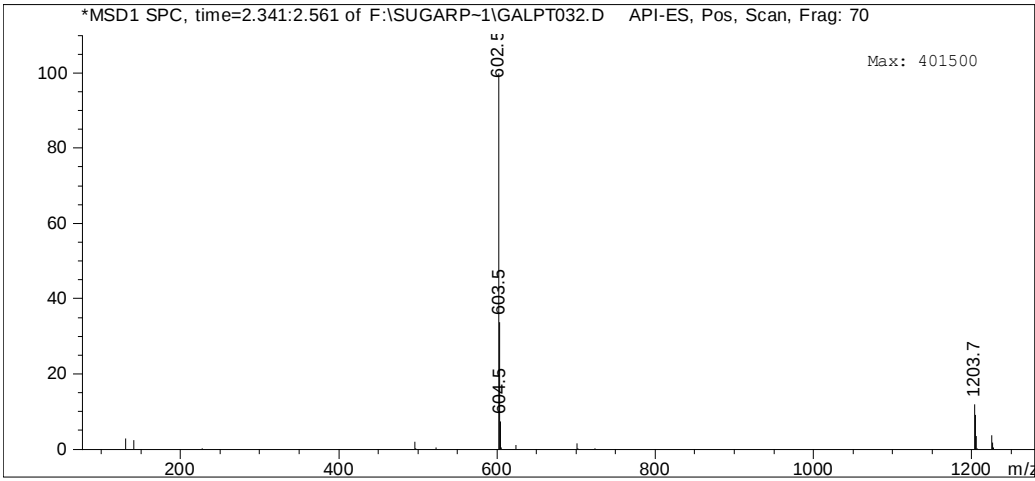
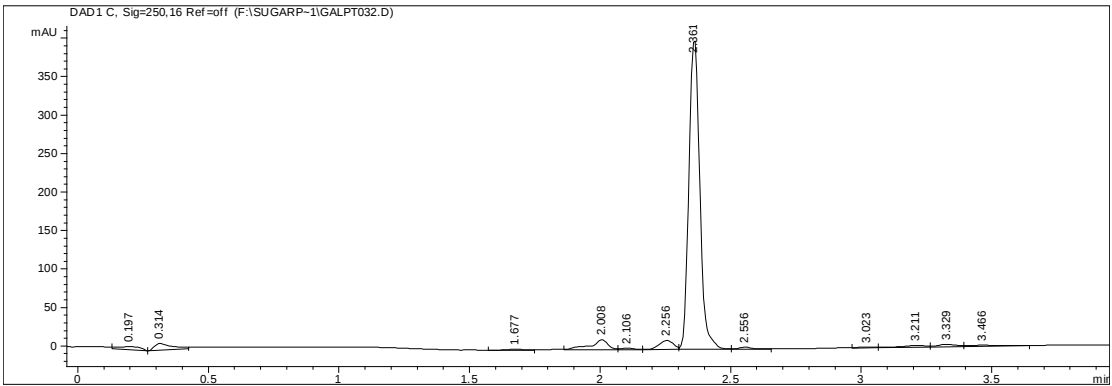
Chemical Formula: $C_{27}H_{41}N_7O_7$
Exact Mass: 575.31



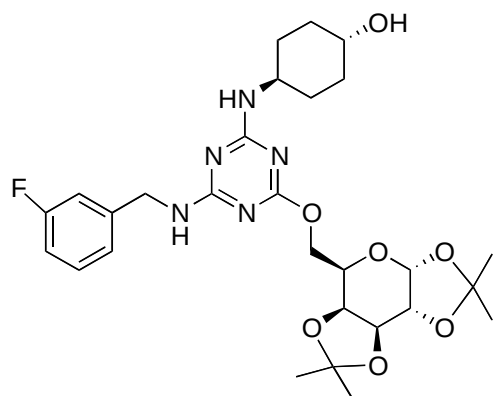
D2



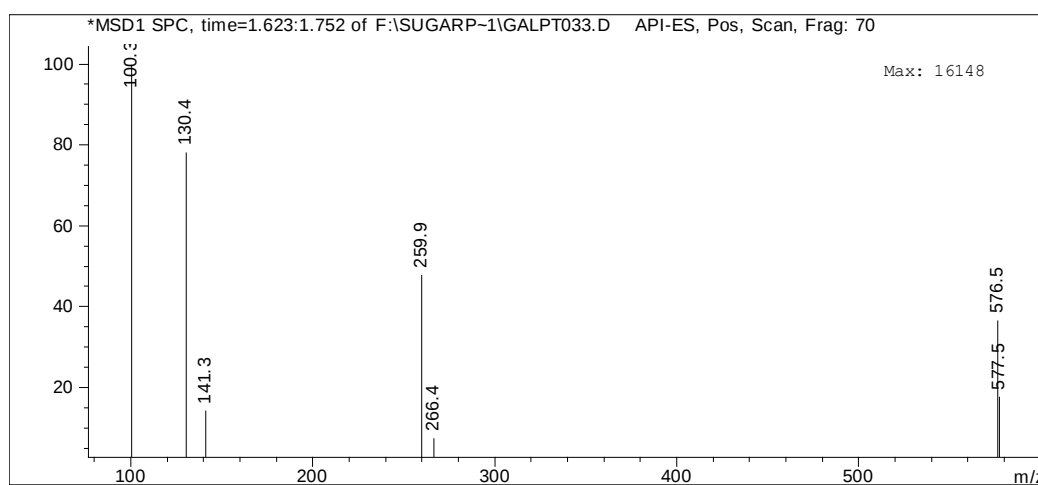
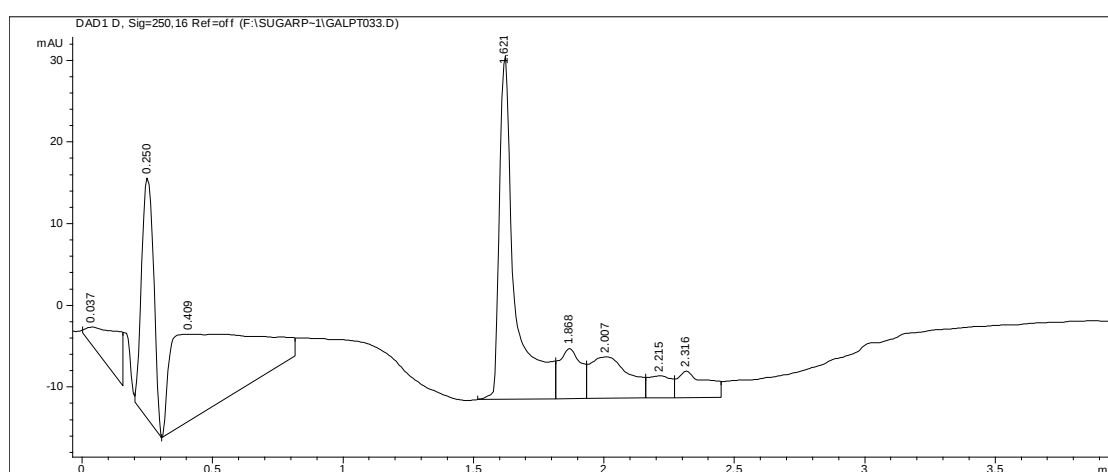
Chemical Formula: C₂₉H₃₉N₅O₉
Exact Mass: 601.27



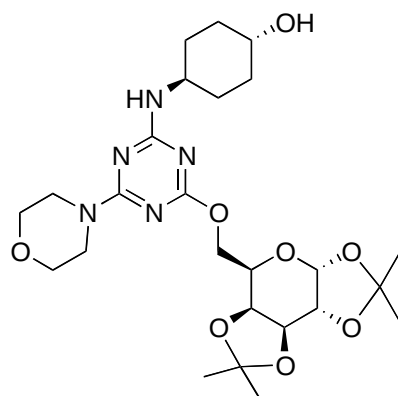
D3



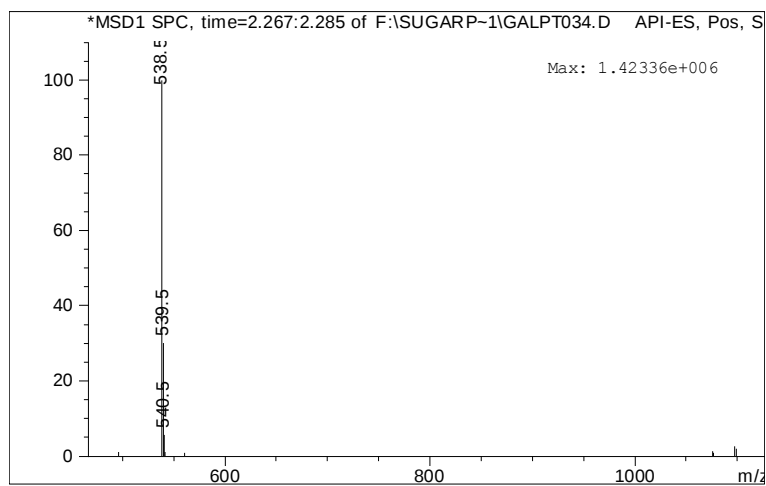
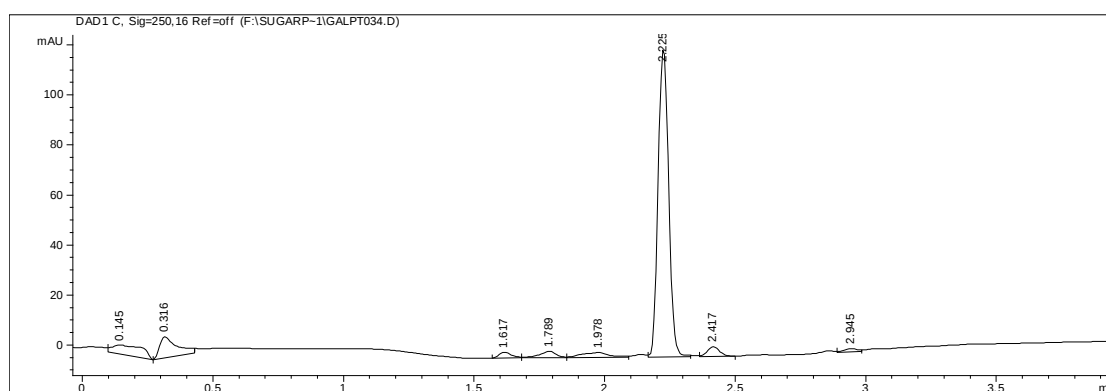
Chemical Formula: $C_{28}H_{38}FN_5O_7$
Exact Mass: 575.28



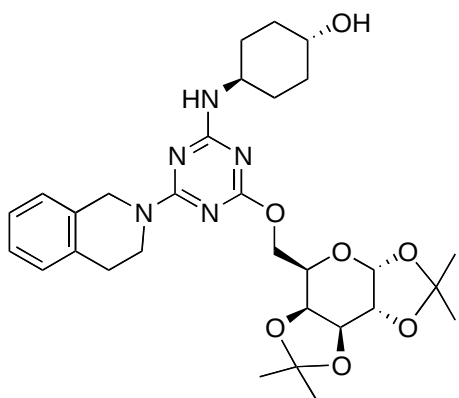
D4



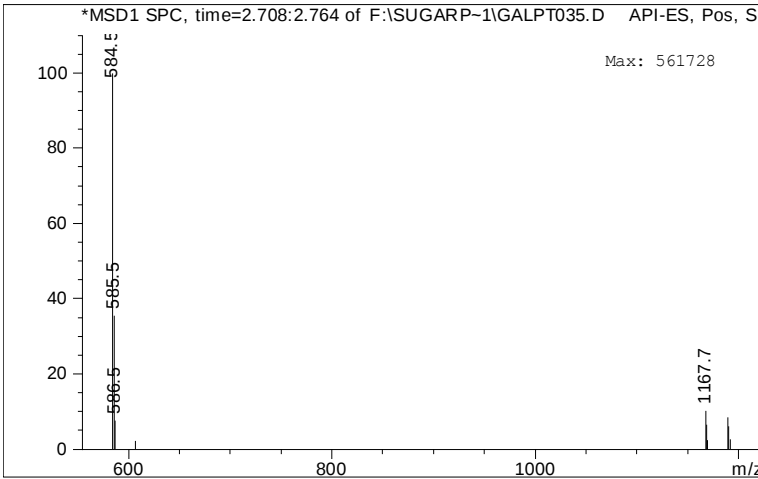
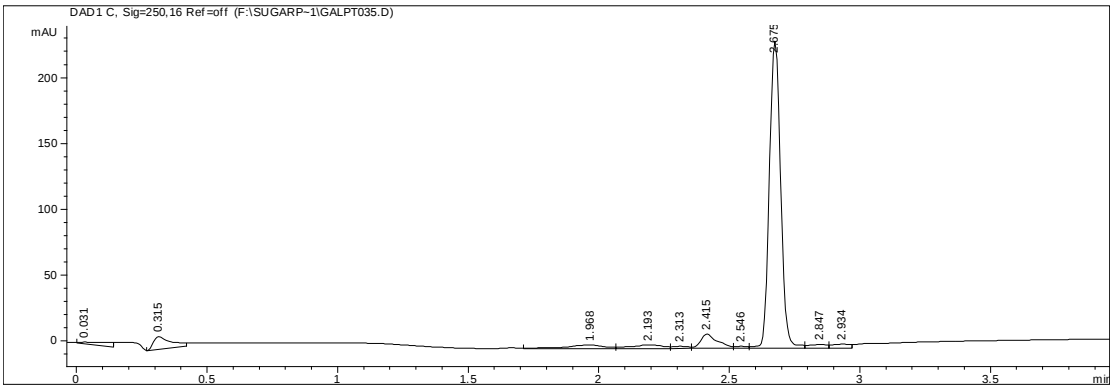
Chemical Formula: $C_{25}H_{39}N_5O_8$
Exact Mass: 537.28



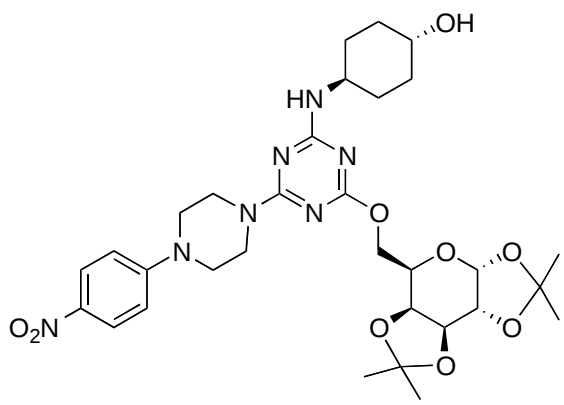
D5



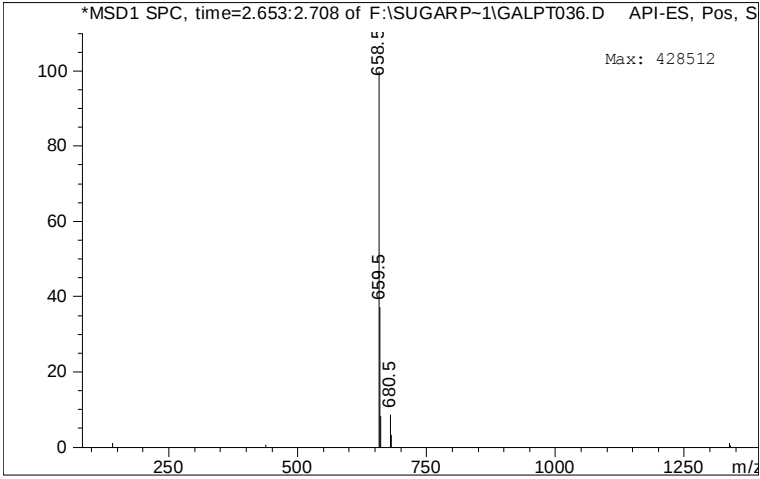
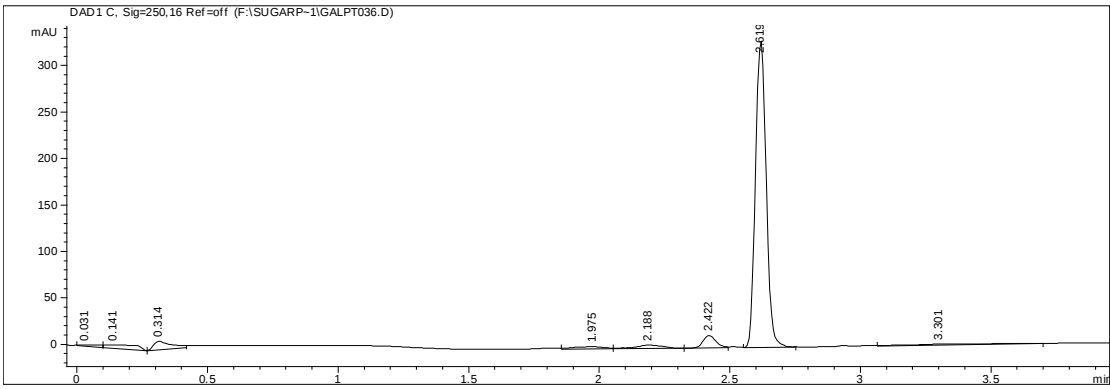
Chemical Formula: C₃₀H₄₁N₅O₇
Exact Mass: 583.30



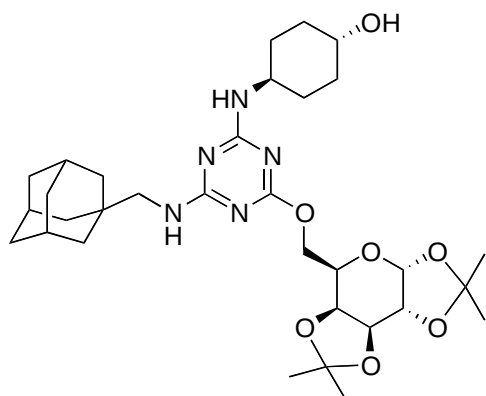
D6



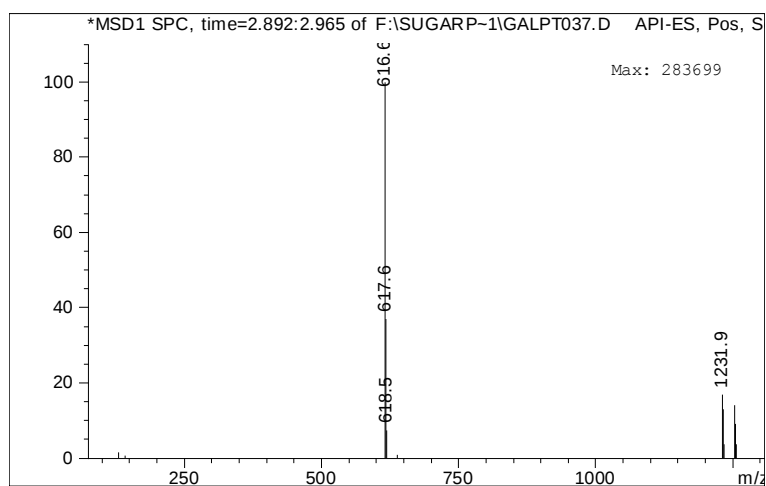
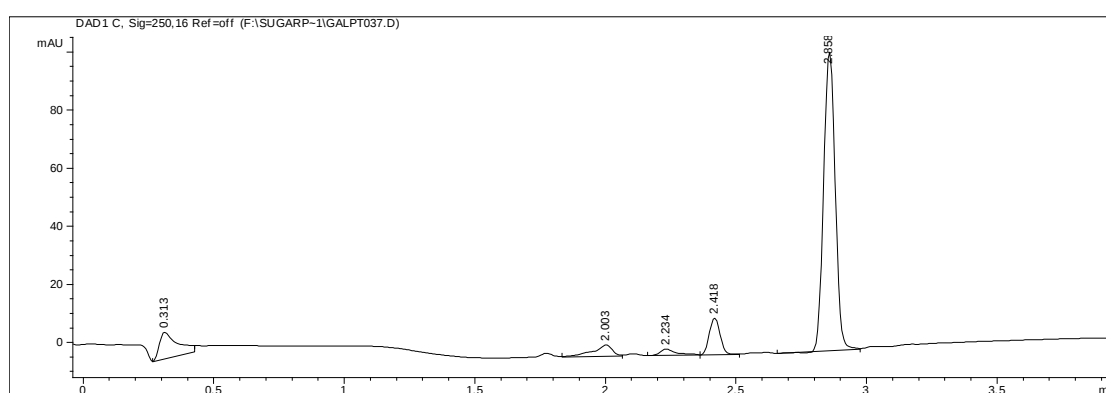
Chemical Formula: C₃₁H₄₃N₇O₉
Exact Mass: 657.31



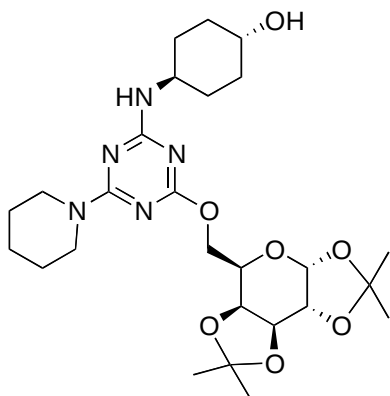
D7



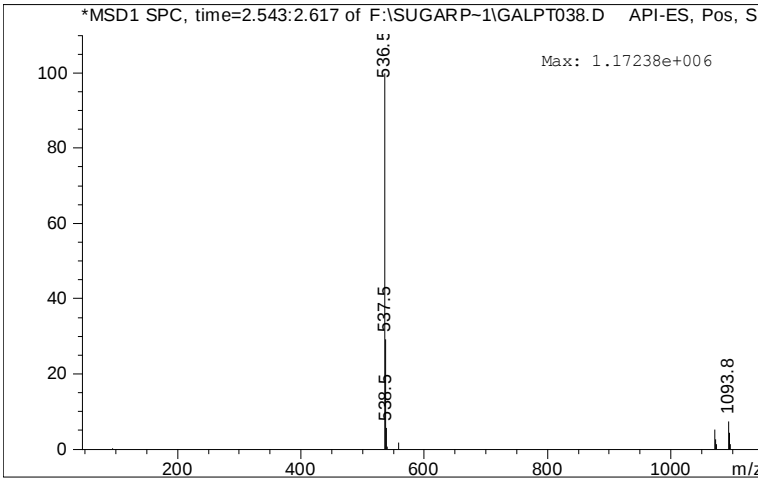
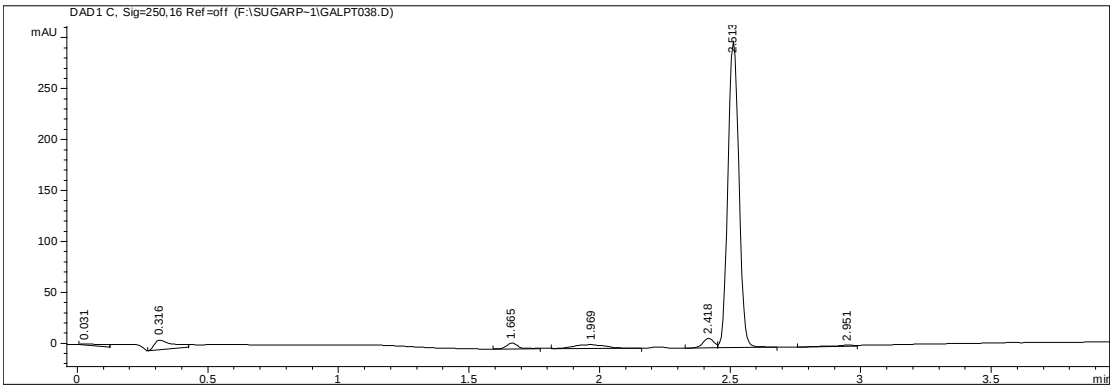
Chemical Formula: $C_{32}H_{49}N_5O_7$
Exact Mass: 615.36



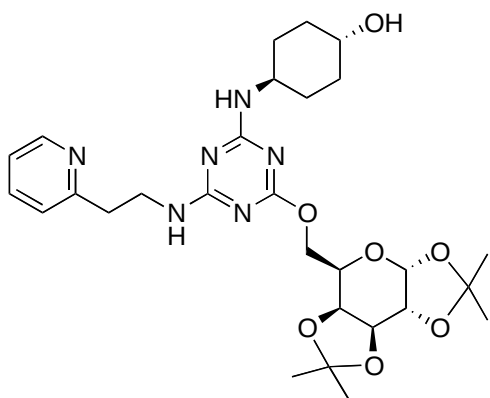
D8



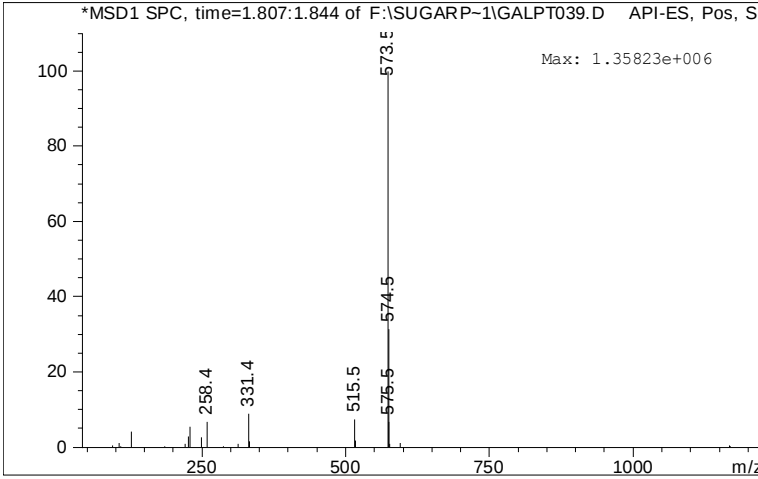
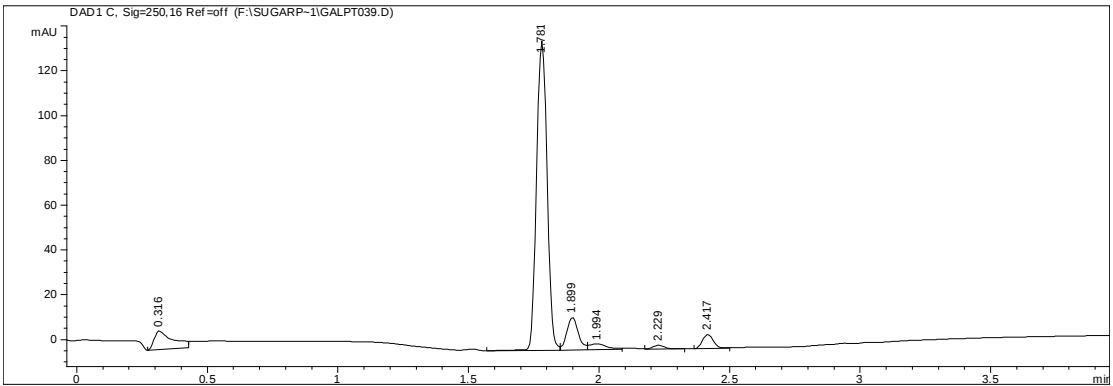
Chemical Formula: $C_{26}H_{41}N_5O_7$
Exact Mass: 535.30



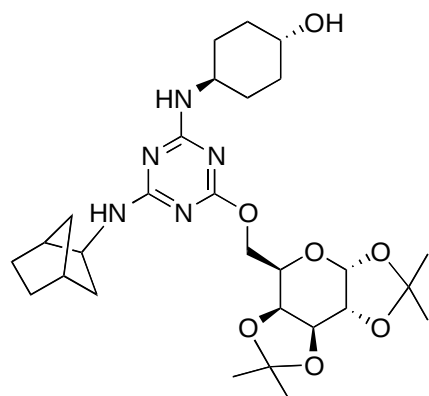
D9



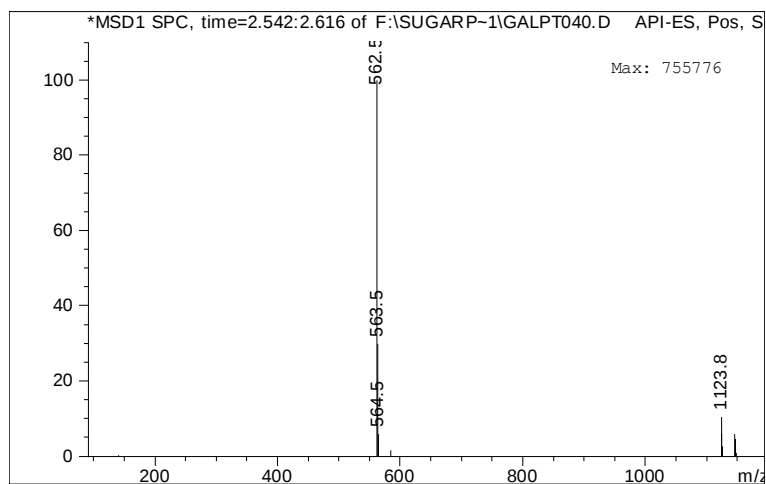
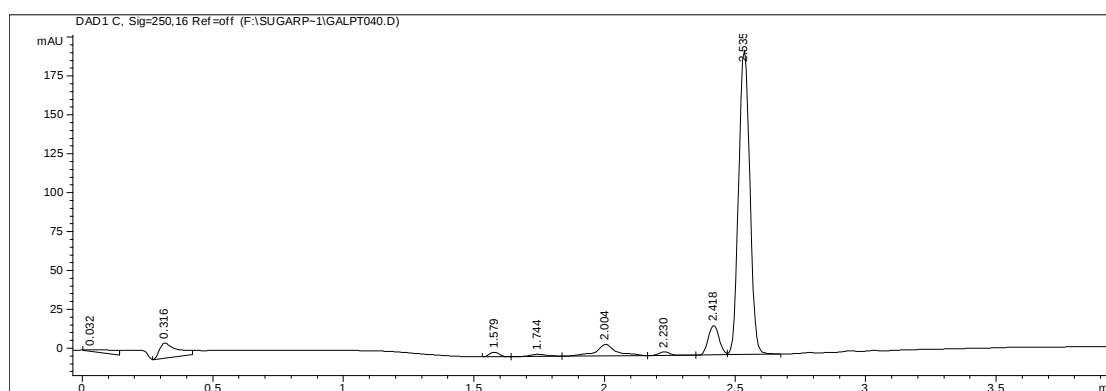
Chemical Formula: C₂₈H₄₀N₆O₇
Exact Mass: 572.30



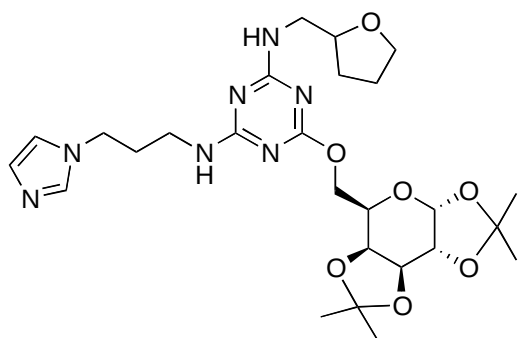
D10



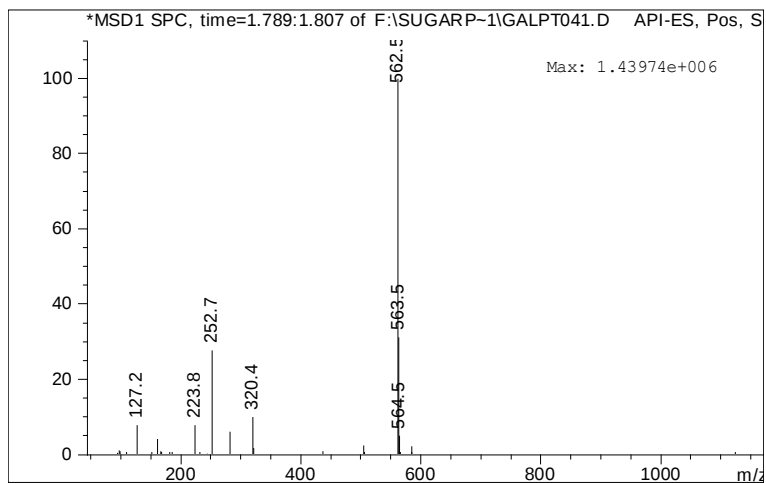
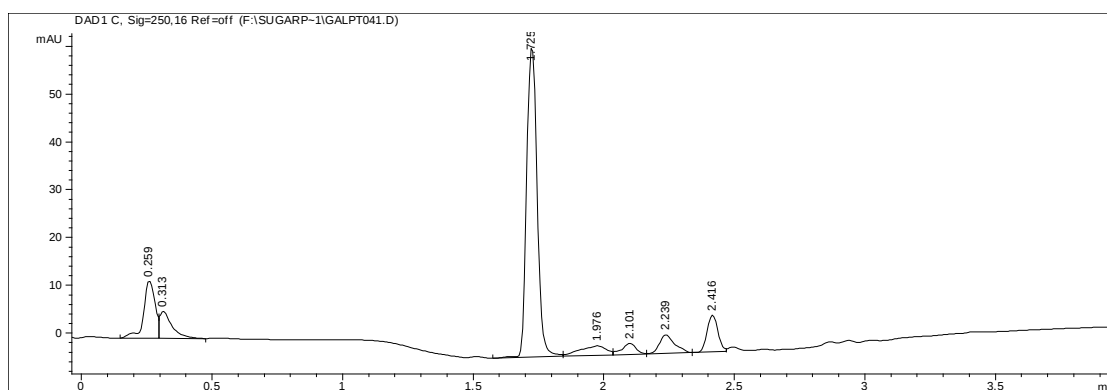
Chemical Formula: $C_{28}H_{43}N_5O_7$
Exact Mass: 561.32



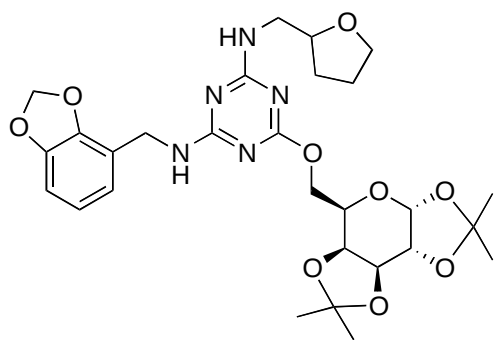
E1



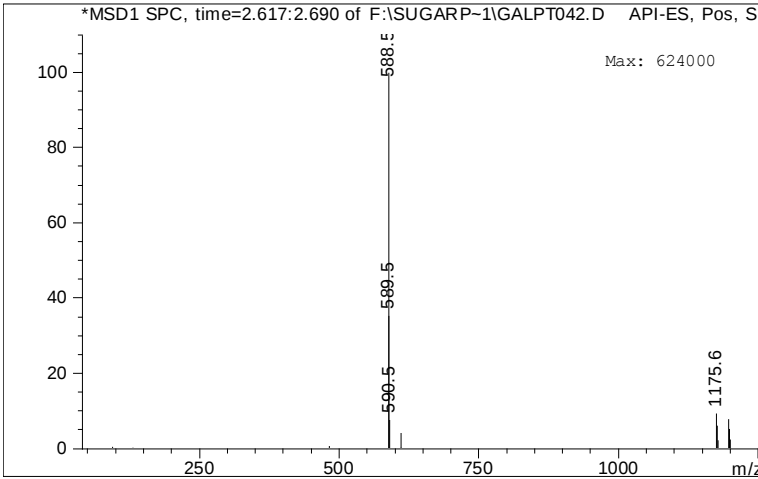
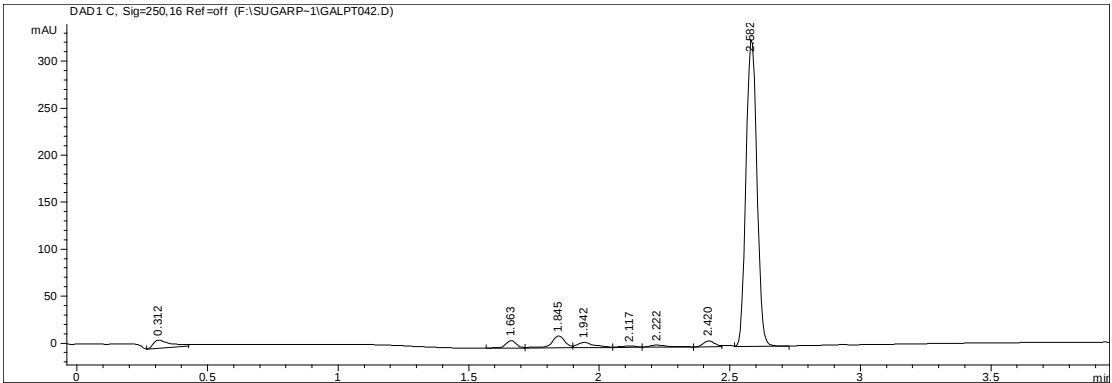
Chemical Formula: $C_{26}H_{39}N_7O_7$
Exact Mass: 561.29



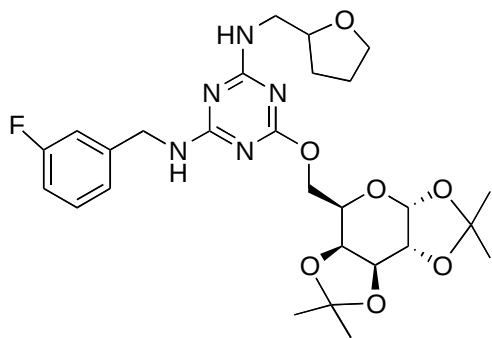
E2



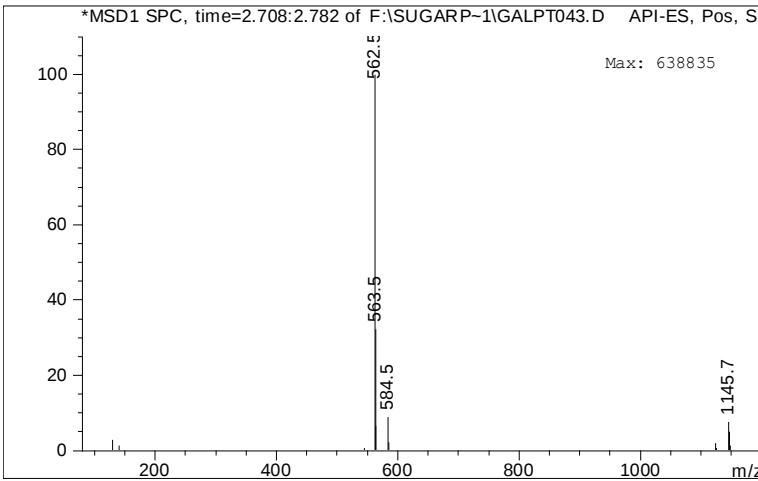
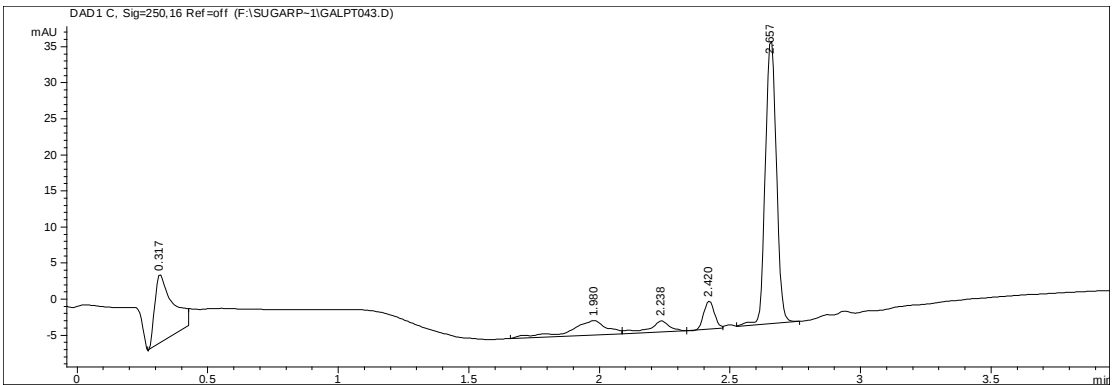
Chemical Formula: C₂₈H₃₇N₅O₉
Exact Mass: 587.26



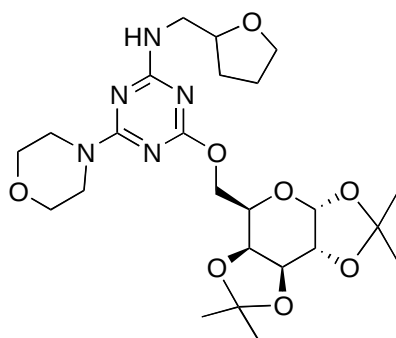
E3



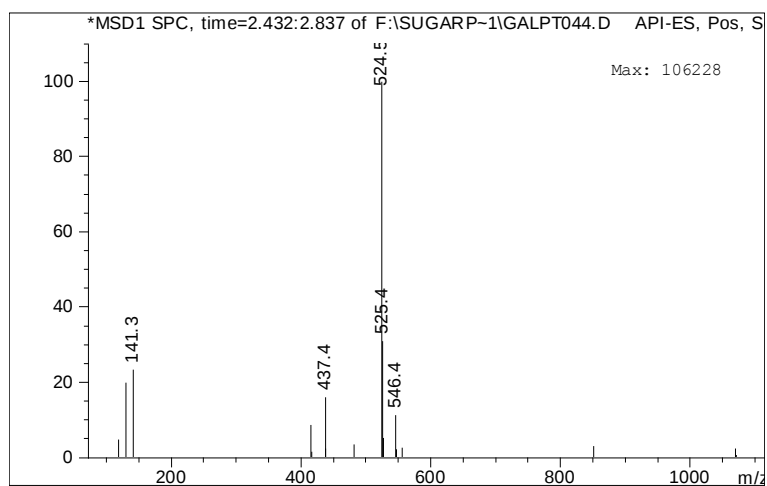
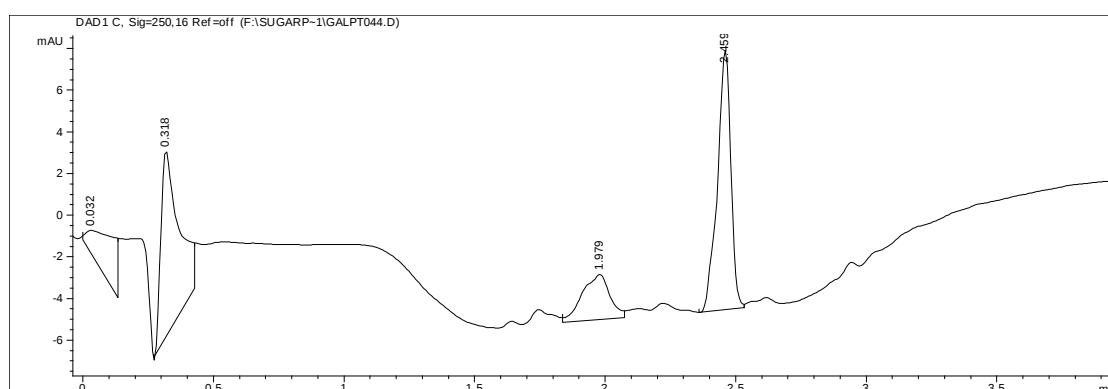
Chemical Formula: C₂₇H₃₆FN₅O₇
Exact Mass: 561.26



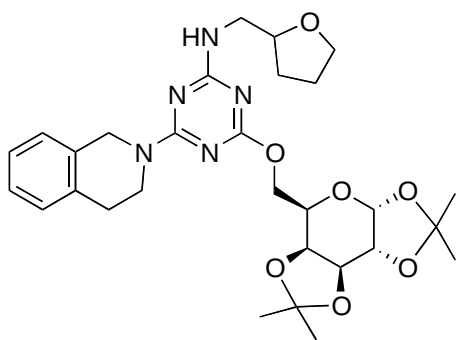
E4



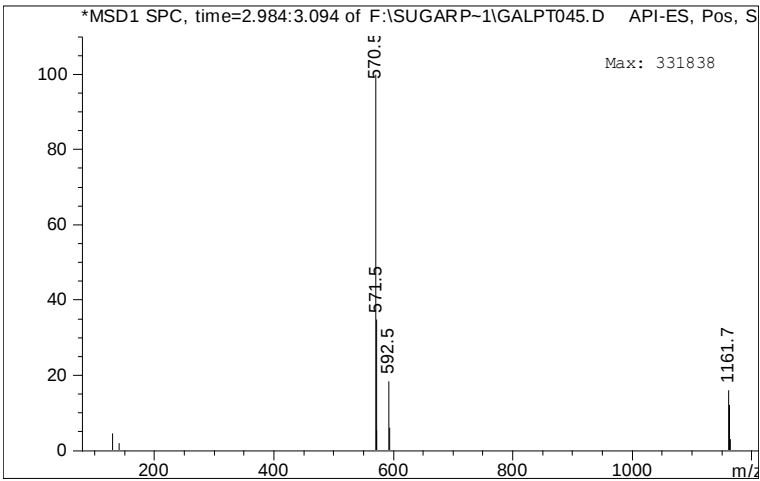
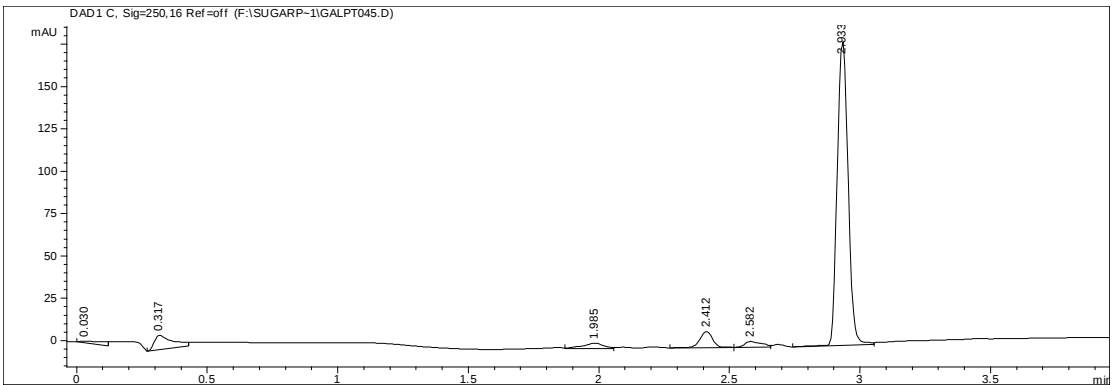
Chemical Formula: $C_{24}H_{37}N_5O_8$
Exact Mass: 523.26



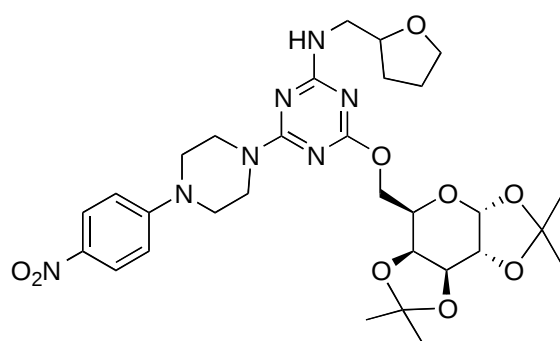
E5



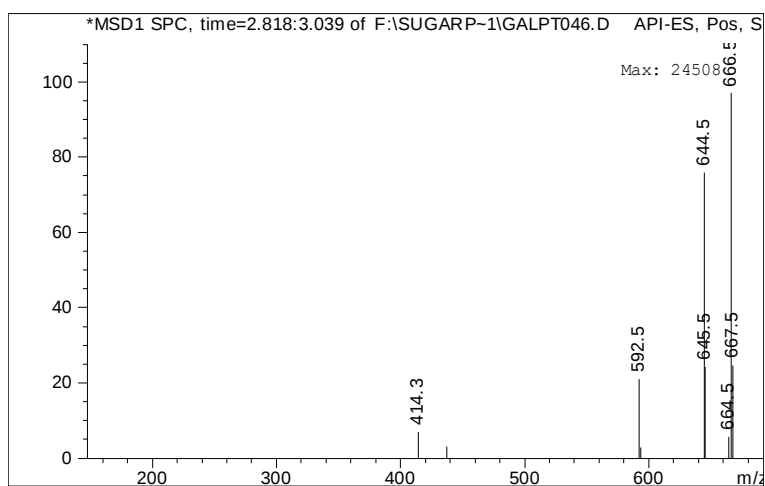
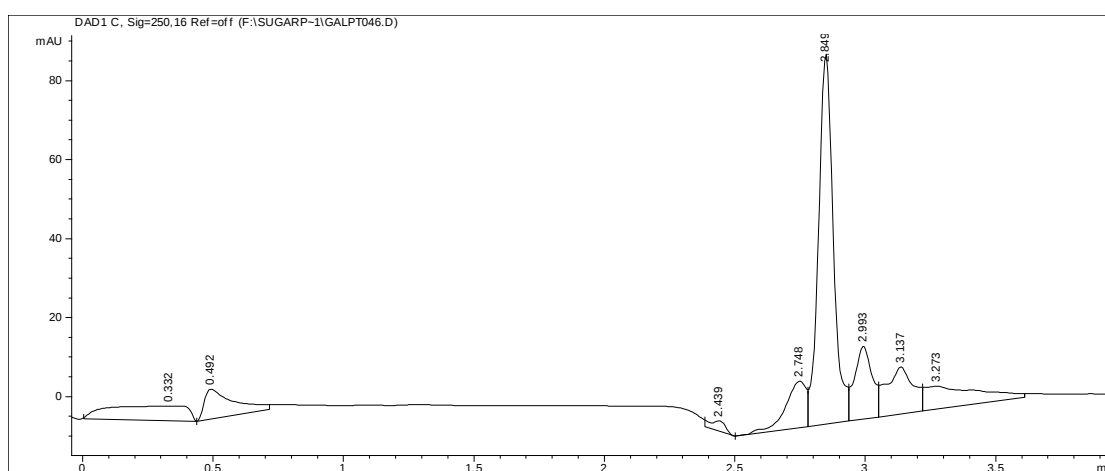
Chemical Formula: C₂₉H₃₉N₅O₇
Exact Mass: 569.28



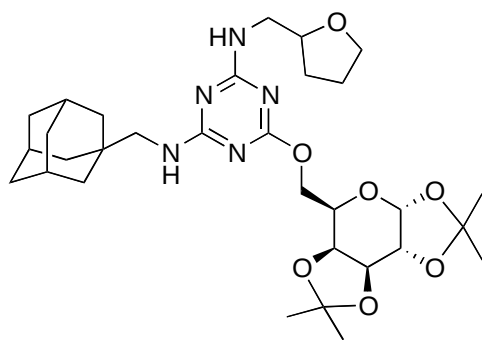
E6



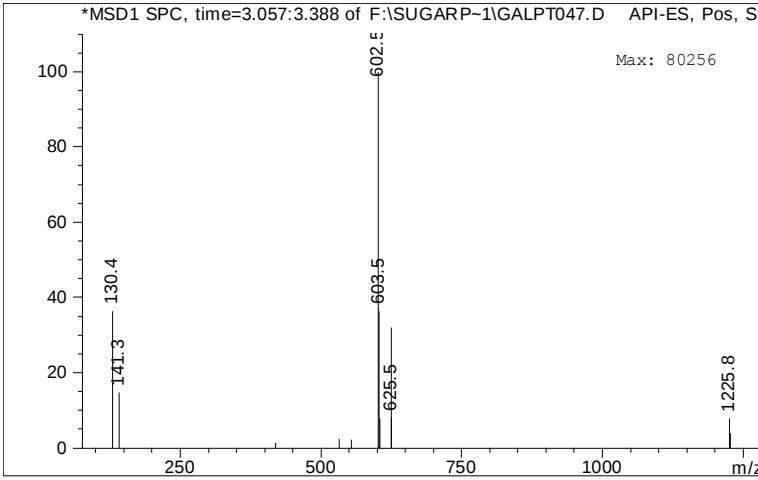
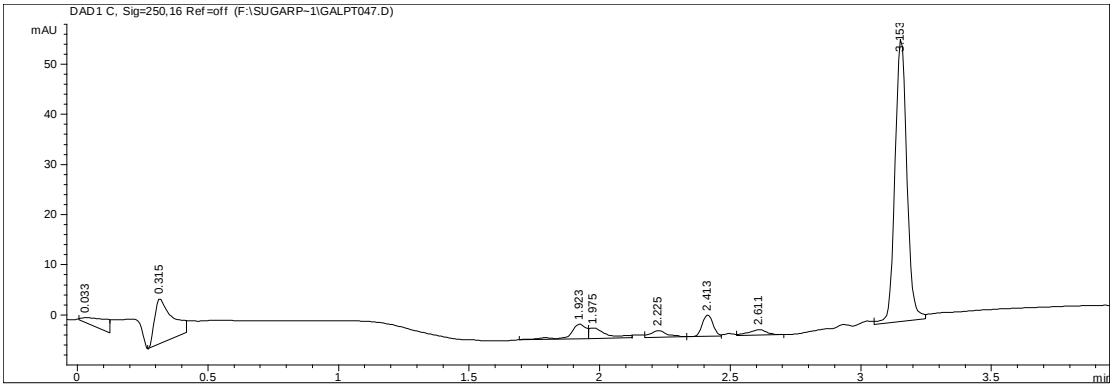
Chemical Formula: $C_{30}H_{41}N_7O_9$
Exact Mass: 643.30



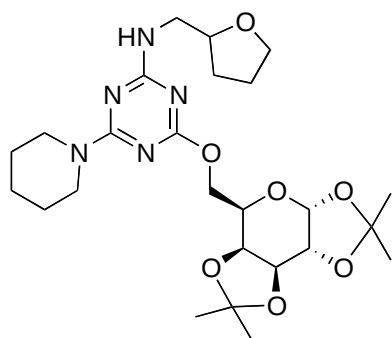
E7



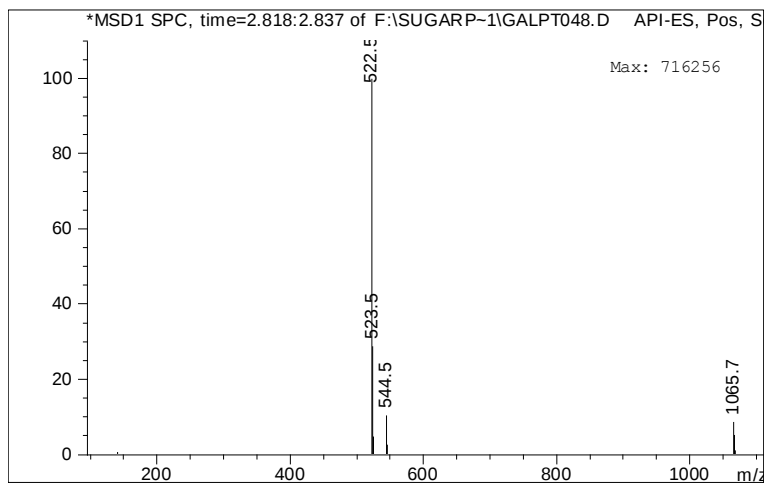
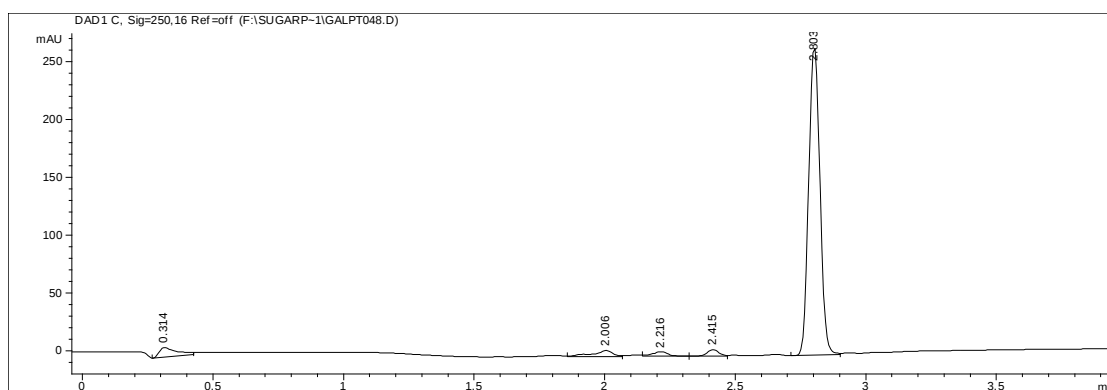
Chemical Formula: $C_{31}H_{47}N_5O_7$
Exact Mass: 601.35



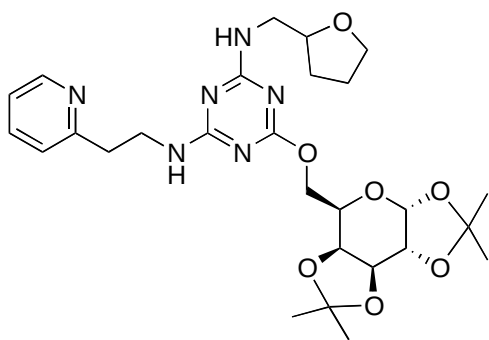
E8



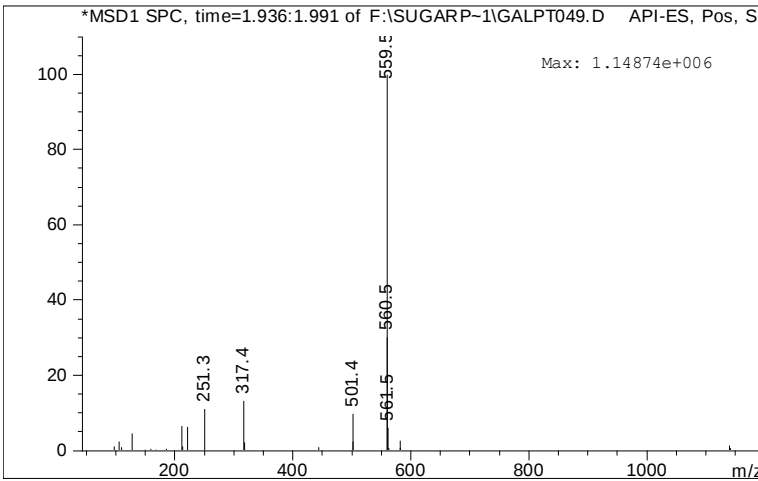
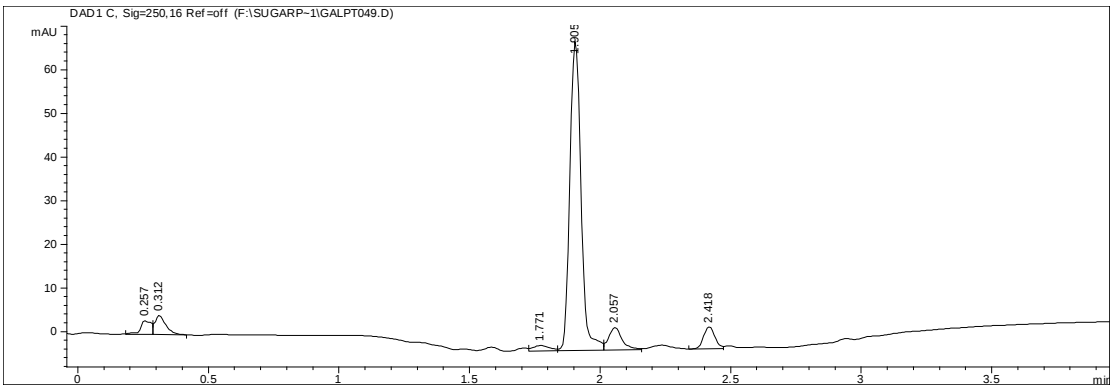
Chemical Formula: $C_{25}H_{39}N_5O_7$
Exact Mass: 521.28



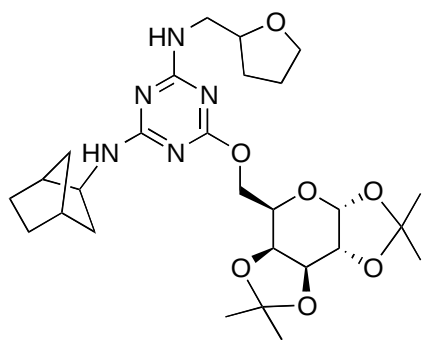
E9



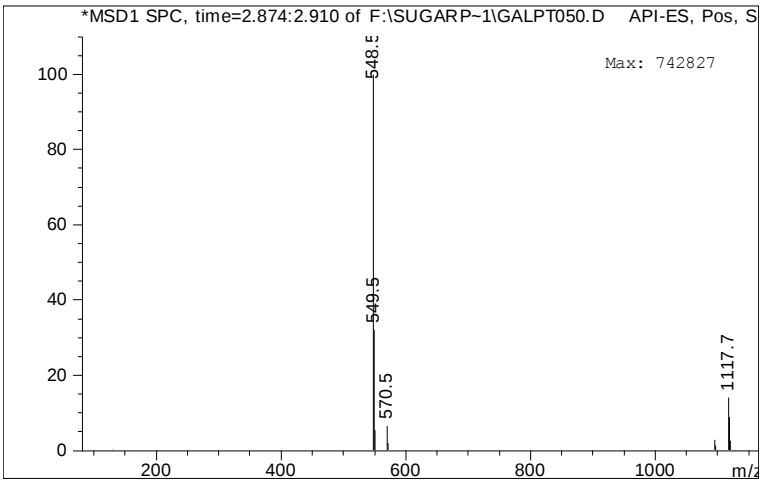
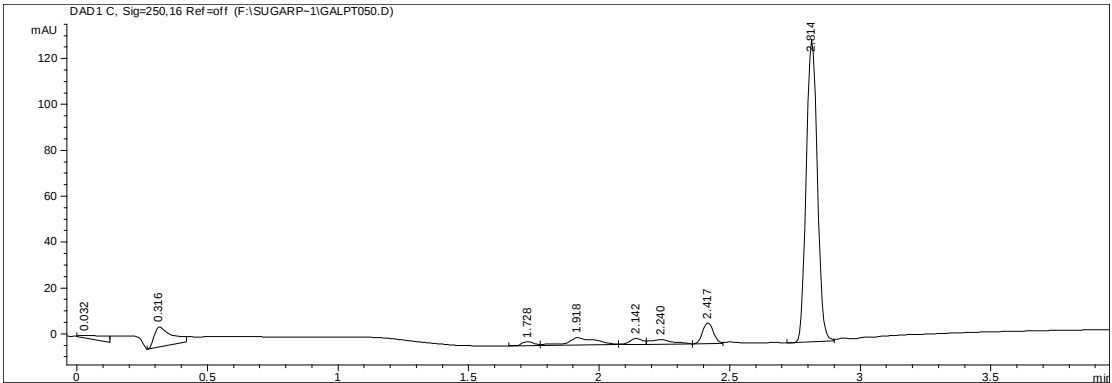
Chemical Formula: C₂₇H₃₈N₆O₇
Exact Mass: 558.28



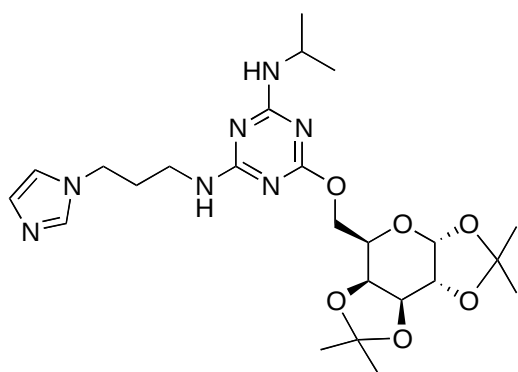
E10



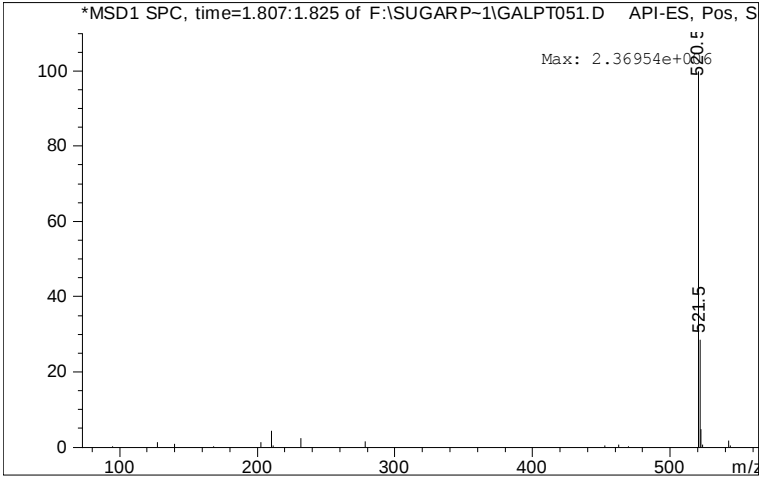
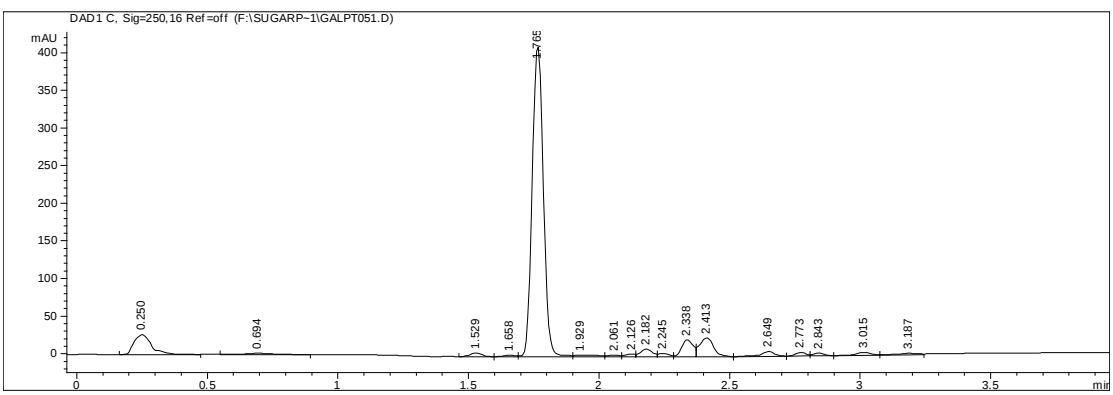
Chemical Formula: $C_{27}H_{41}N_5O_7$
Exact Mass: 547.30



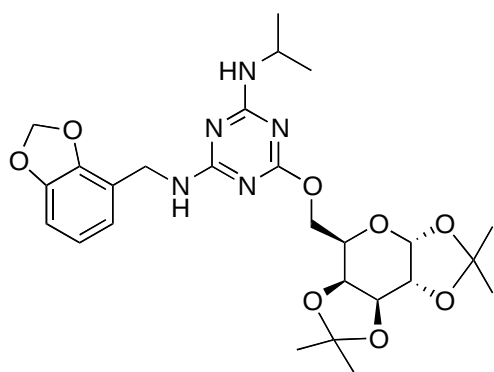
F1



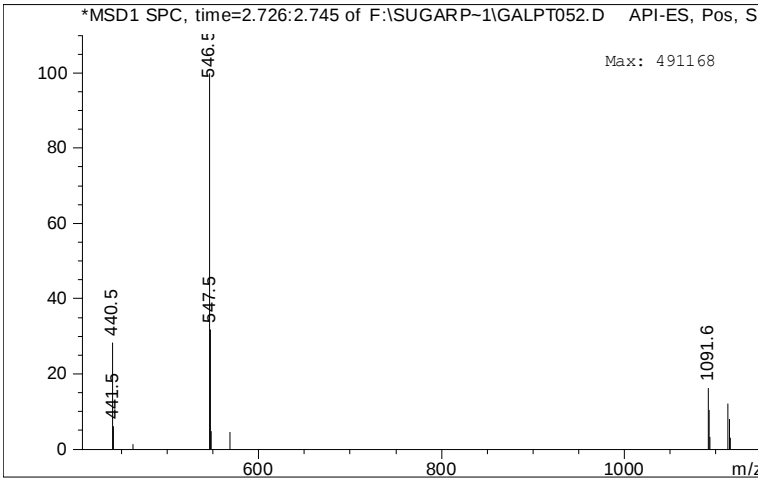
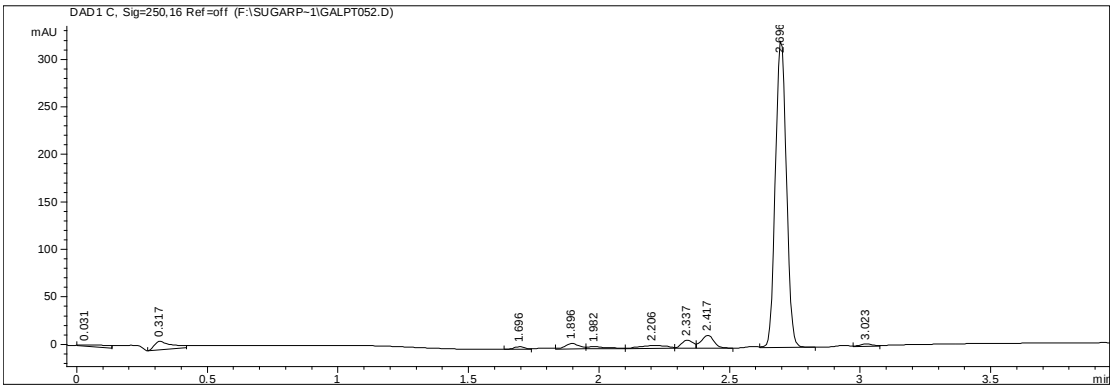
Chemical Formula: C₂₄H₃₇N₇O₆
Exact Mass: 519.28



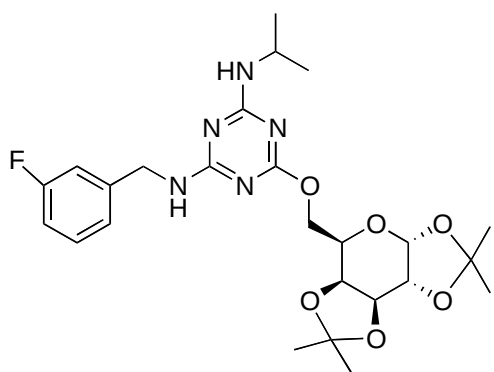
F2



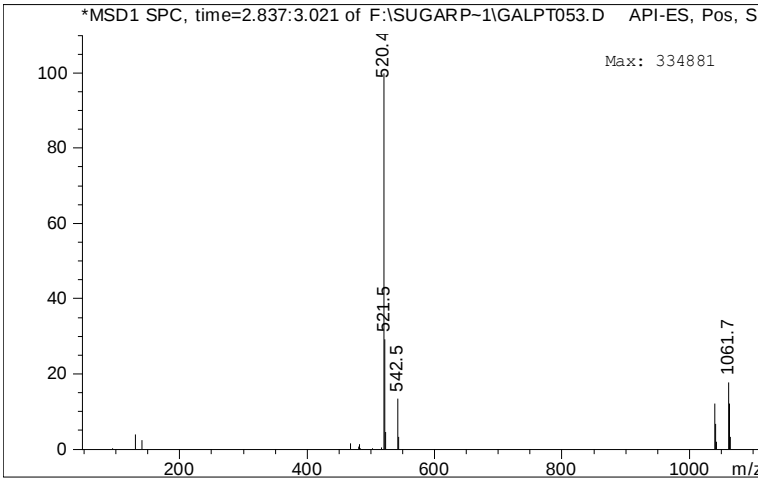
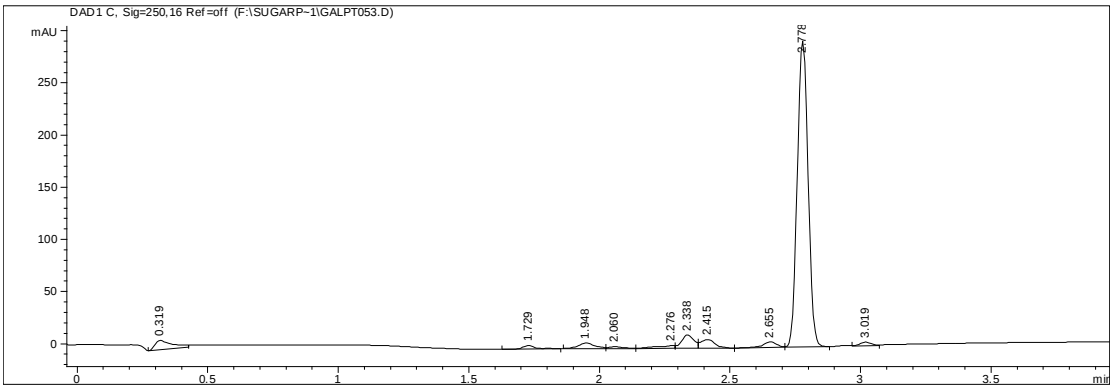
Chemical Formula: C₂₆H₃₅N₅O₈
Exact Mass: 545.25



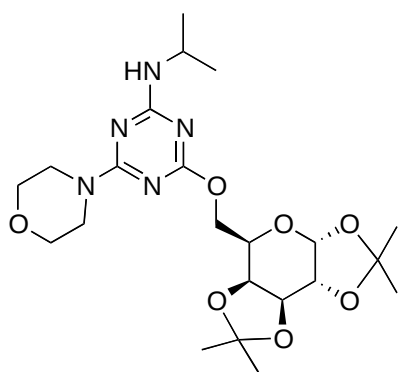
F3



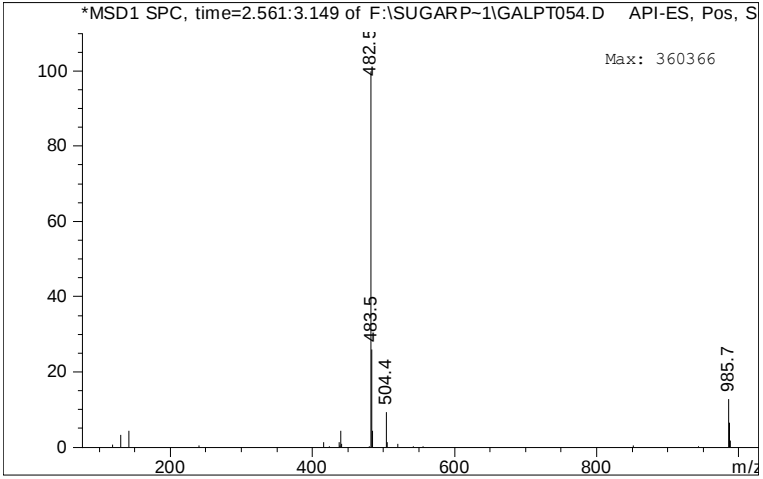
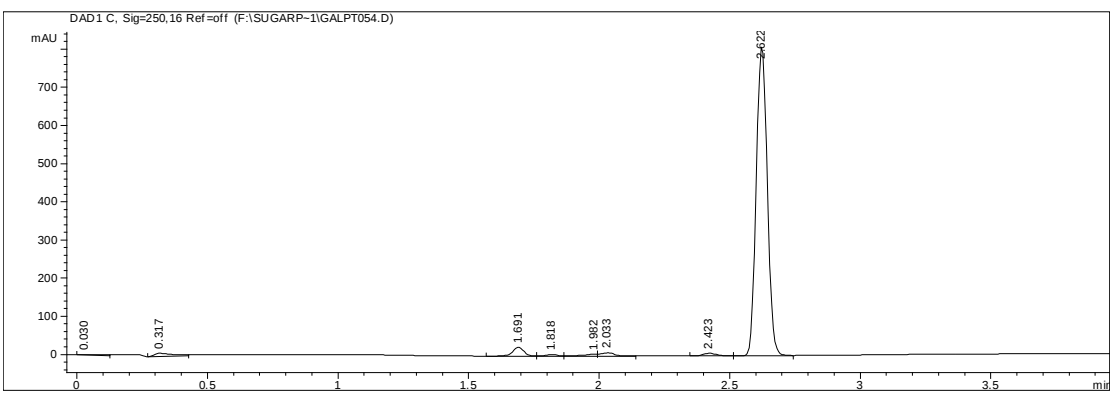
Chemical Formula: C₂₅H₃₄FN₅O₆
Exact Mass: 519.25



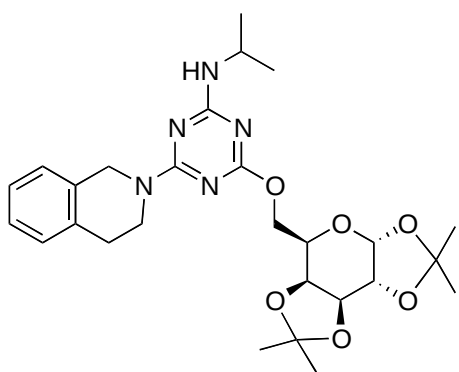
F4



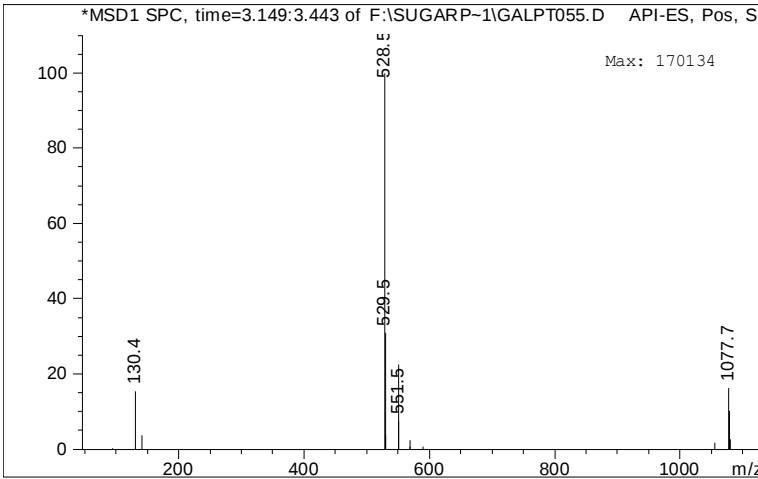
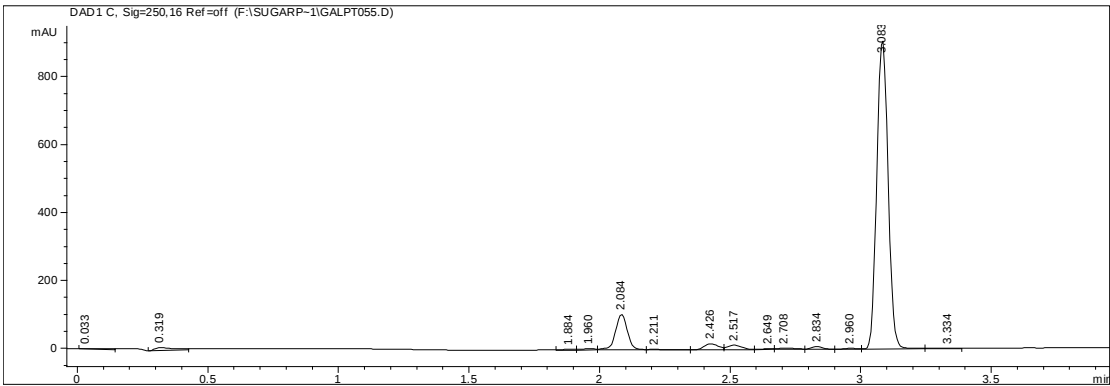
Chemical Formula: C₂₂H₃₅N₅O₇
Exact Mass: 481.25



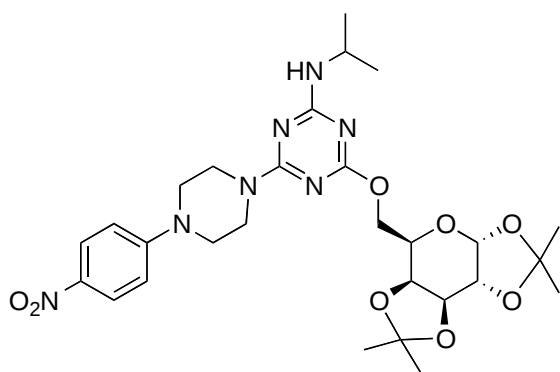
F5



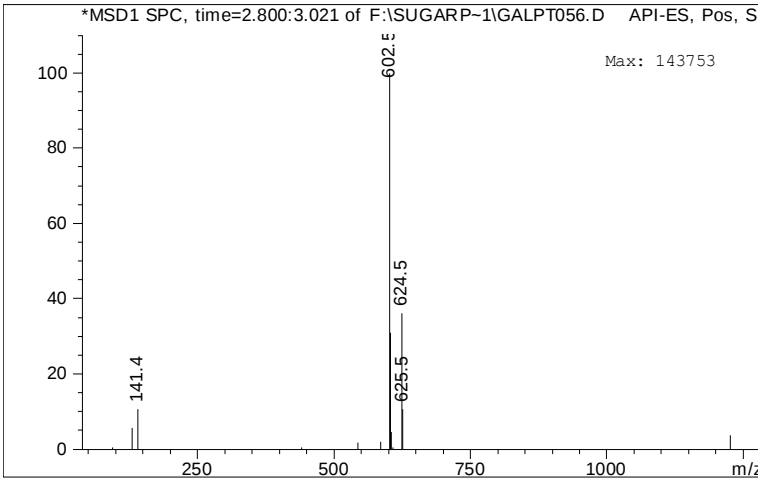
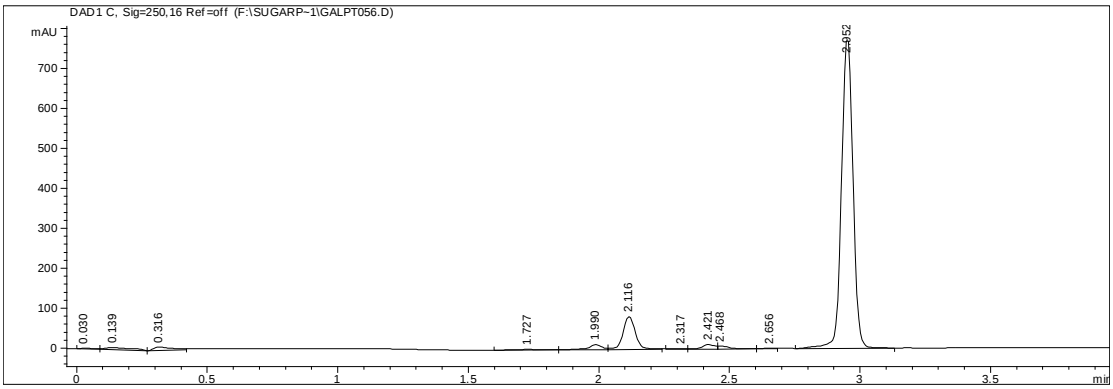
Chemical Formula: $C_{27}H_{37}N_5O_6$
Exact Mass: 527.27



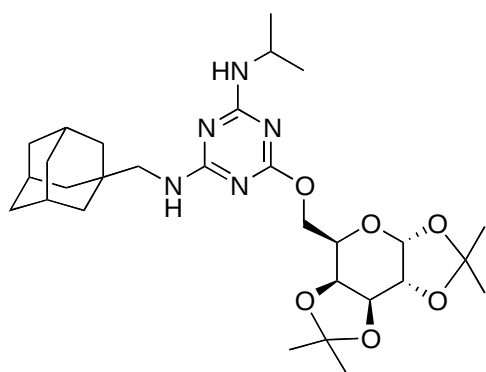
F6



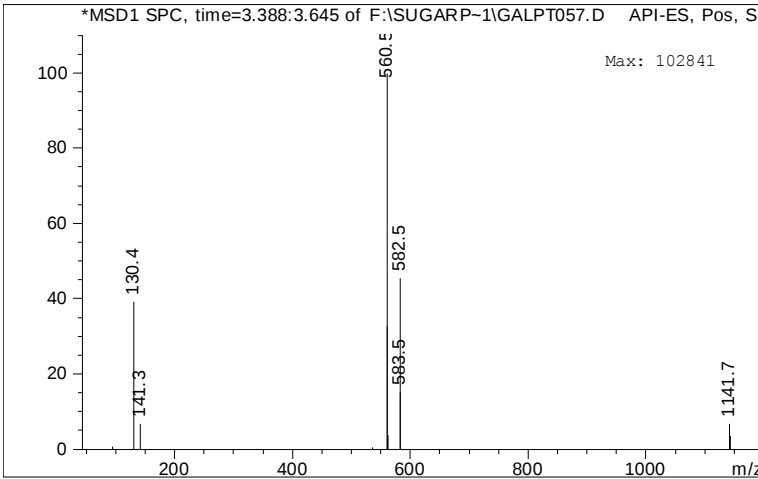
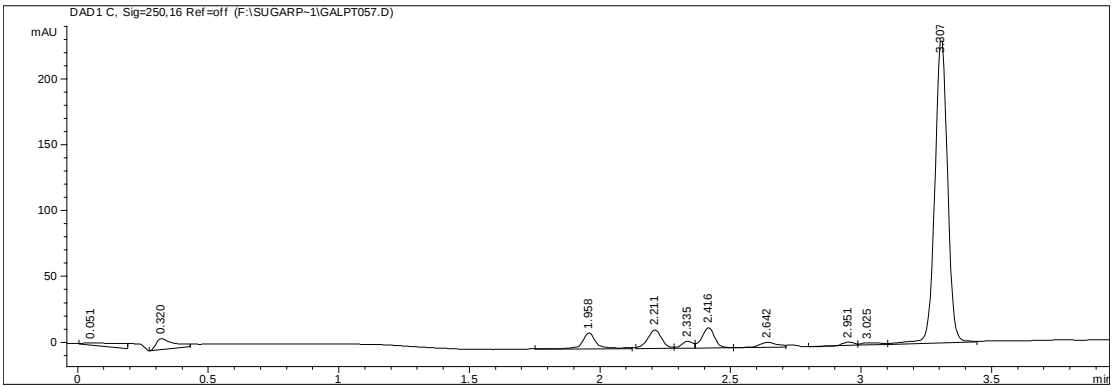
Chemical Formula: $C_{28}H_{39}N_7O_8$
Exact Mass: 601.29



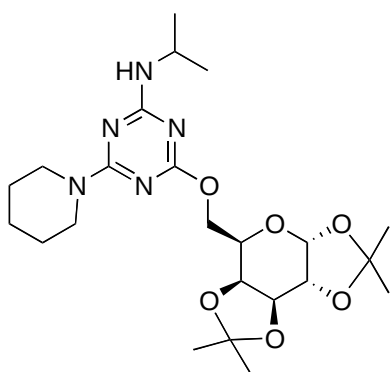
F7



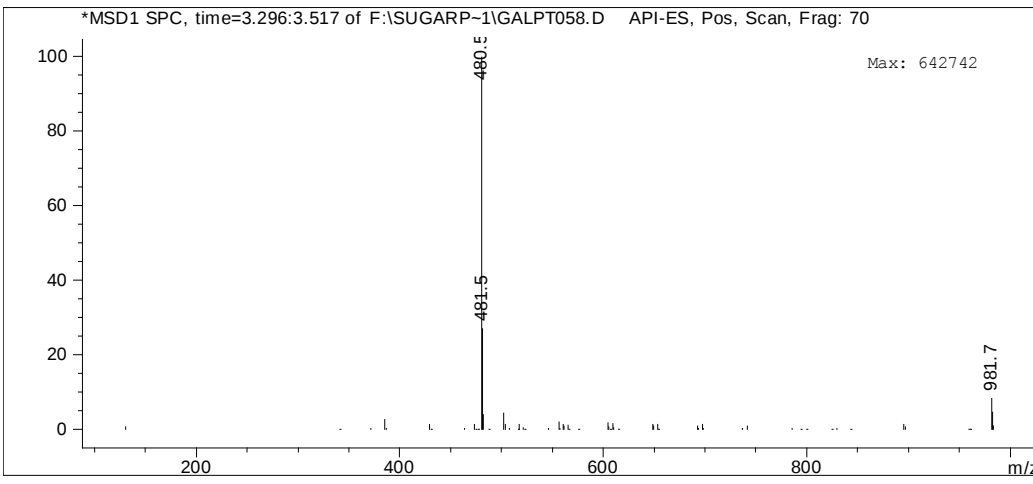
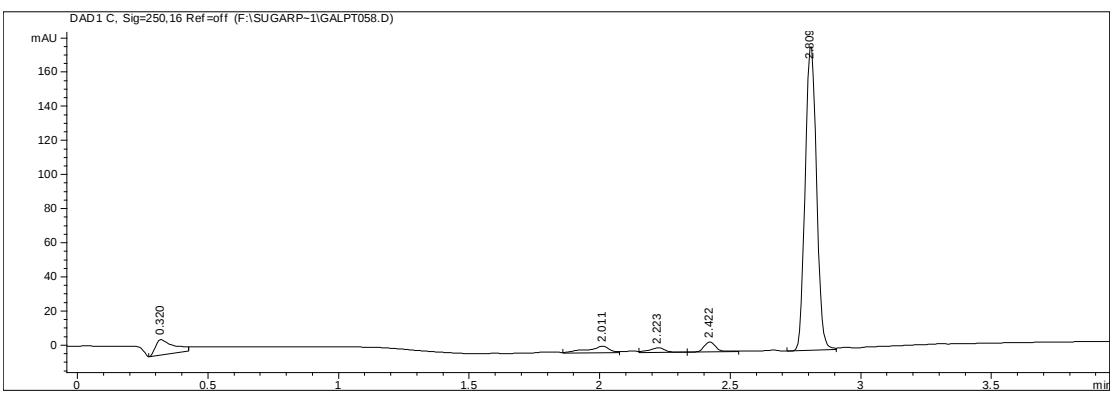
Chemical Formula: $C_{29}H_{45}N_5O_6$
Exact Mass: 559.34



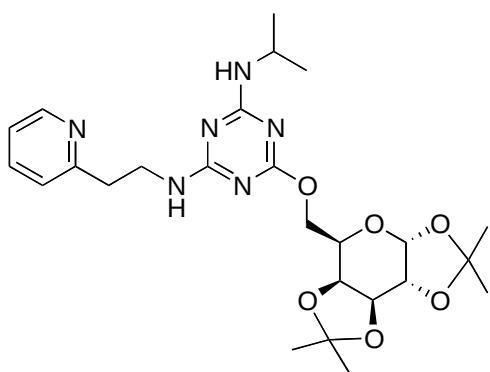
F8



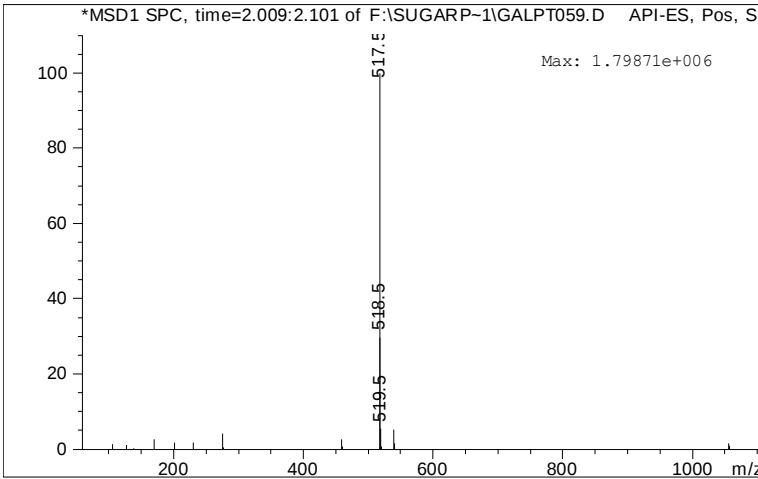
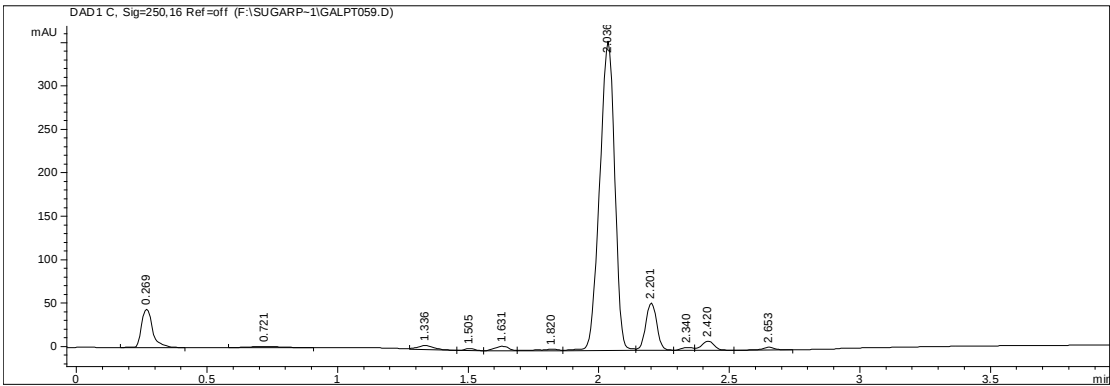
Chemical Formula: C₂₃H₃₇N₅O₆
Exact Mass: 479.27



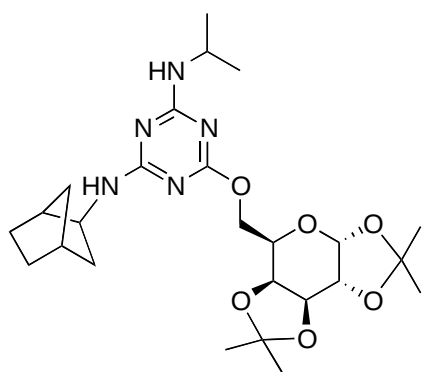
F9



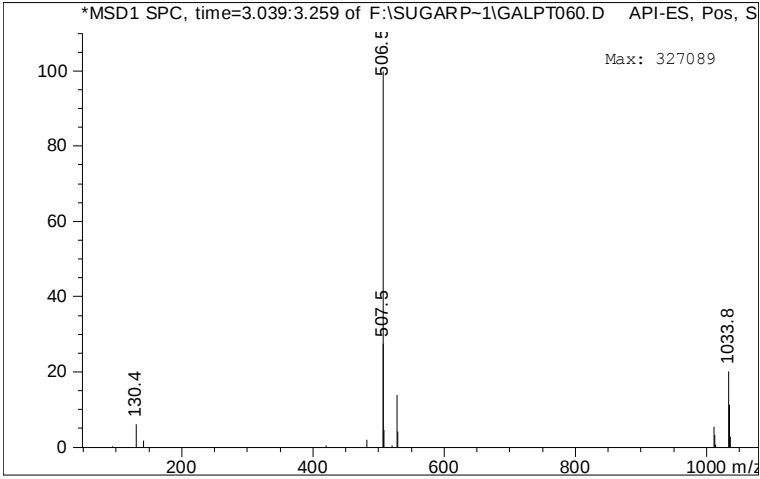
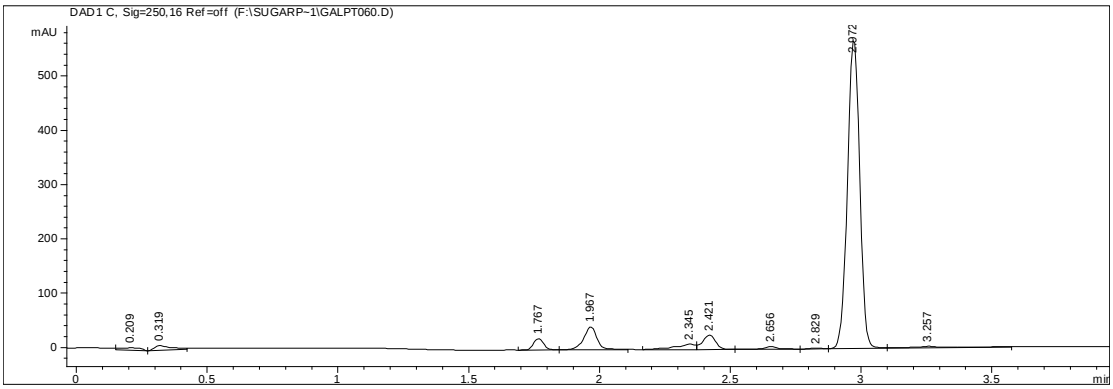
Chemical Formula: $C_{25}H_{36}N_6O_6$
Exact Mass: 516.27



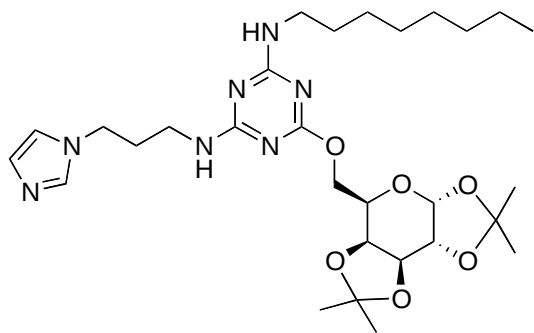
F10



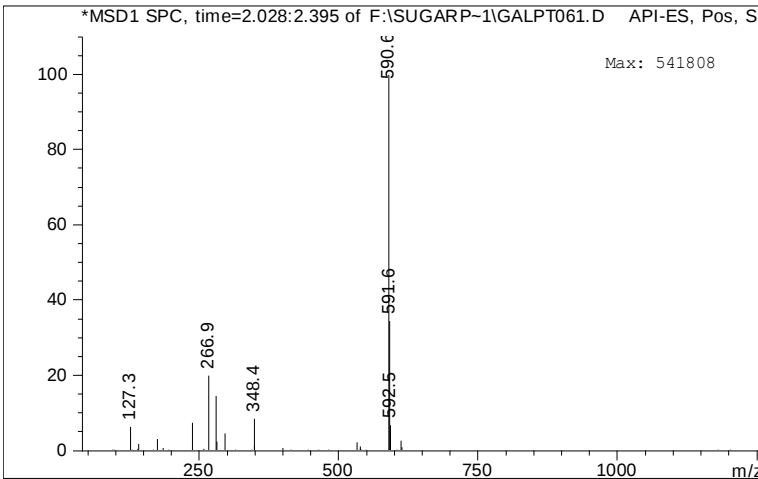
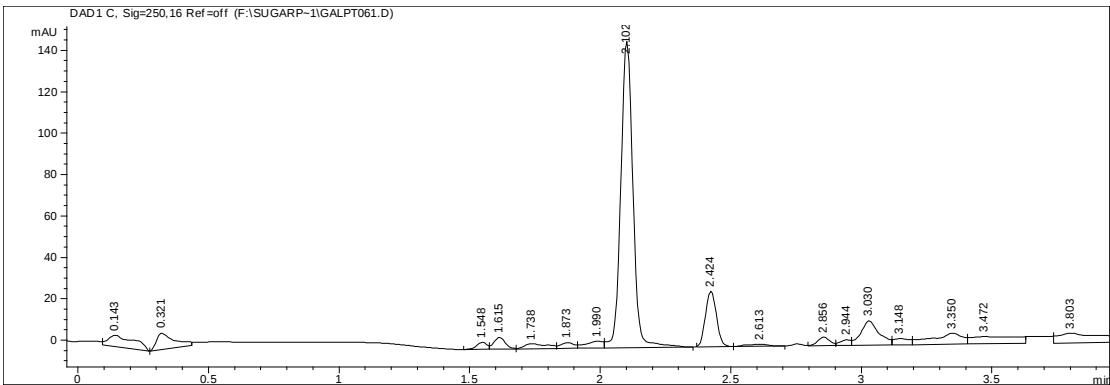
Chemical Formula: $C_{25}H_{39}N_5O_6$
Exact Mass: 505.29



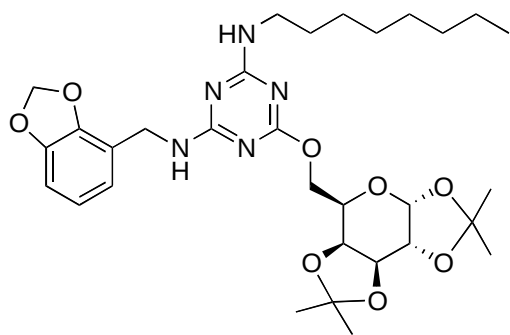
G1



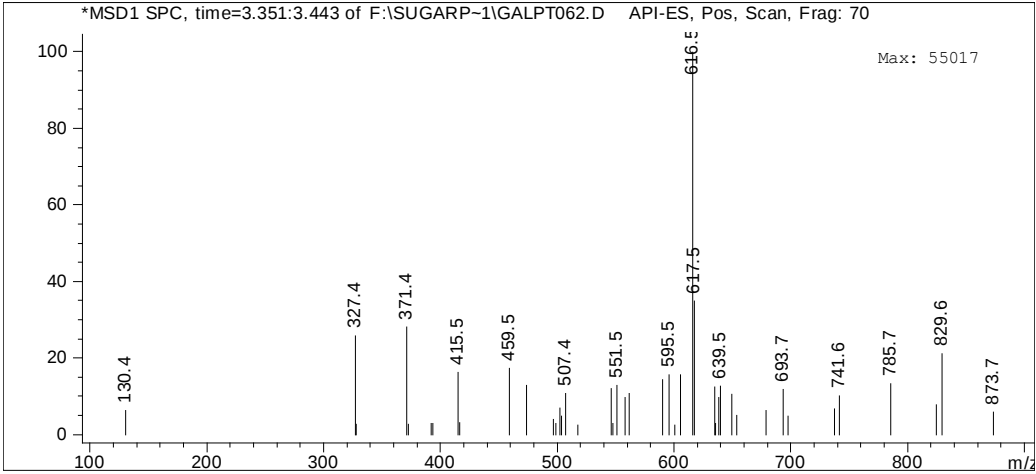
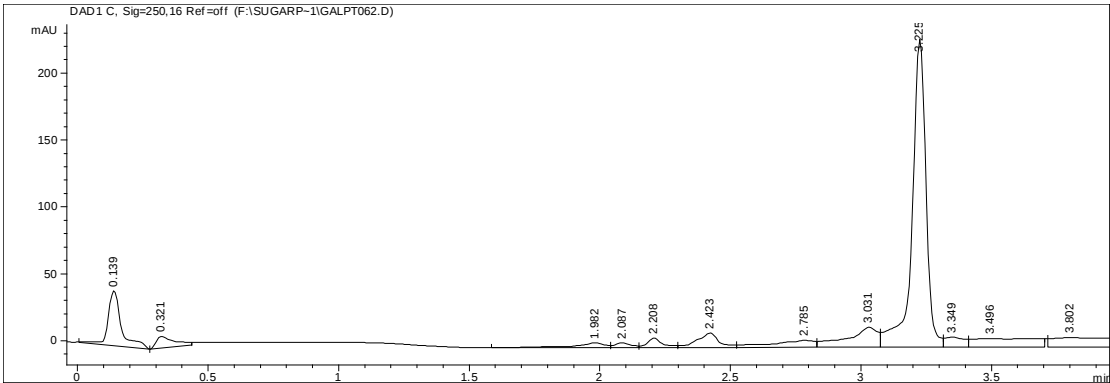
Chemical Formula: $C_{29}H_{47}N_7O_6$
Exact Mass: 589.36



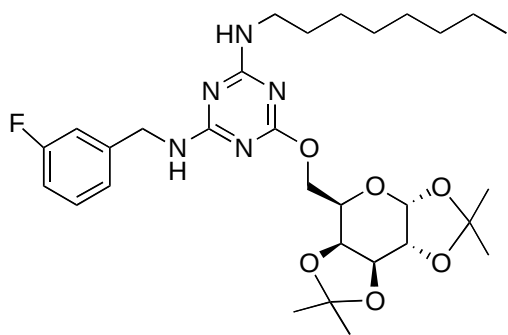
G2



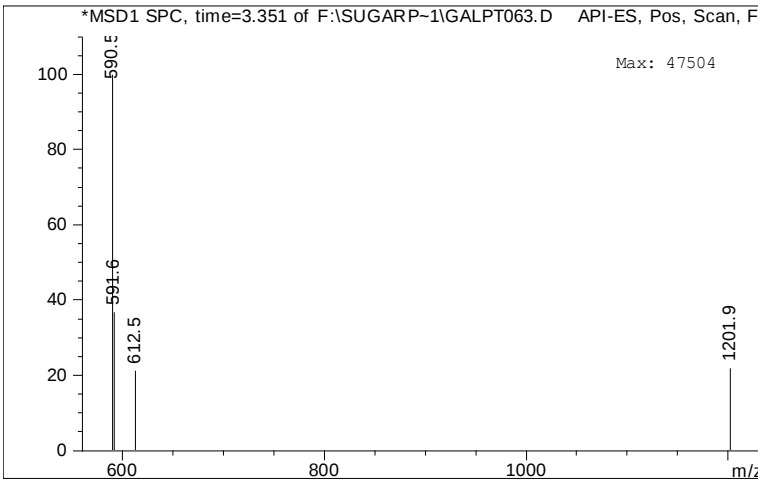
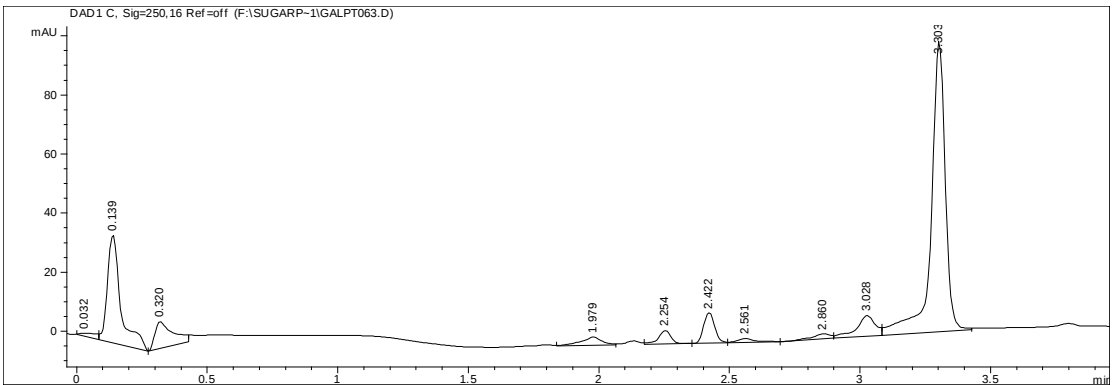
Chemical Formula: C₃₁H₄₅N₅O₈
Exact Mass: 615.33



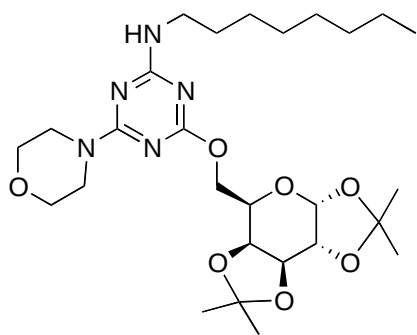
G3



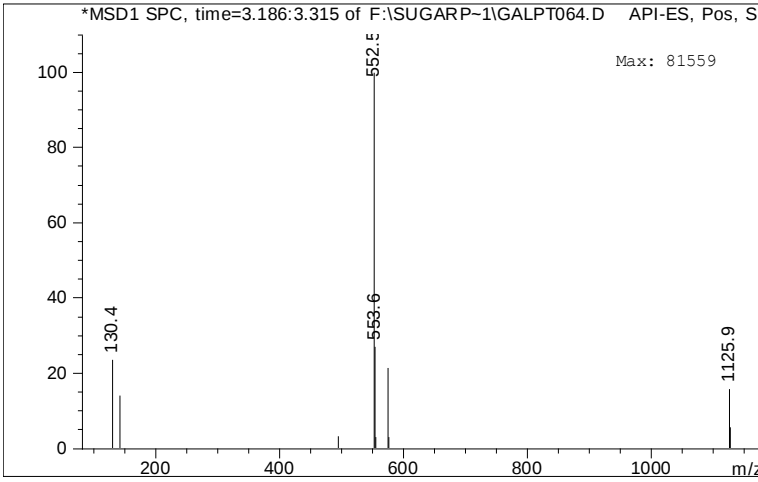
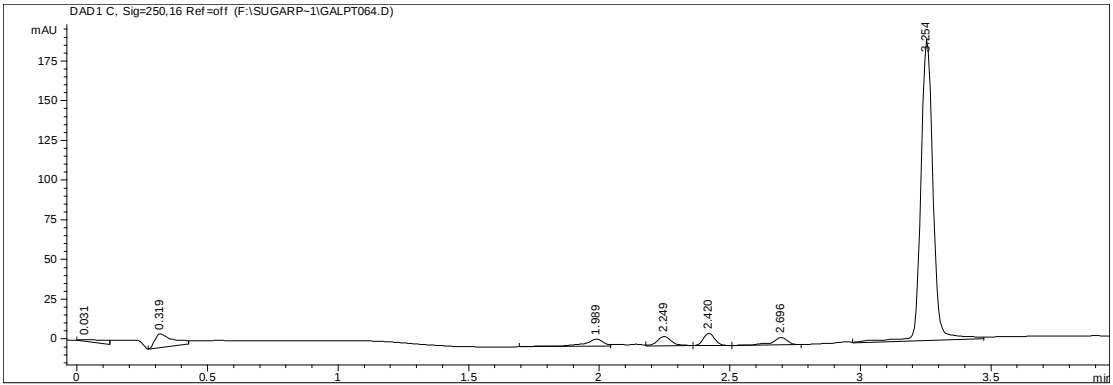
Chemical Formula: C₃₀H₄₄FN₅O₆
Exact Mass: 589.33



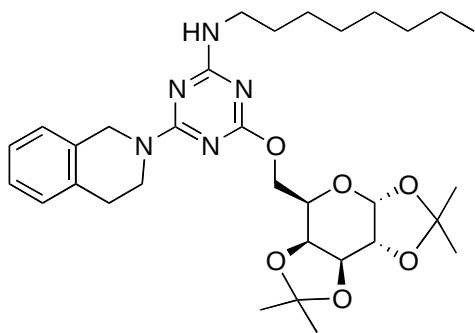
G4



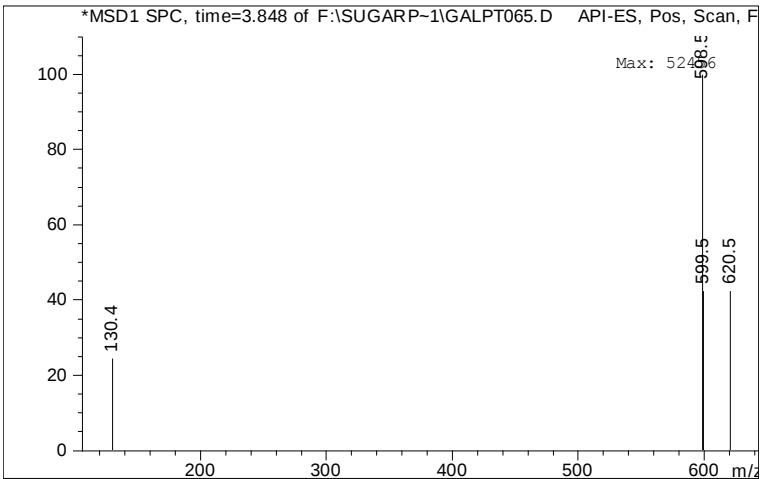
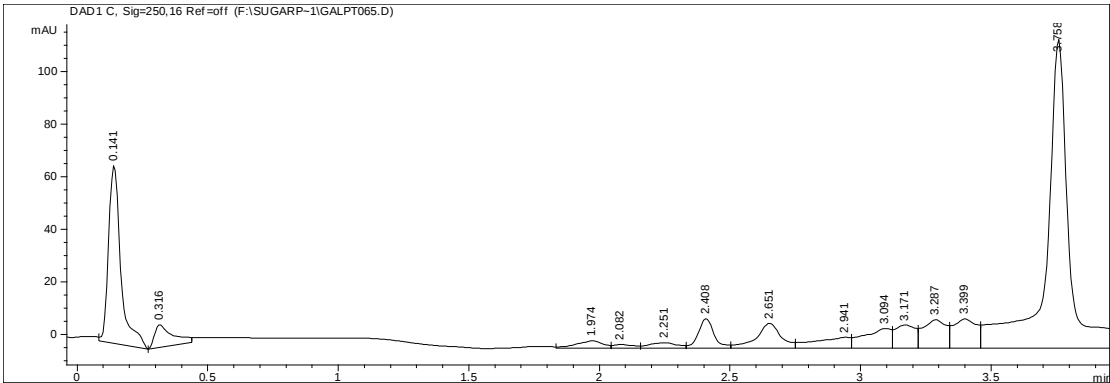
Chemical Formula: $C_{27}H_{45}N_5O_7$
Exact Mass: 551.33



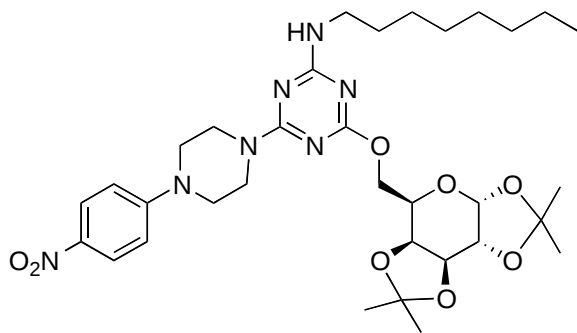
G5



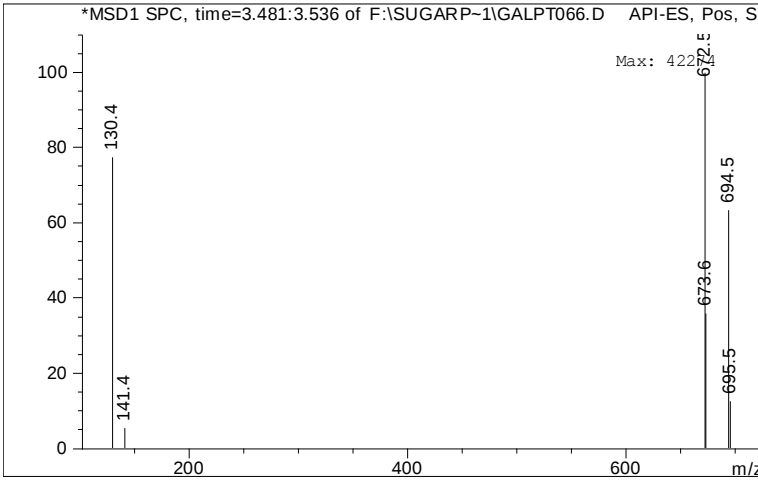
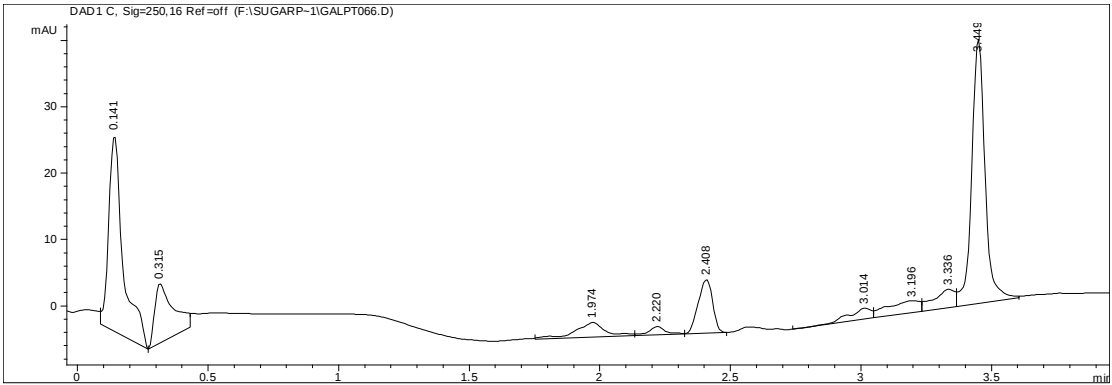
Chemical Formula: C₃₂H₄₇N₅O₆
Exact Mass: 597.35



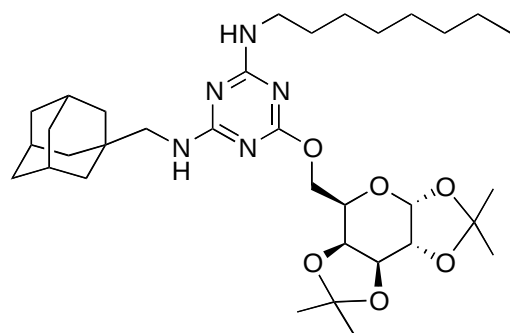
G6



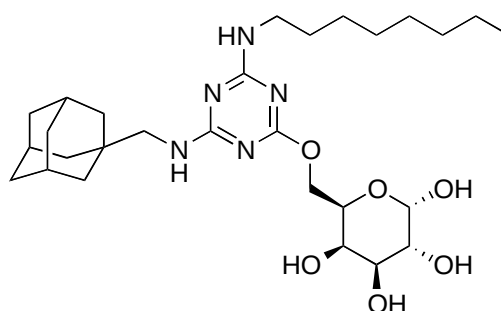
Chemical Formula: C₃₃H₄₉N₇O₈
Exact Mass: 671.36



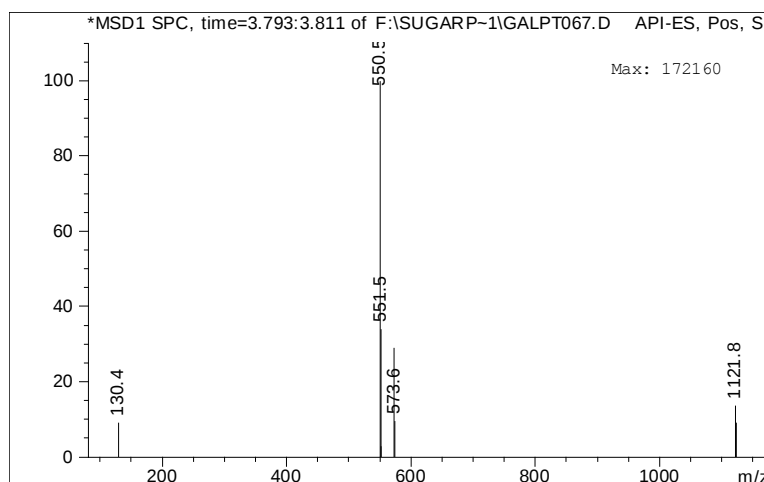
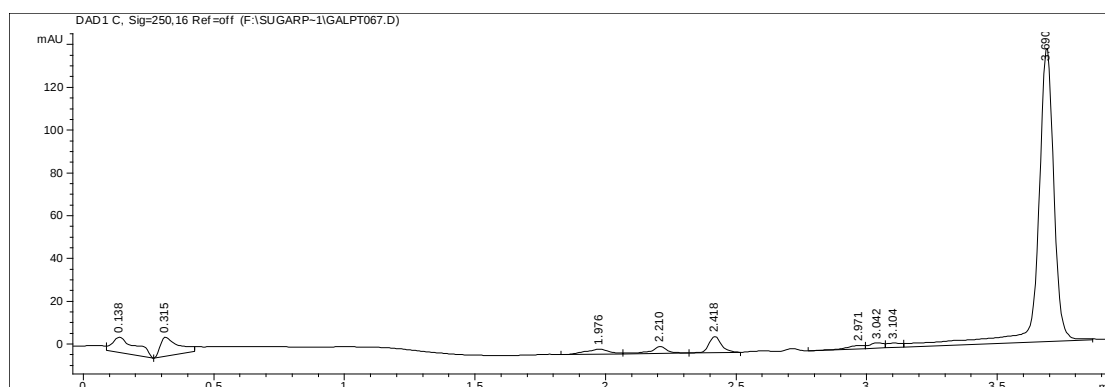
G7



Chemical Formula: $C_{34}H_{55}N_5O_6$
Exact Mass: 629.42

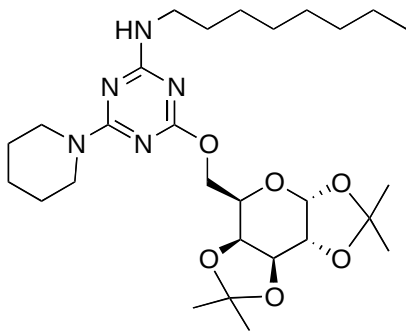


Chemical Formula: $C_{28}H_{47}N_5O_6$
Exact Mass: 549.35

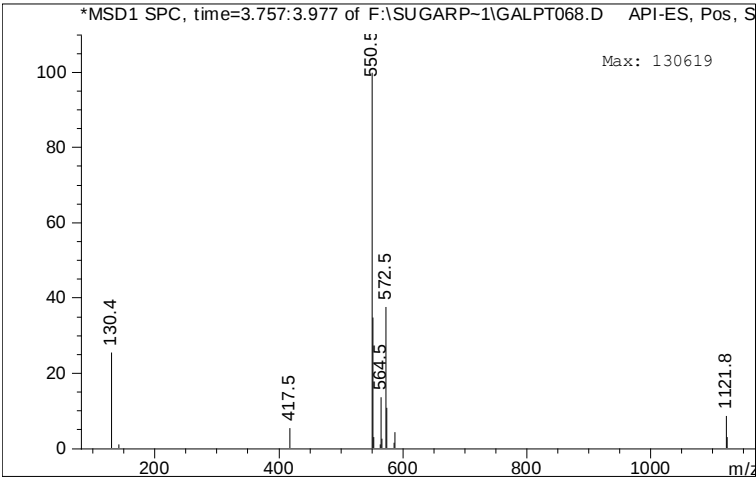
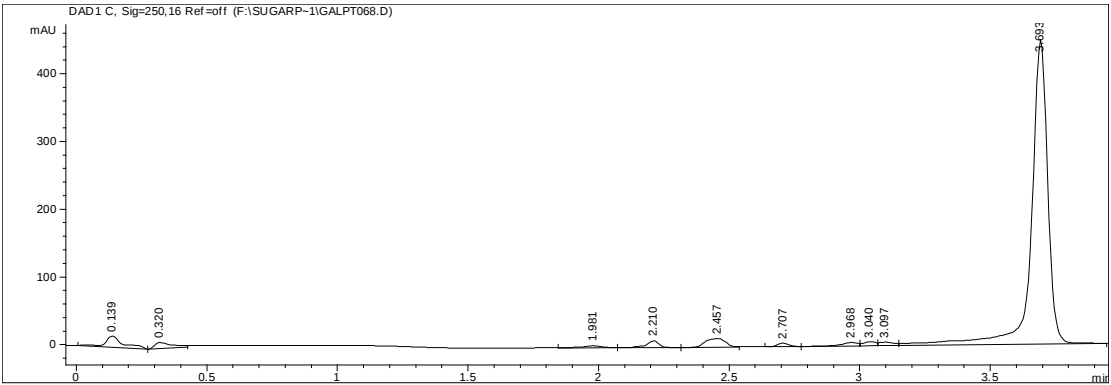


(Mass found corresponds to isopropylidene deprotected fragment. However, based on the LC retention time, the compound is postulated as protected product.)

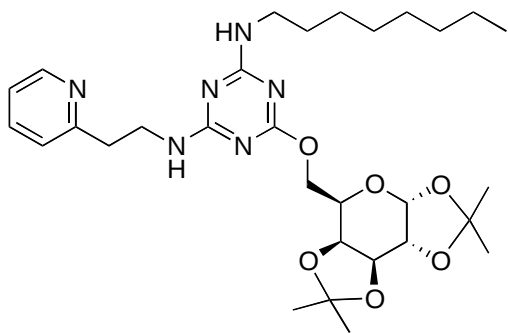
G8



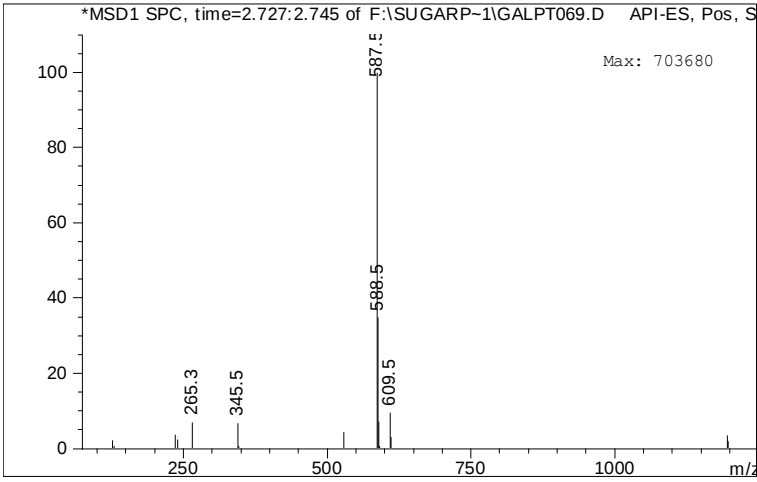
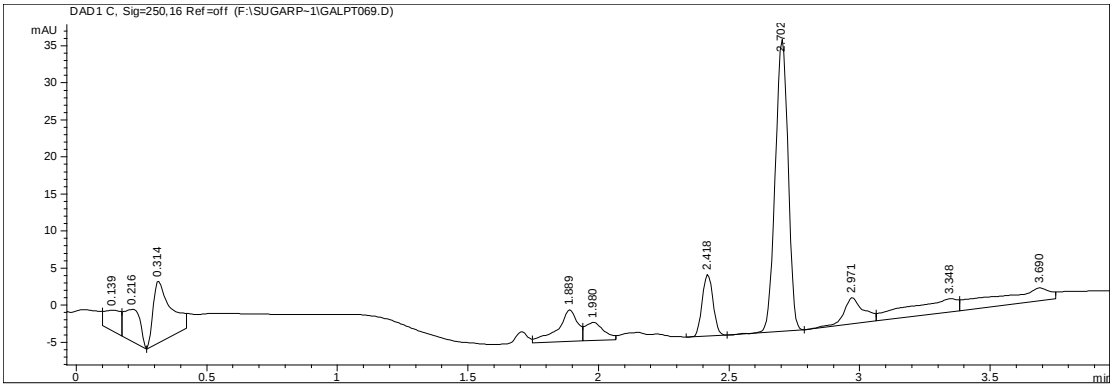
Chemical Formula: C₂₈H₄₇N₅O₆
Exact Mass: 549.35



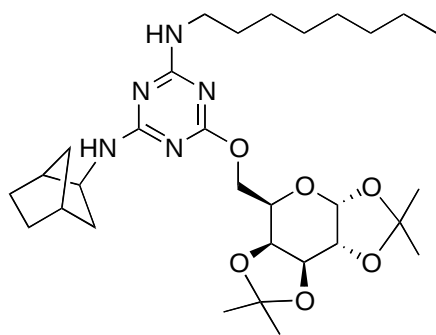
G9



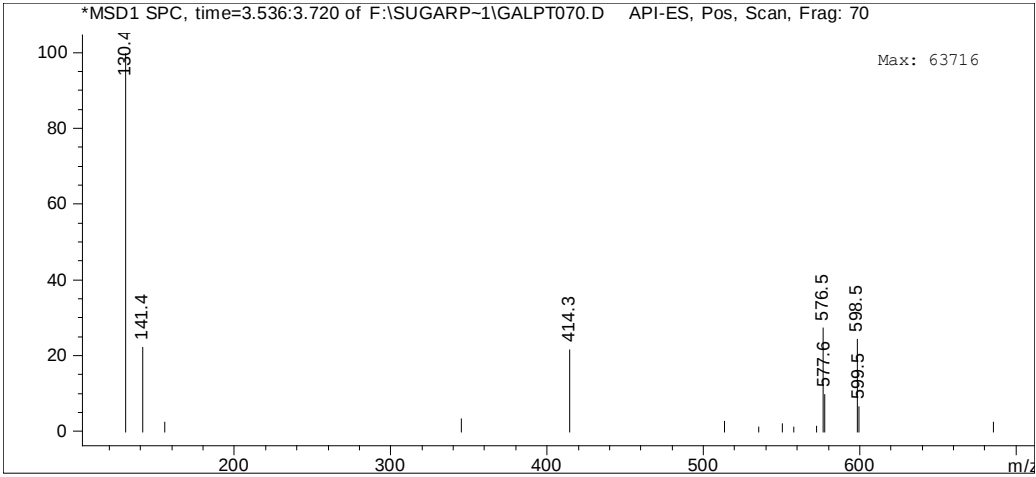
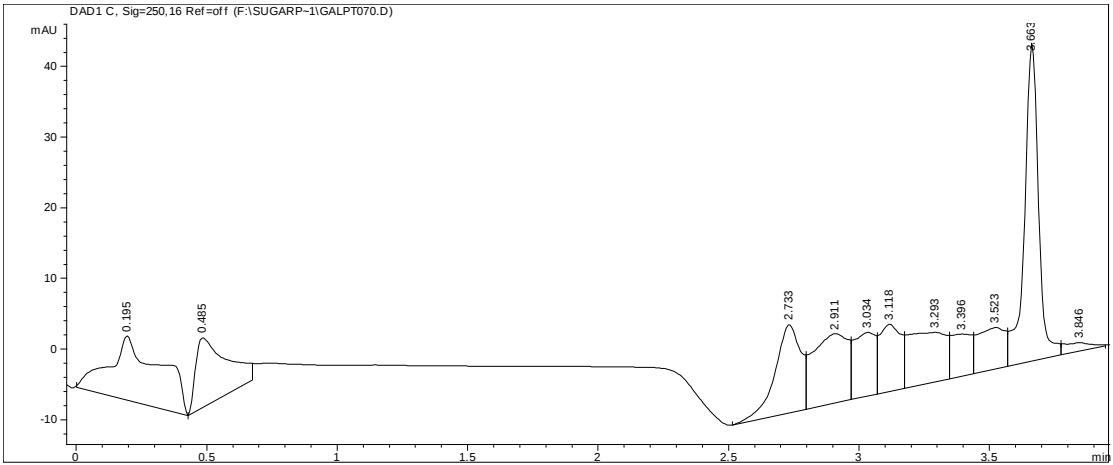
Chemical Formula: C₃₀H₄₆N₆O₆
Exact Mass: 586.35



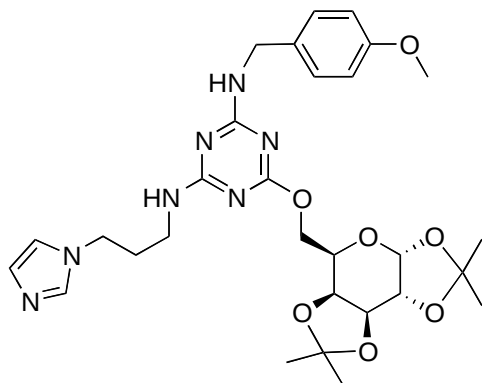
G10



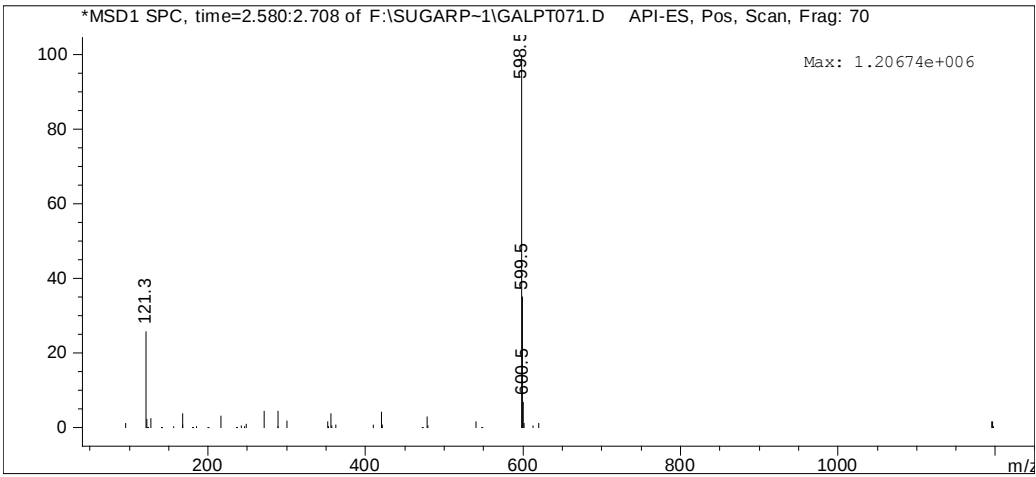
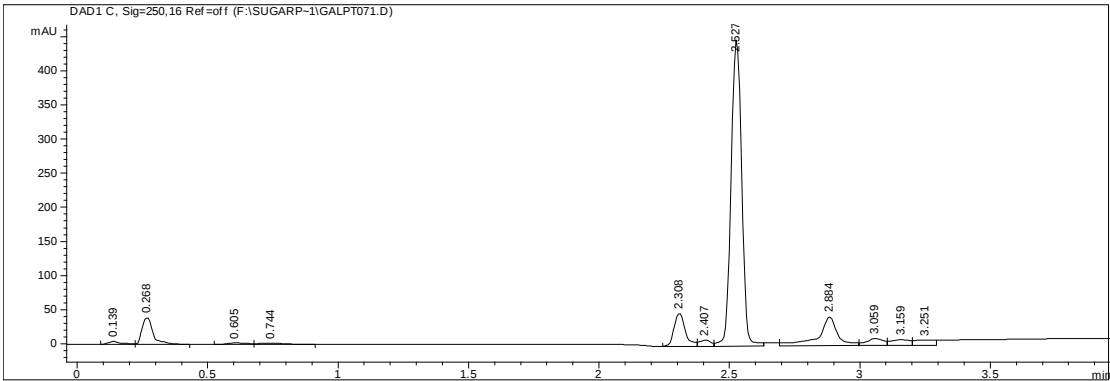
Chemical Formula: $C_{30}H_{49}N_5O_6$
Exact Mass: 575.37



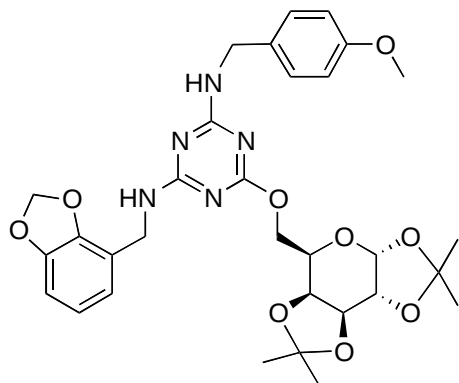
H1



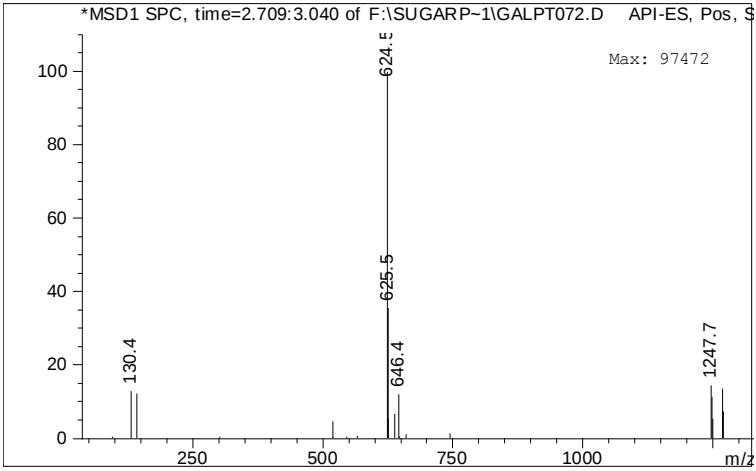
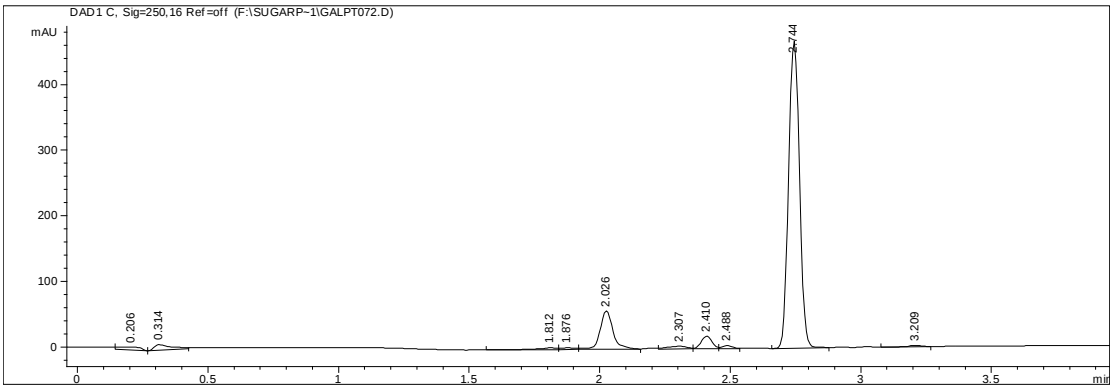
Chemical Formula: C₂₉H₃₉N₇O₇
Exact Mass: 597.29



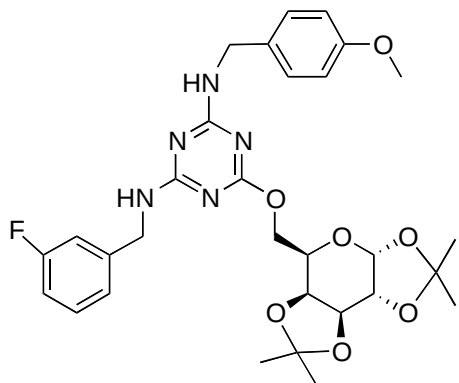
H2



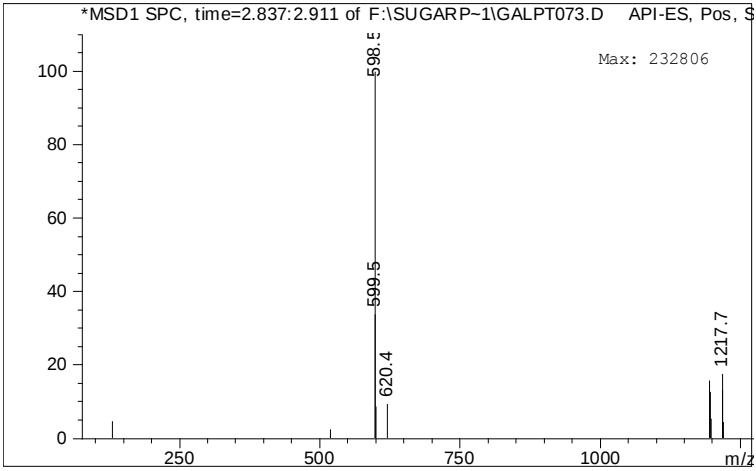
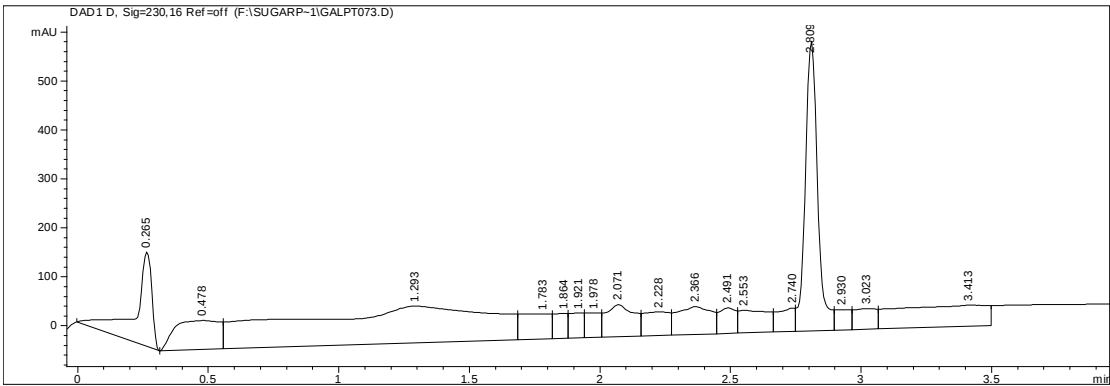
Chemical Formula: $C_{31}H_{37}N_5O_9$
Exact Mass: 623.26



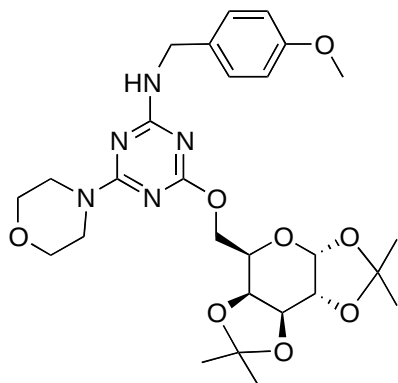
H3



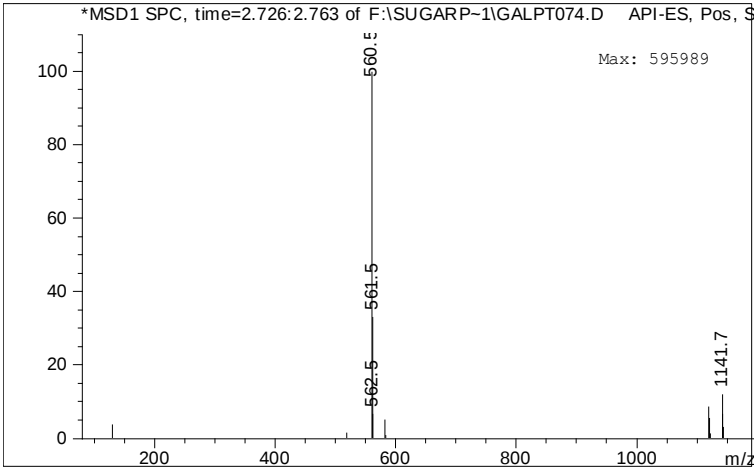
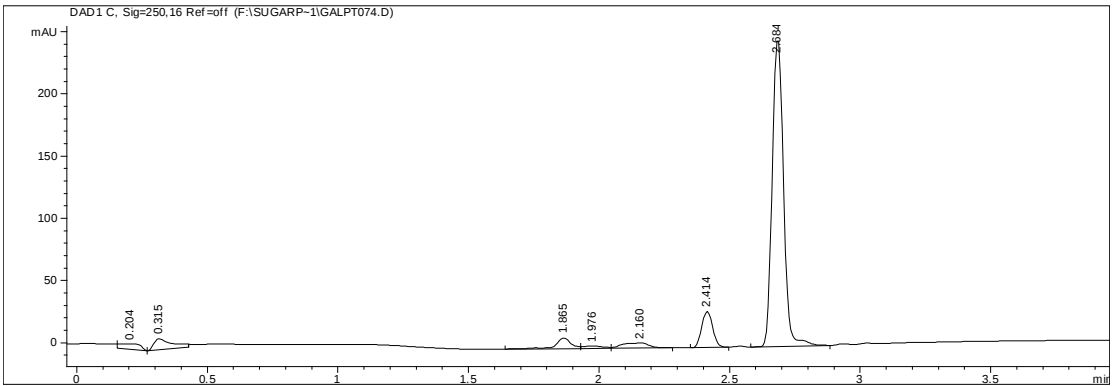
Chemical Formula: C₃₀H₃₆FN₅O₇
Exact Mass: 597.26



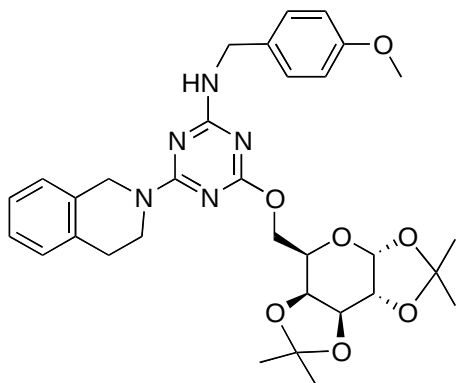
H4



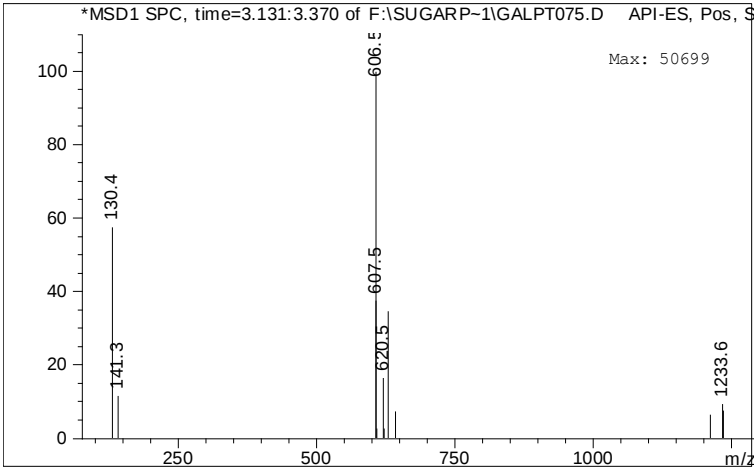
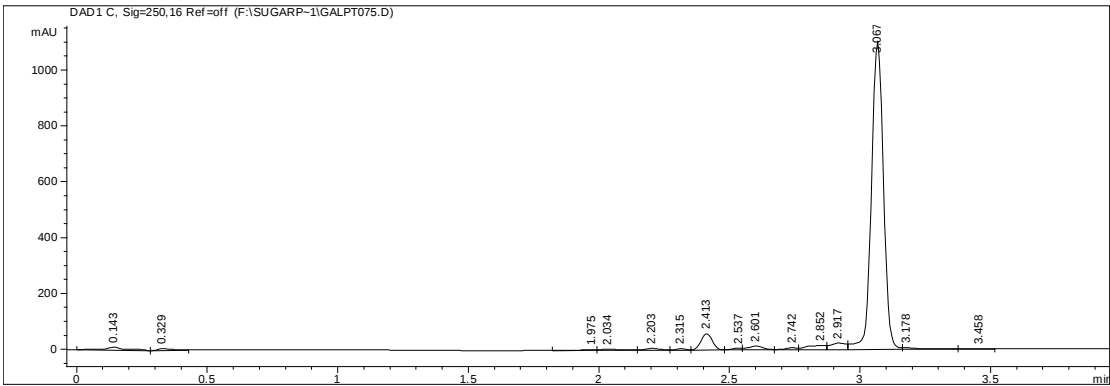
Chemical Formula: C₂₇H₃₇N₅O₈
Exact Mass: 559.26



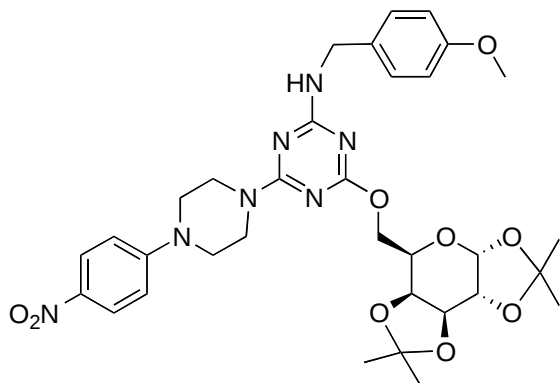
H5



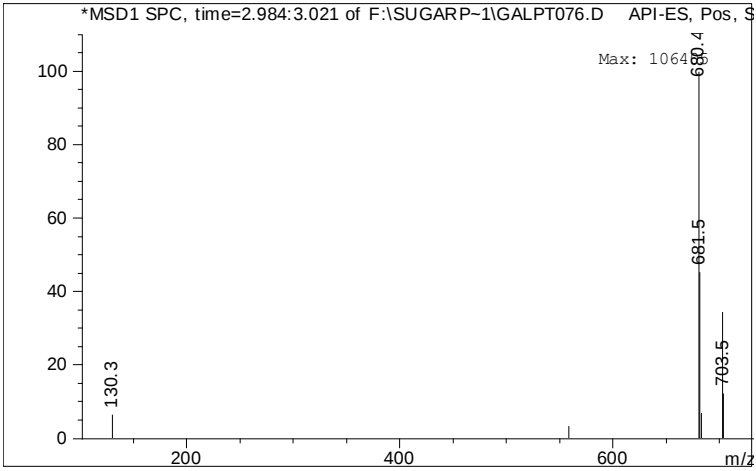
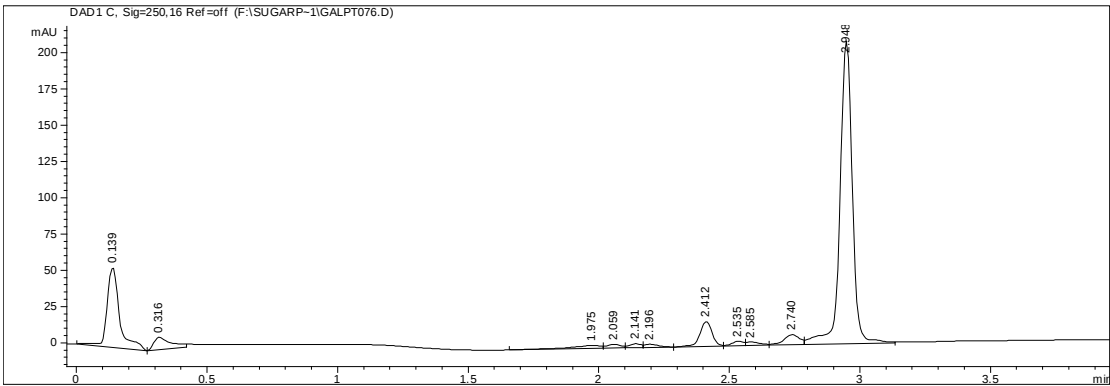
Chemical Formula: C₃₂H₃₉N₅O₇
Exact Mass: 605.28



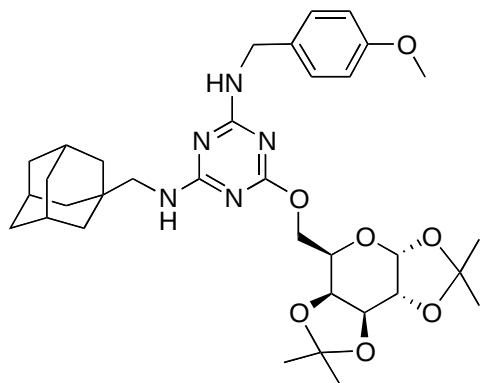
H6



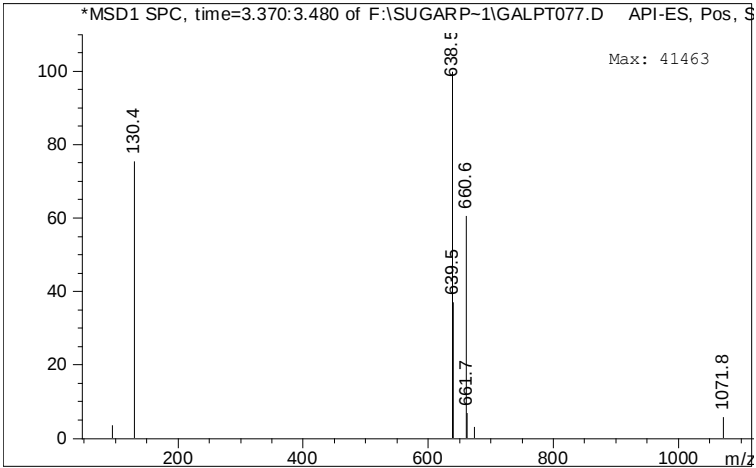
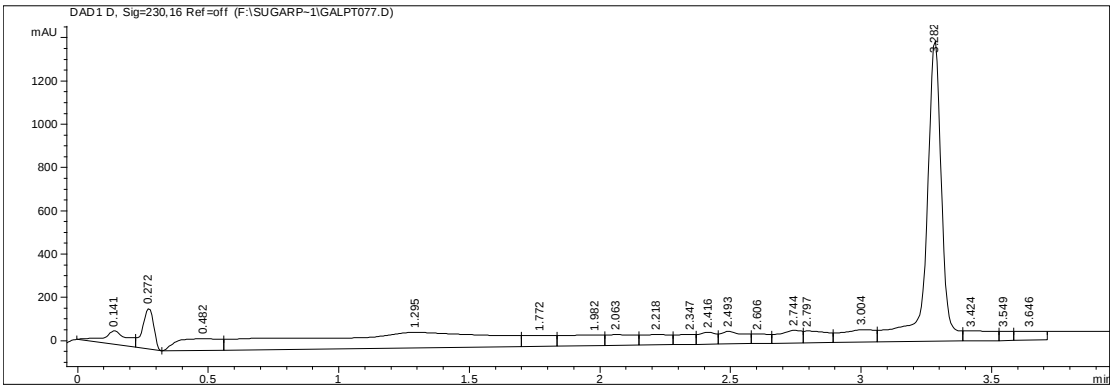
Chemical Formula: $C_{33}H_{41}N_7O_9$
Exact Mass: 679.30



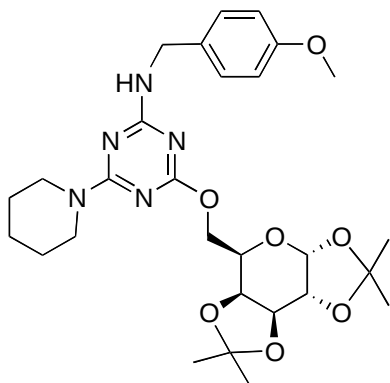
H7



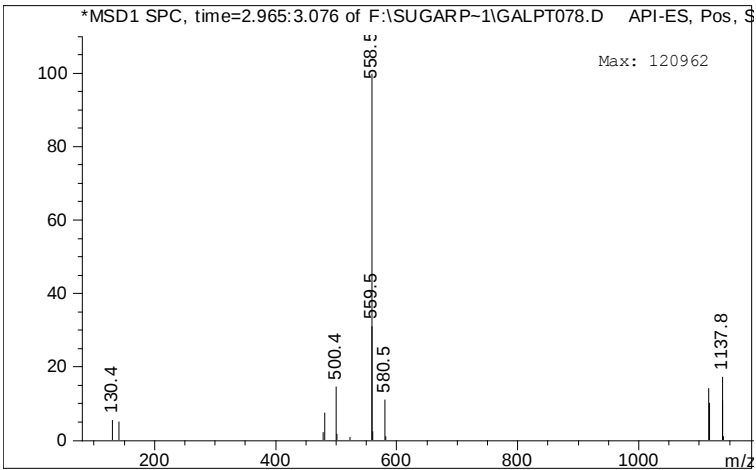
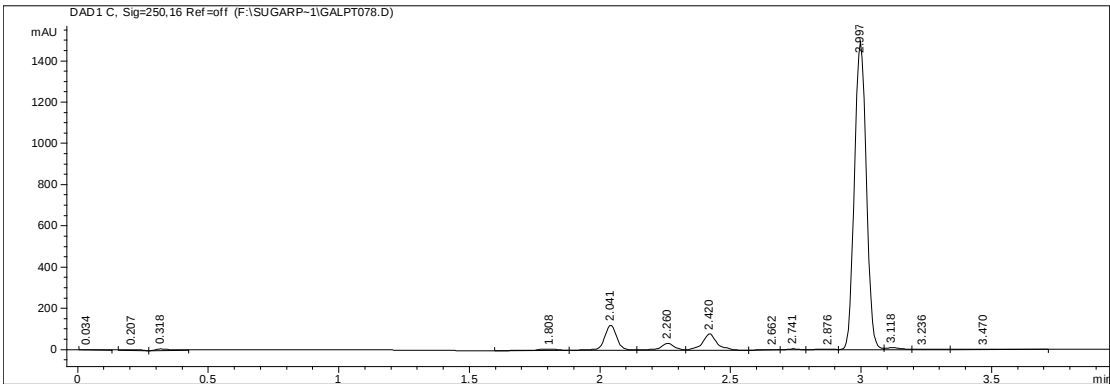
Chemical Formula: $C_{34}H_{47}N_5O_7$
Exact Mass: 637.35



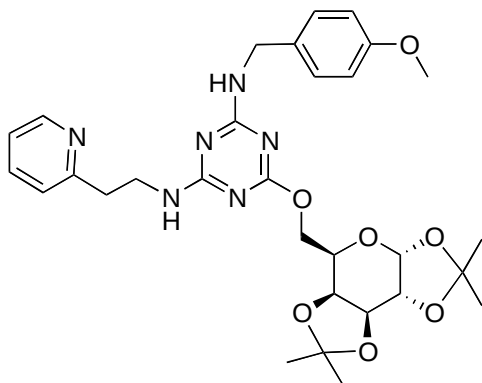
H8



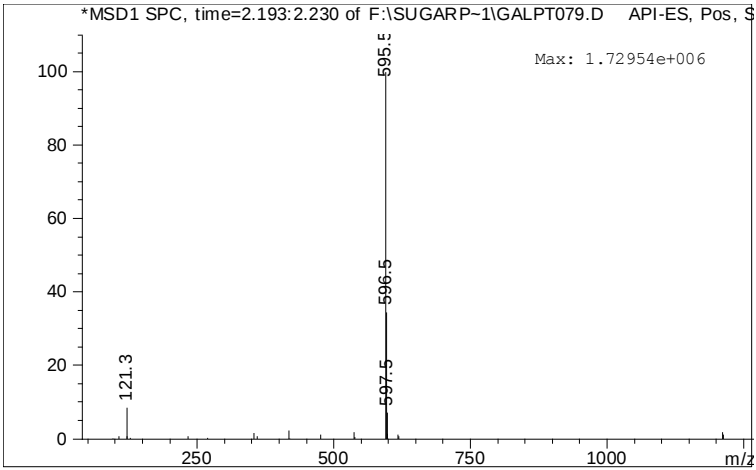
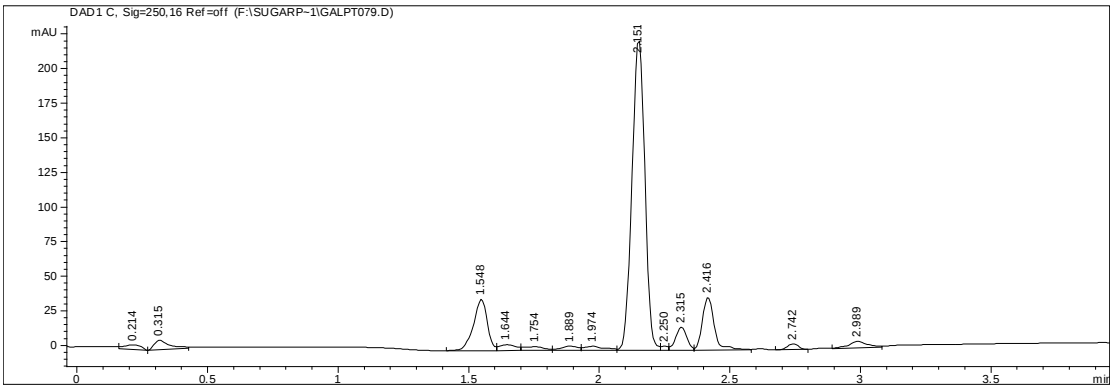
Chemical Formula: C₂₈H₃₉N₅O₇
Exact Mass: 557.28



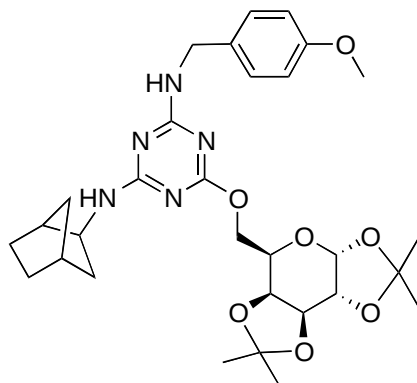
H9



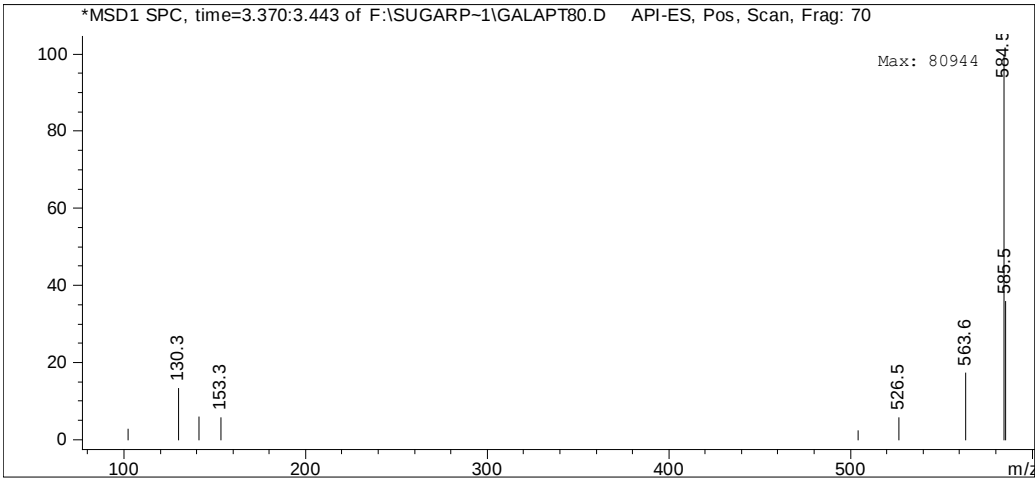
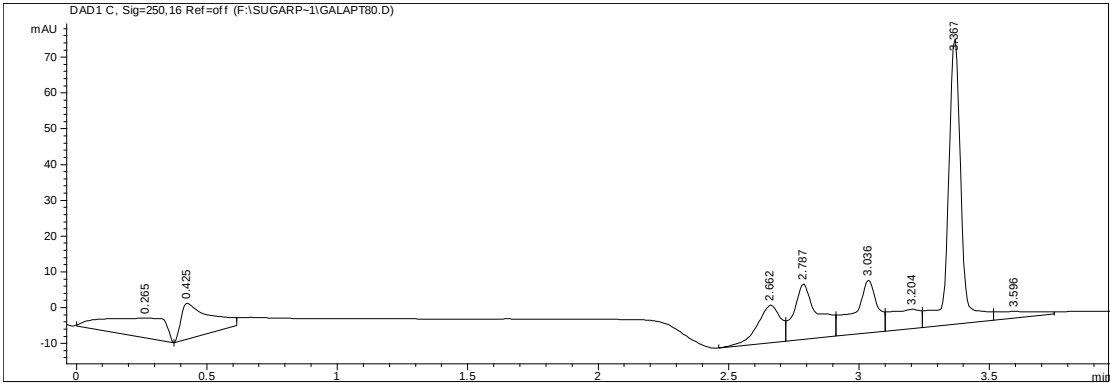
Chemical Formula: C₃₀H₃₈N₆O₇
Exact Mass: 594.28



H10

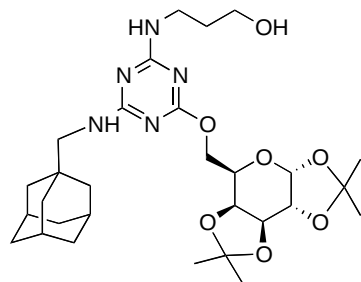


Chemical Formula: C₃₀H₄₁N₅O₇
Exact Mass: 583.30



<Characterization Data of Representative Compounds>

A7



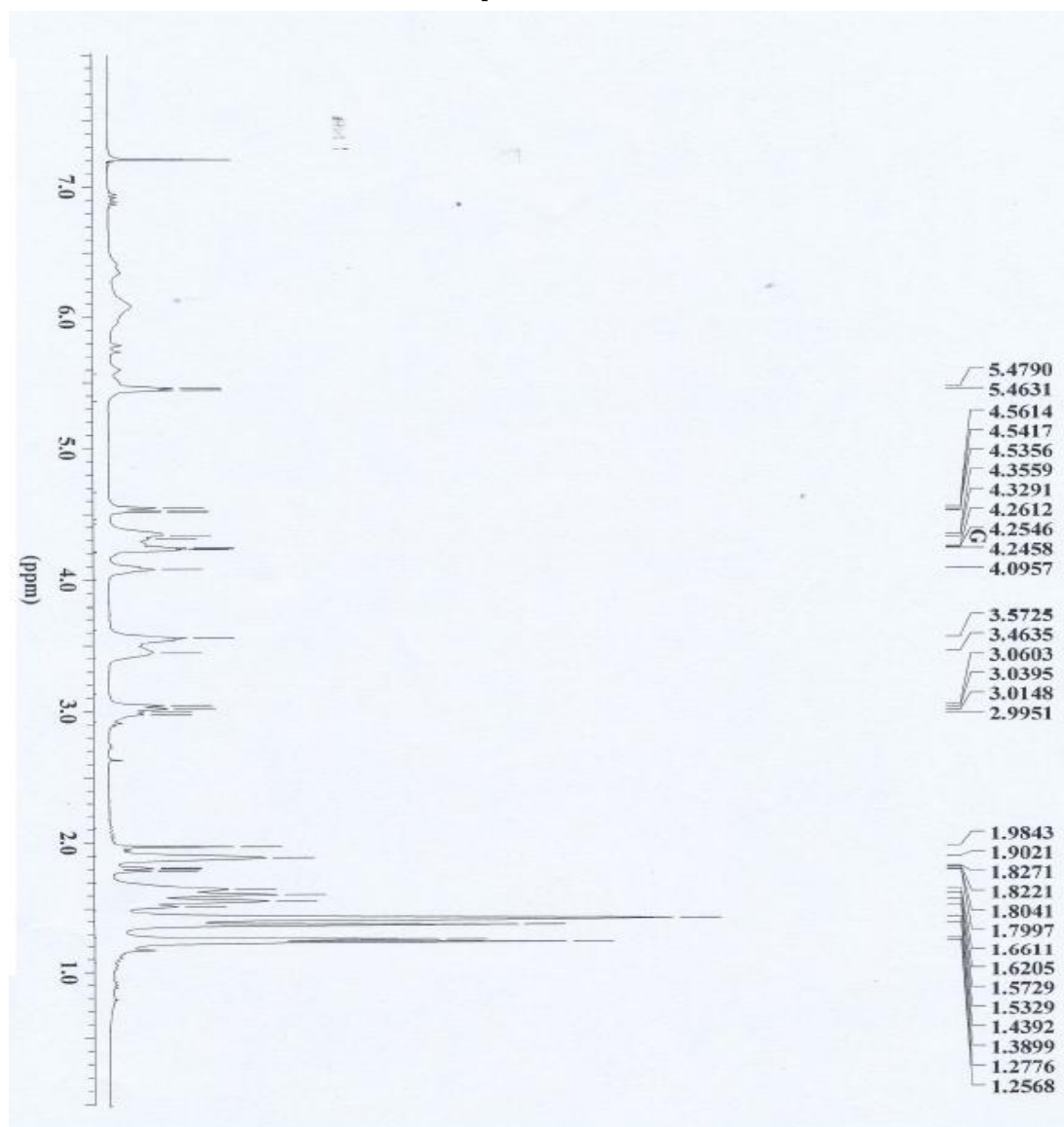
Chemical Formula: C₂₉H₄₅N₅O₇

Exact Mass: 575.33

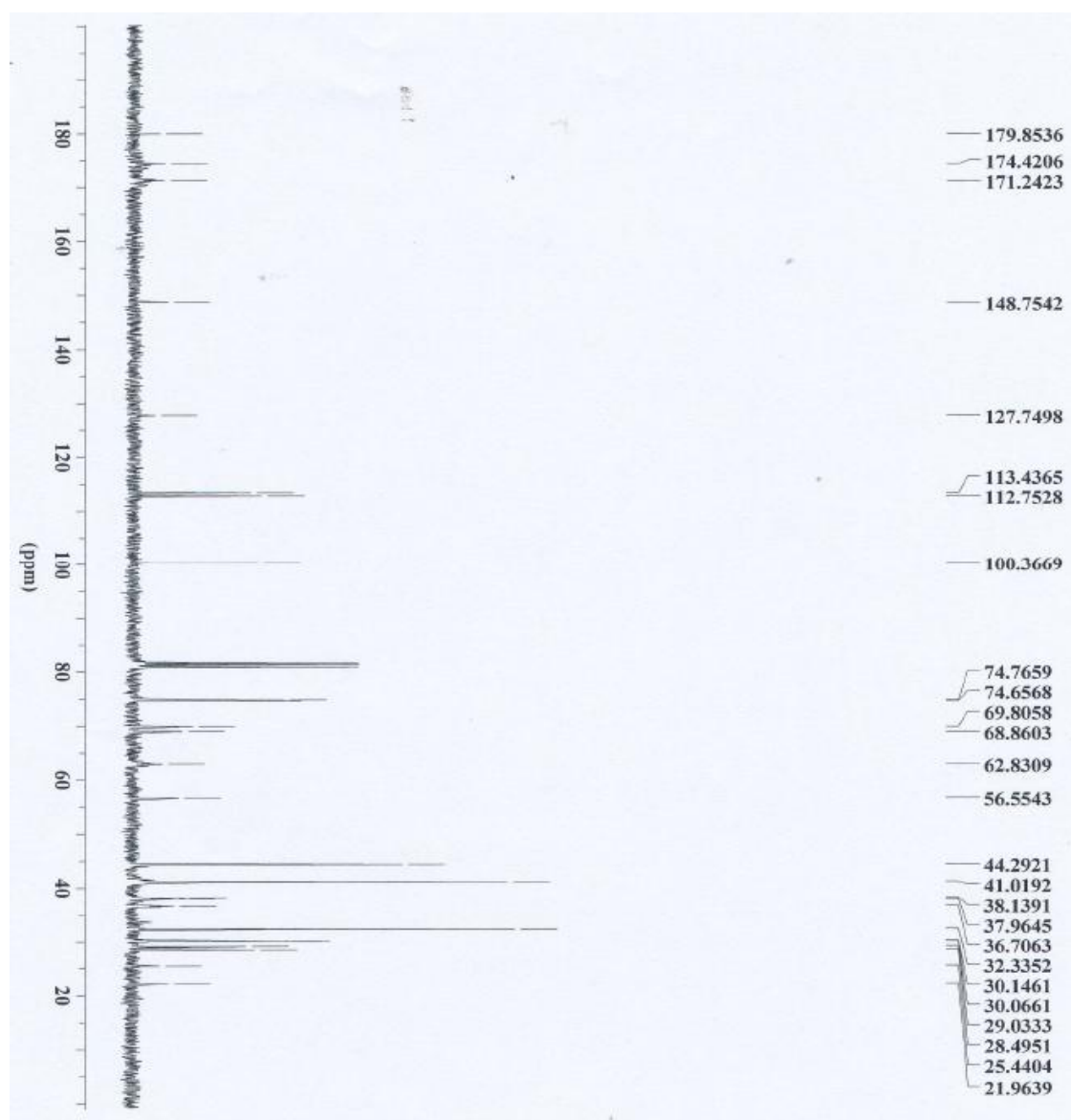
¹H-NMR (300MHz, CDCl₃): δ= 5.48 (d, 1H, J=4.8 Hz), 4.56 (dd, 1H, J=7.7, 1.8 Hz), 4.24-4.35 (m, 4H), 4.10 (brs, 1H), 3.46-3.57 (m, 4H), 3.06 (dd, 2H, J= 13.6, 6.1 Hz), 1.98 (s, 4H), 1.53-1.66 (s, 8H), 1.44 (s, 8H), 1.39 (s, 4H), 1.28 (d, 7H, J=6.2 Hz); ¹³C-NMR (75MHz) δ= 179.8, 174.4, 171.2, 148.7, 127.7, 113.4, 112.7, 100.4, 74.8, 74.6, 69.8, 62.8, 56.5, 44.3, 41.0, 38.1, 38.0, 36.7, 32.3, 30.1, 29.0, 28.5, 25.4, 22.0 ppm; UV λ_{max} (CHCl₃): 247 nm; HRMS (m/z): [M+H]⁺ calcd. for C₂₉H₄₆N₅O₇: 576.3397, found 576.3416.

HPLC chromatogram of **A7** (5-95% CH₃CN-H₂O) over 10 min.

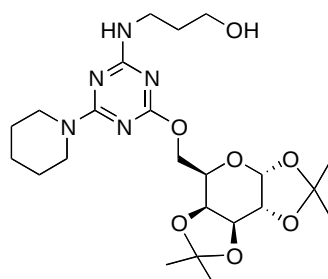
<¹H-NMR Spectral data of A7>



< ^{13}C -NMR Spectral data of A7>



A8

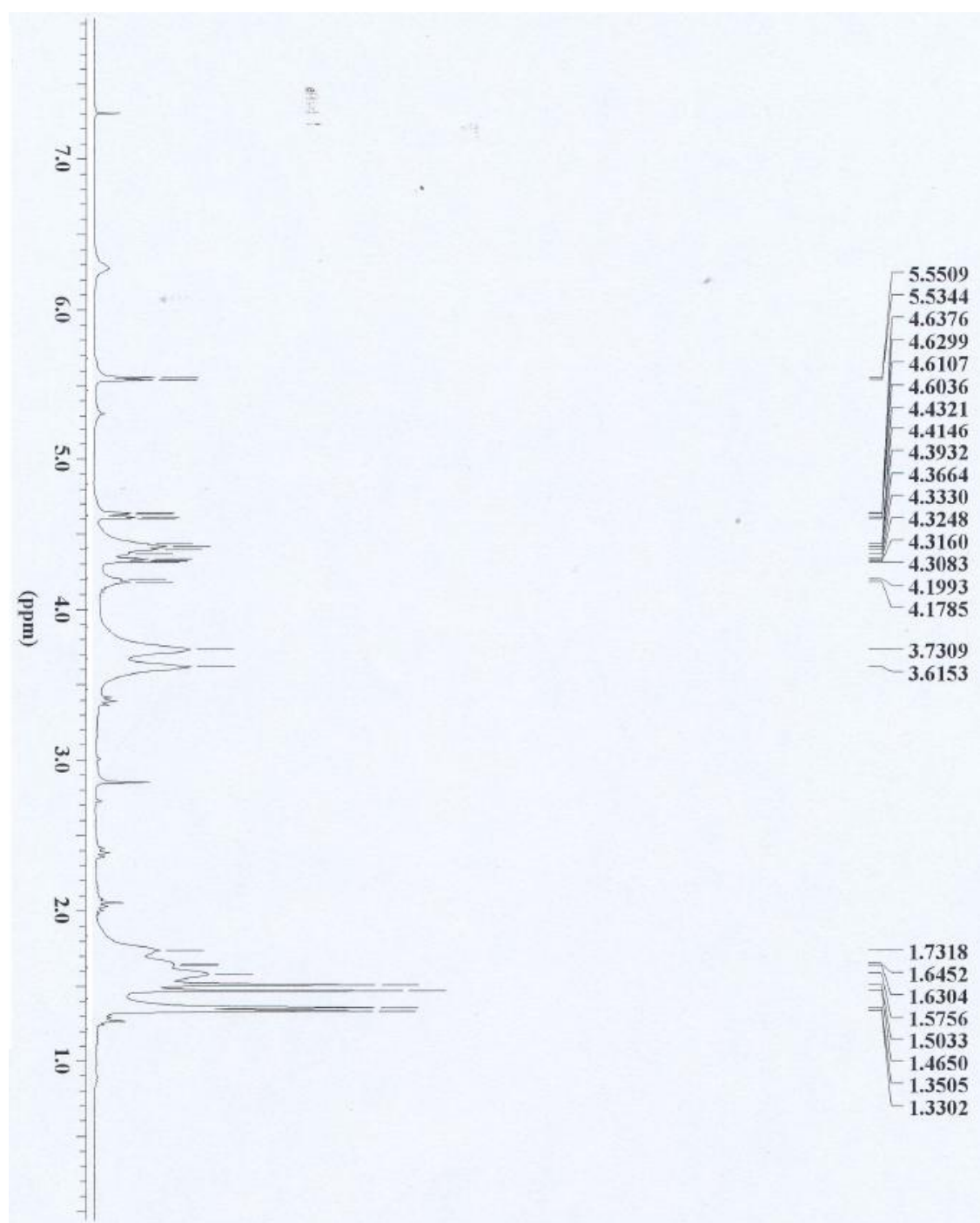


Chemical Formula: $C_{23}H_{37}N_5O_7$
Exact Mass: 495.27

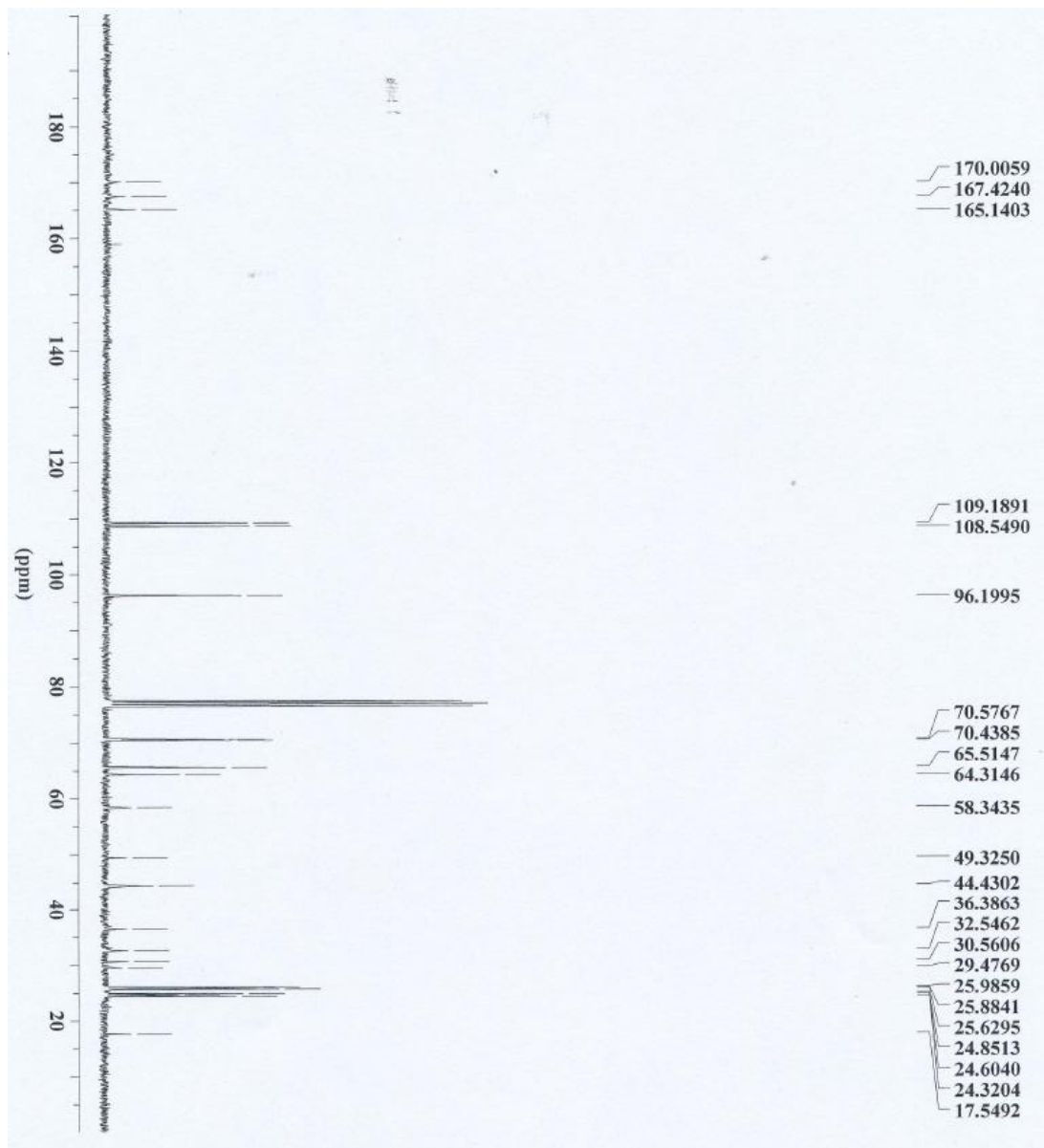
1H -NMR (300MHz, $CDCl_3$): δ = 5.55 (d, 1H, J = 5.0 Hz), 4.64 (dd, 1H, J = 8.07, 2.3 Hz), 4.37-4.43 (m, 1H), 4.33 (q, 1H, J = 2.4 Hz), 4.20 (m, 1H), 3.73 (brs, 6H), 3.62 (brs, 4H), 1.58-1.73 (m, 8H), 1.50 (s, 3H), 1.46 (s, 3H), 1.35 (d, 6H, J = 6.1 Hz); ^{13}C -NMR (75MHz) δ = 170.0, 167.4, 165.1, 109.2, 108.5, 96.2, 70.6, 70.4, 65.5, 64.3, 58.3, 49.3, 44.4, 36.4, 32.5, 30.6, 29.5, 26.0, 25.9, 25.6, 24.8, 24.6, 24.3 ppm; UV λ_{max} ($CHCl_3$): 247 nm; HRMS (m/z): $[M+H]^+$ calcd. for $C_{23}H_{38}N_5O_7$: 496.2771, found 496.2773.

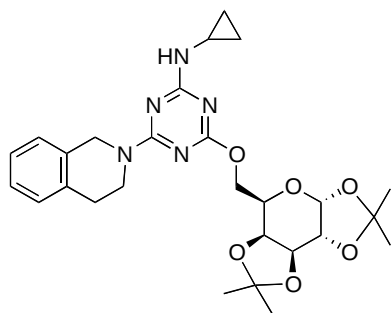
HPLC chromatogram of **A8** (5-95% CH_3CN - H_2O) over 10 min.

< 1H -NMR Spectral data of **A8**>



< ^{13}C -NMR Spectral data of **A8**>



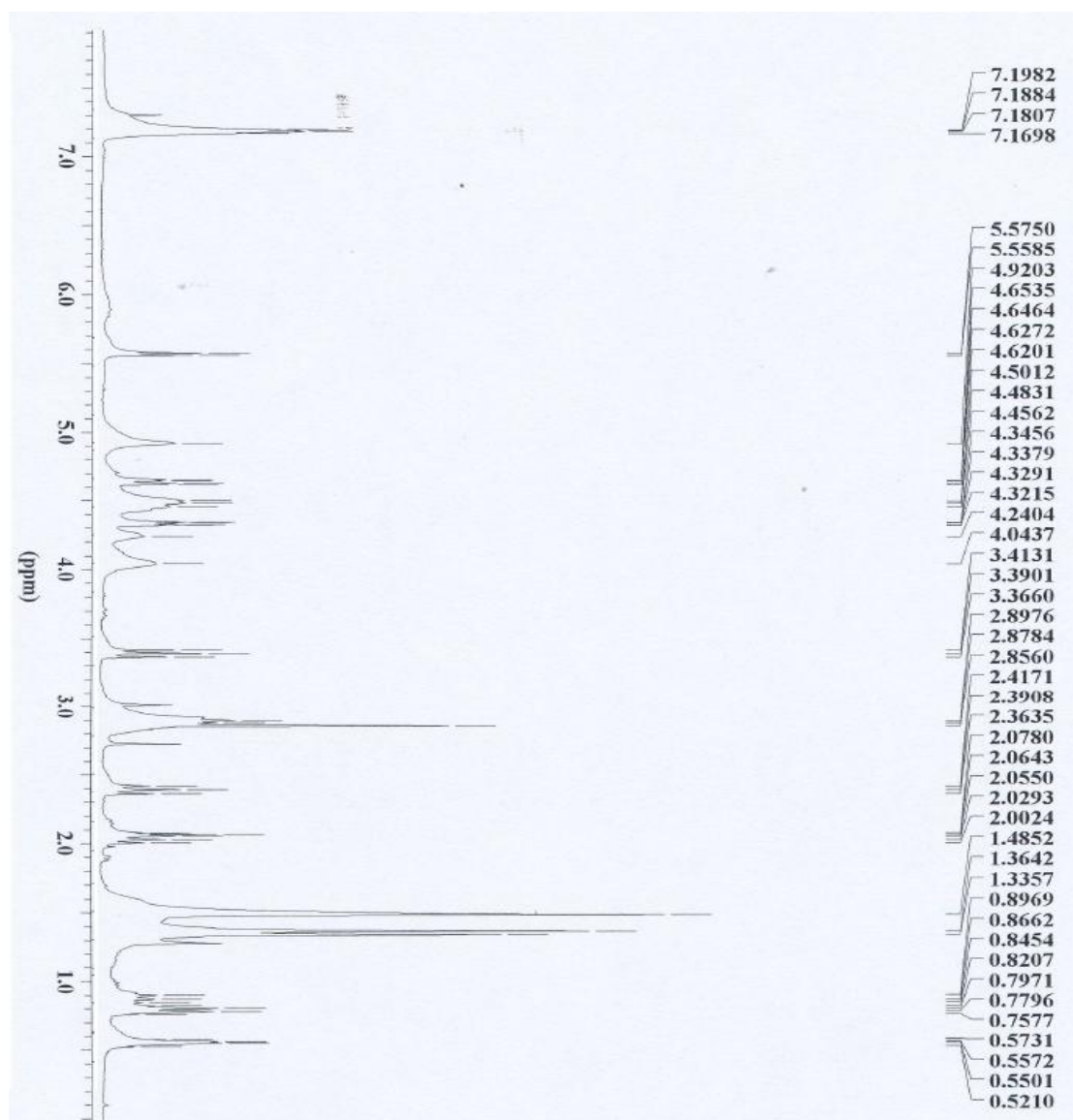


Chemical Formula: $C_{27}H_{35}N_5O_6$
Exact Mass: 525.26

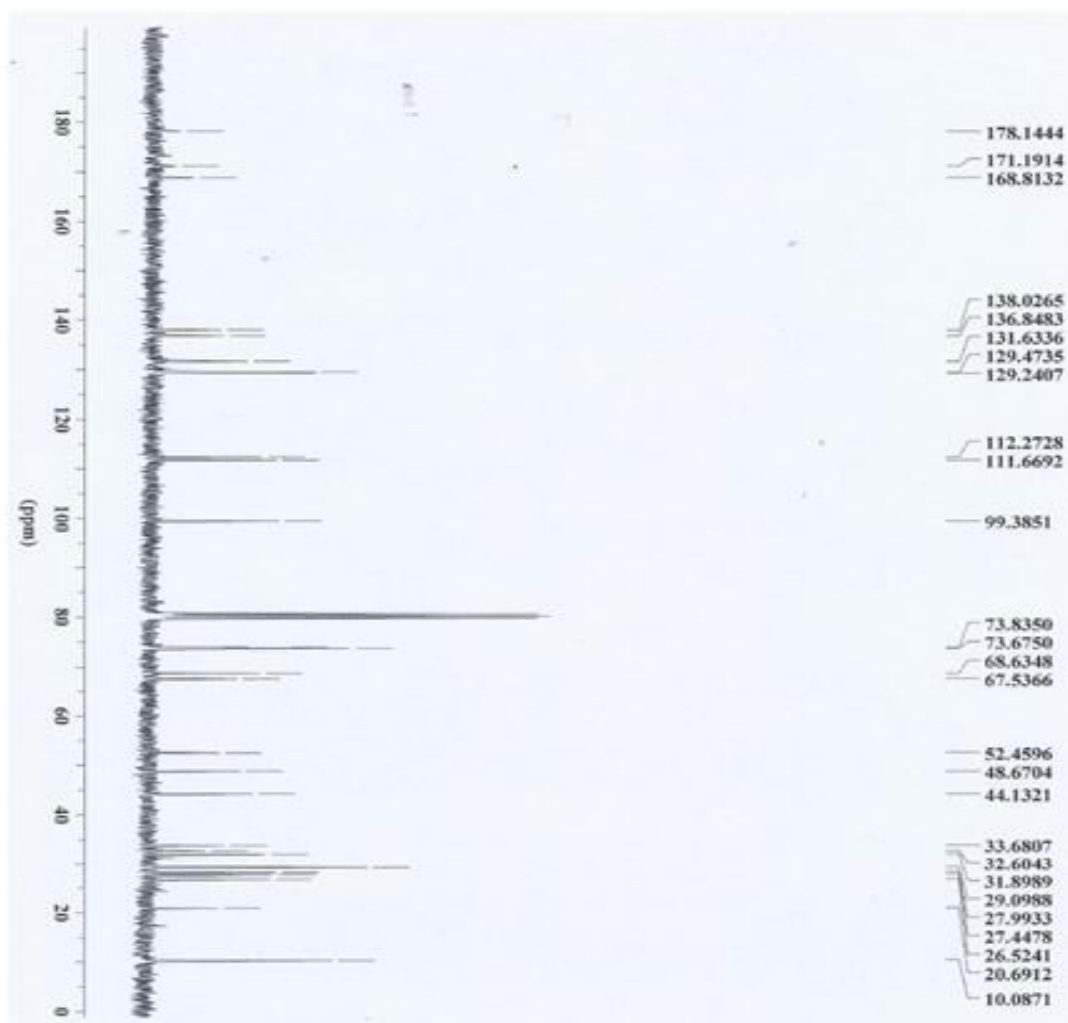
1H -NMR (300MHz, $CDCl_3$): δ = 7.17-7.20 (m, 4H), 5.58 (d, 1H, J =5.0 Hz), 4.92 (brs, 2H), 4.65 (dd, 1H, J =7.9, 2.1 Hz), 4.46-4.50 (m, 1H), 4.34 (q, 1H, J = 2.3 Hz), 4.20-4.30 (m, 1H), 4.04 (brs, 1H), 3.39 (t, 1H, J =6.9 Hz), 2.86-2.90 (m, 1H), 2.39 (t, 1H, J =7.9 Hz), 2.00-2.08 (m, 1H), 1.48 (s, 6H), 1.36 (d, 6H, J =8.6), 0.76-0.90 (m, 3H), 0.52-0.57 (m, 2H); ^{13}C -NMR (75MHz) δ = 178.1, 171.2, 168.8, 138.0, 136.8, 131.6, 129.5, 129.4, 112.3, 111.7, 99.4, 73.8, 73.7, 68.6, 67.5, 52.4, 48.7, 44.1, 33.7, 32.6, 31.9, 29.1, 28.0, 27.4, 26.5, 20.7, 10.1 ppm; UV λ_{max} ($CHCl_3$): 247 nm; HRMS (m/z): $[M+H]^+$ calcd. for $C_{27}H_{36}N_5O_6$: 526.2666, found 526.2660.

HPLC chromatogram of **B5** (5-95% CH_3CN-H_2O) over 10 min.

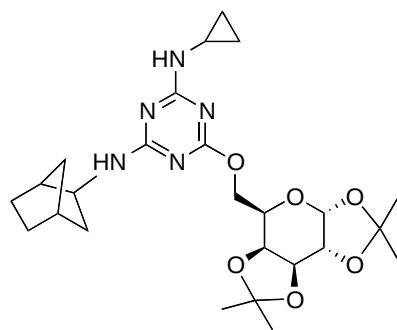
< ^1H -NMR Spectral data of **B5**>



< ^{13}C -NMR Spectral data of **B5**>



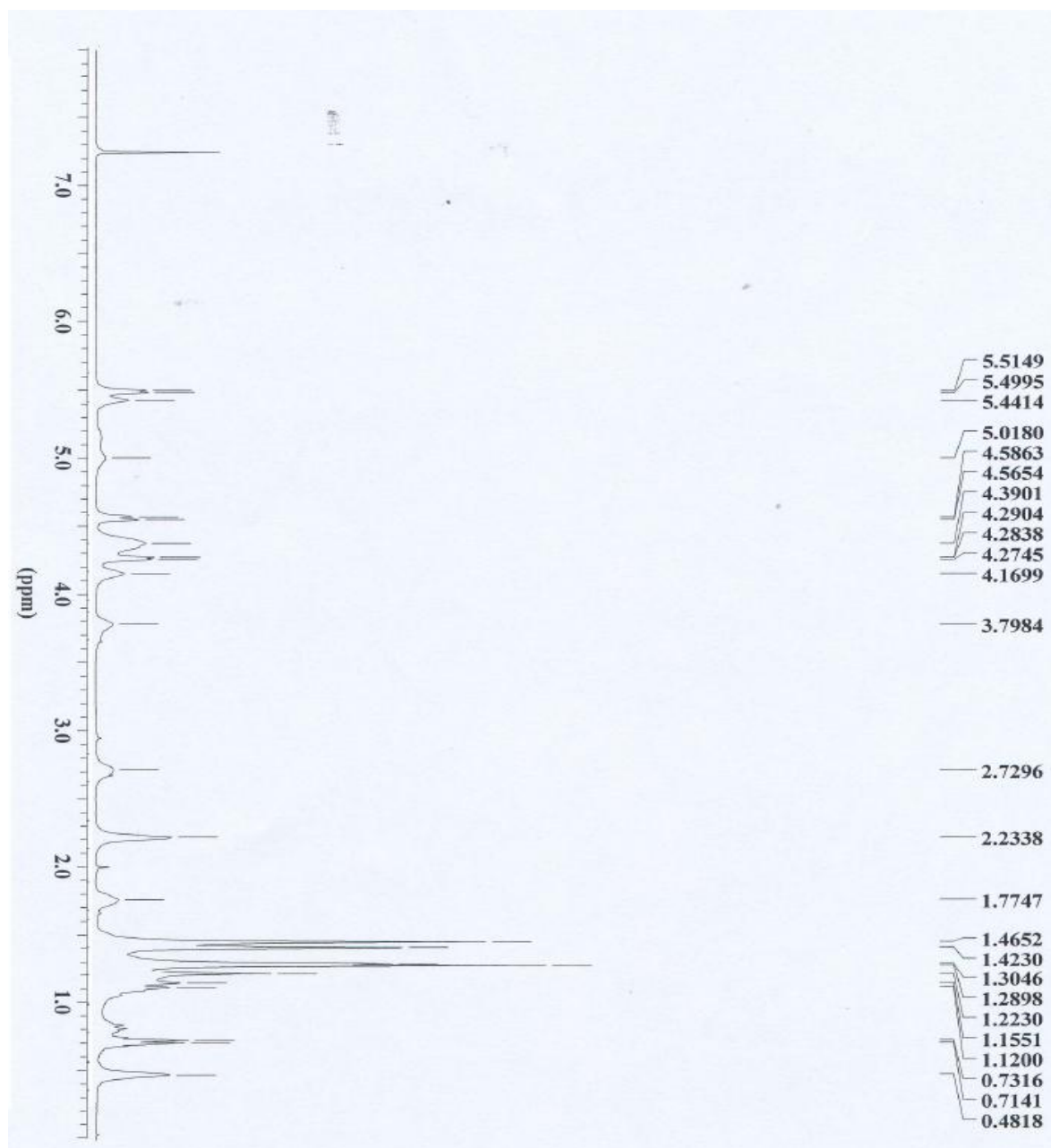
B10



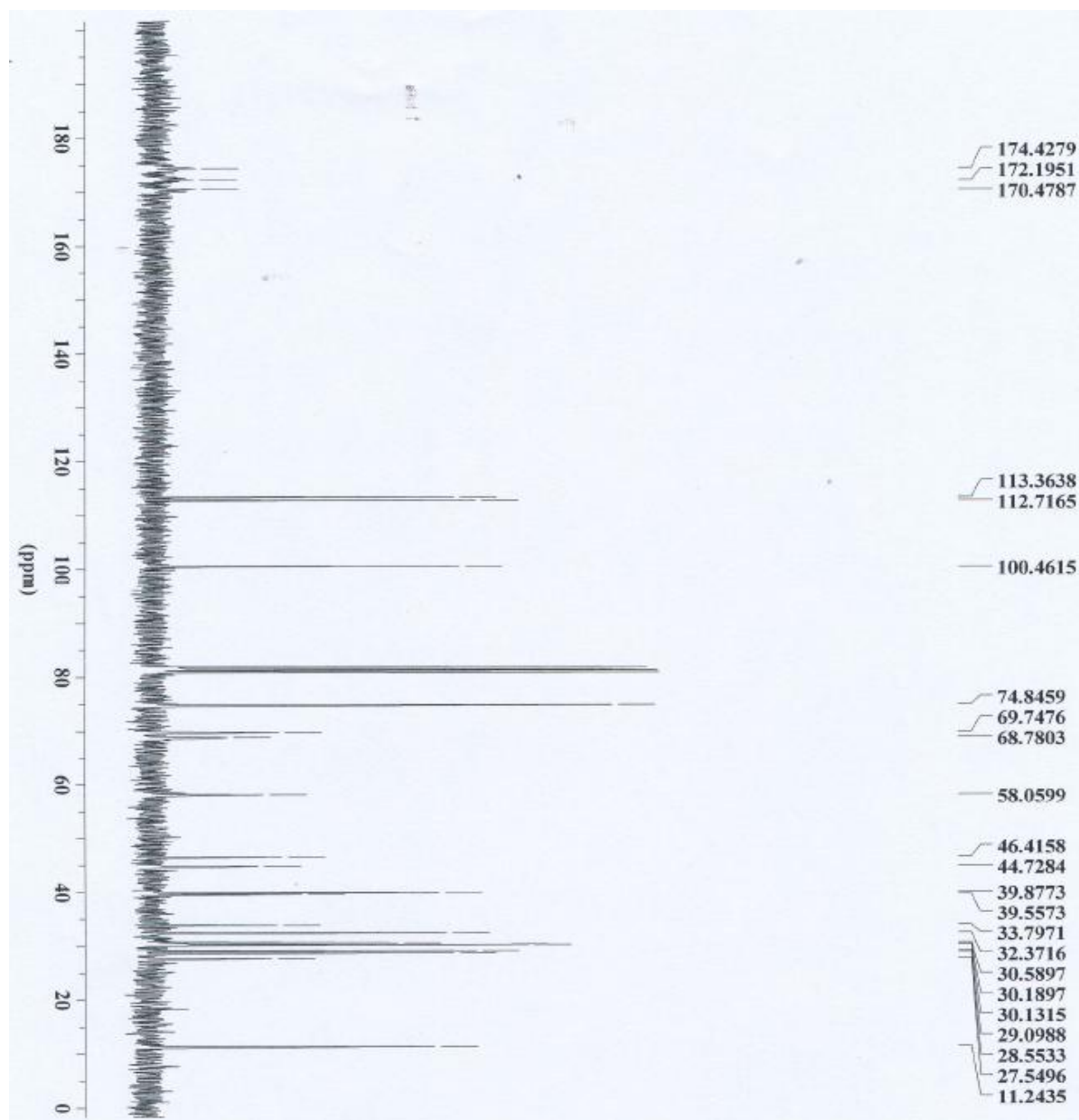
Chemical Formula: $C_{25}H_{37}N_5O_6$
Exact Mass: 503.27

1H -NMR (300MHz, $CDCl_3$): δ 5.51 (d, 1H, $J=4.6$ Hz), 4.58 (d, 1H, $J=6.2$ Hz), 4.27-4.39 (m, 4H), 4.17 (brs, 1H), 3.80 (brs, 1H), 2.73 (brs, 1H), 2.23 (s, 2H), 1.77 (brs, 1H), 1.46 (s, 4H), 1.42 (s, 3H), 1.30 (d, 7H, $J=4.4$ Hz), 1.12-1.22 (m, 6H), 0.78-0.99 (m, 1H), 0.73 (d, 2H, $J=5.2$ Hz), 0.48 (s, 2H); ^{13}C -NMR (75MHz) δ = 174.4, 172.2, 170.5, 113.4, 112.7, 100.5, 74.8, 69.7, 68.8, 58.0, 46.4, 44.7, 39.9, 39.6, 33.8, 32.4, 30.6, 30.2, 30.1, 29.0, 28.6, 27.5, 11.2 ppm; UV λ_{max} ($CHCl_3$): 247 nm [ϵ = 10,000 ($cm^{-1}M^{-1}$)]; HRMS (m/z): $[M+H]^+$ calcd. for $C_{25}H_{38}N_5O_6$: 504.2822, found 504.2840.
HPLC chromatogram of **B10** (5-95% CH_3CN-H_2O) over 10 min.

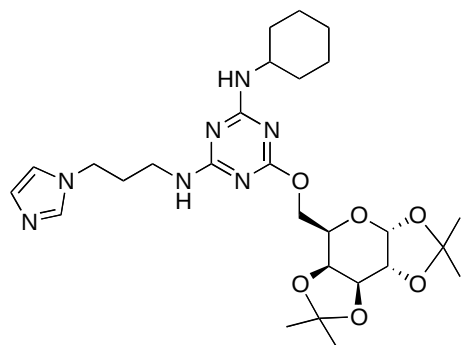
< ^1H -NMR Spectral data of **B10**>



< ^{13}C -NMR Spectral data of **B10**>



C1

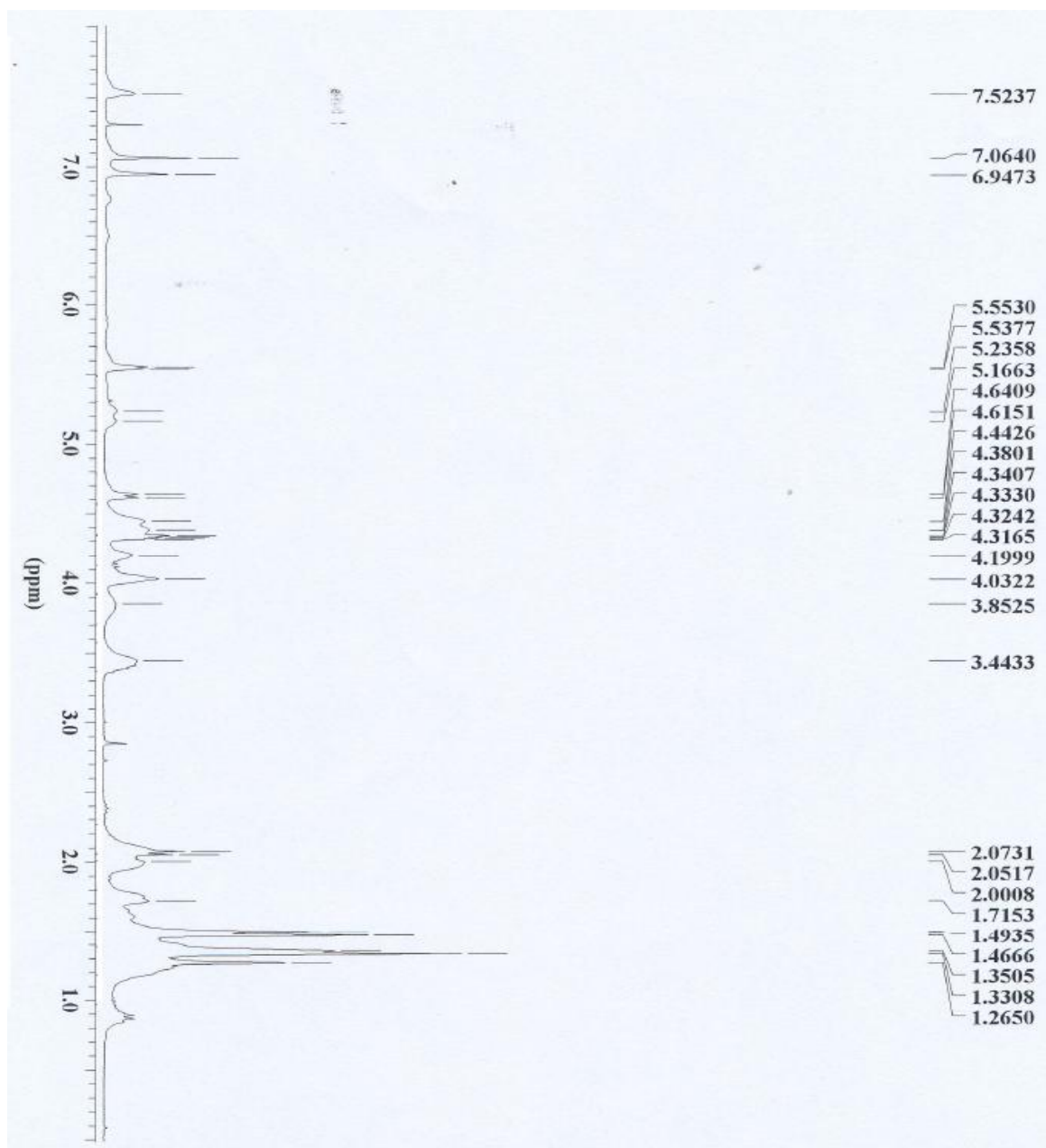


Chemical Formula: $C_{27}H_{41}N_7O_6$
Exact Mass: 559.31

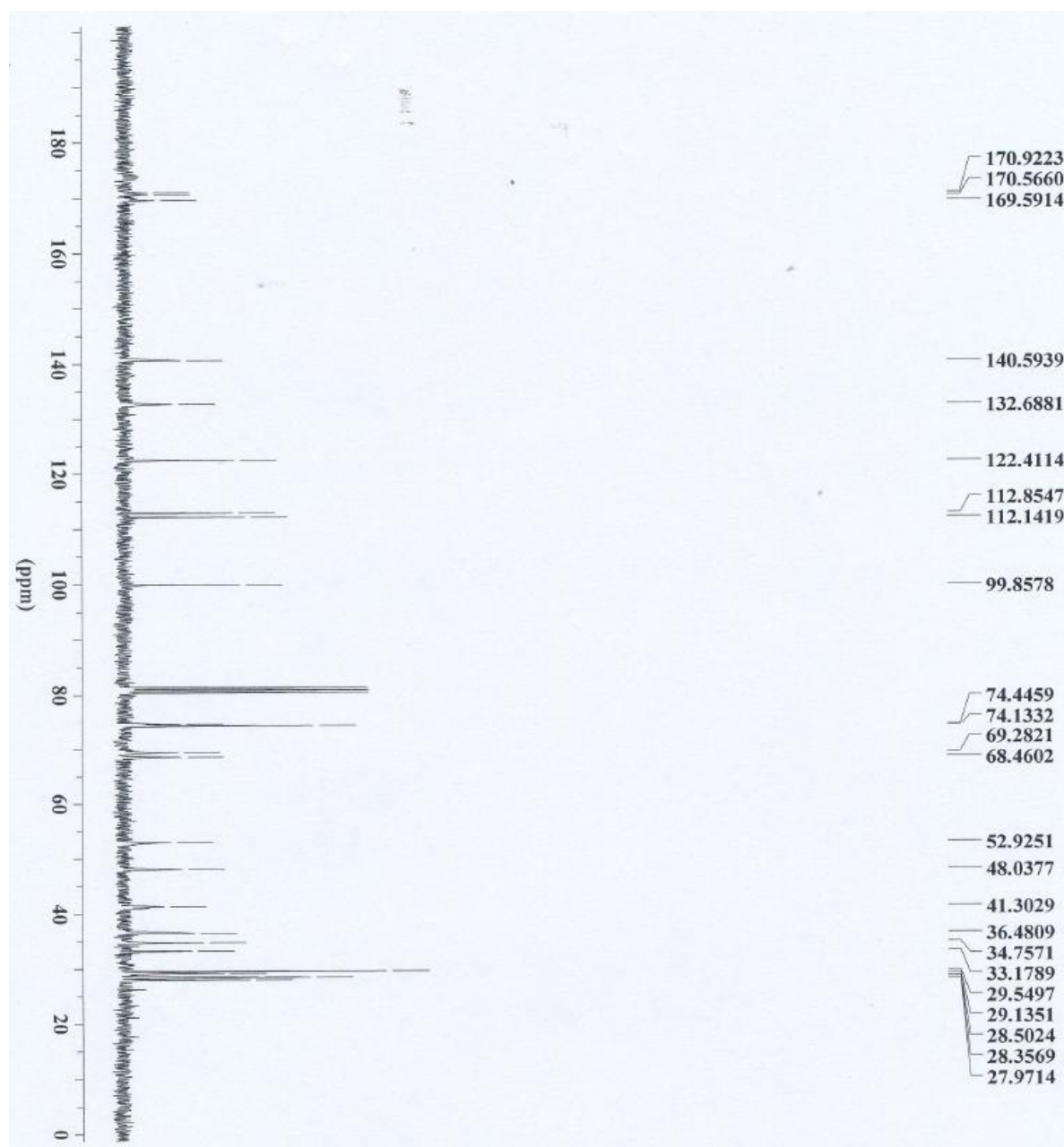
1H -NMR (300MHz, $CDCl_3$): δ =7.52 (brs, 1H), 7.06 (s, 1H), 6.95 (s, 1H), 5.55 (d, 1H, J =4.6 Hz), 5.17-5.24 (m, 1H), 4.64 (d, 1H, J =7.7 Hz), 4.38-4.44 (m, 3H), 4.34 (q, 1H, J = 2.3 Hz), 4.20 (brs, 1H), 4.03 (brs, 2H), 3.85 (brs, 1H), 3.44 (brs, 2H), 1.90-2.27 (m, 4H), 1.59-1.81 (m, 3H), 1.49 (d, 6H, J =8.1 Hz), 1.35 (d, 8H, J =5.9), 1.26 (s, 4H); ^{13}C -NMR (75MHz) δ = 170.9, 170.6, 169.6, 140.6, 132.7, 122.4, 112.8, 112.1, 99.8, 74.4, 74.1, 69.3, 68.5, 52.9, 48.0, 41.3, 36.5, 34.8, 33.2, 29.5, 29.1, 28.5, 28.4, 28.0 ppm; UV λ_{max} ($CHCl_3$): 246 nm [ϵ = 10,000 ($cm^{-1}M^{-1}$)]; HRMS (m/z): $[M+H]^+$ calcd. for $C_{27}H_{42}N_7O_6$: 560.3197, found 560.3217.

HPLC chromatogram of **C1** (5-95% CH_3CN-H_2O) over 10 min.

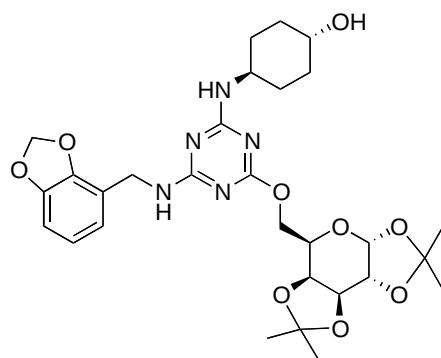
<¹H-NMR Spectral data of C1>



< ^{13}C -NMR Spectral data of C1>



D2

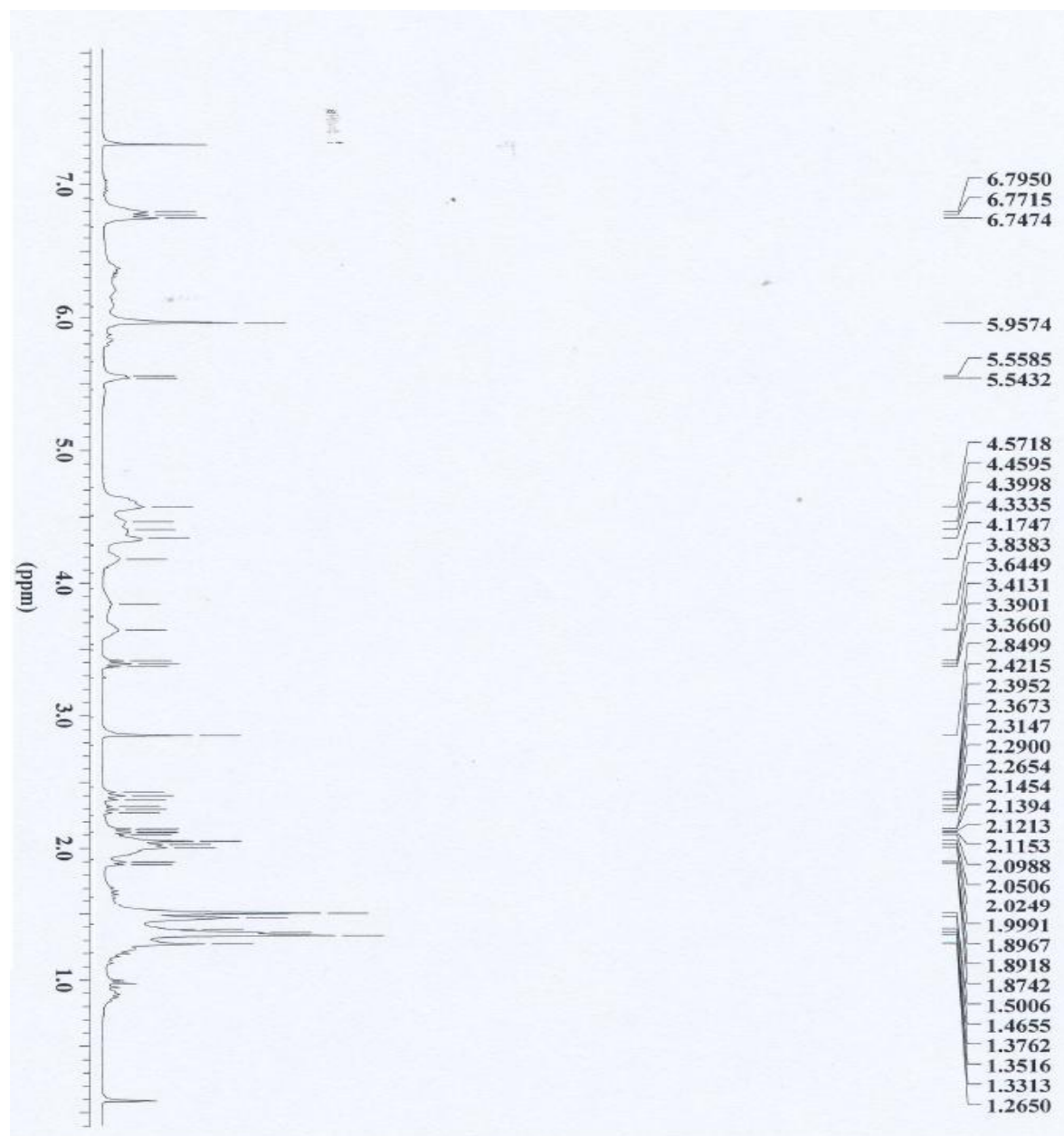


Chemical Formula: $C_{29}H_{39}N_5O_9$
Exact Mass: 601.27

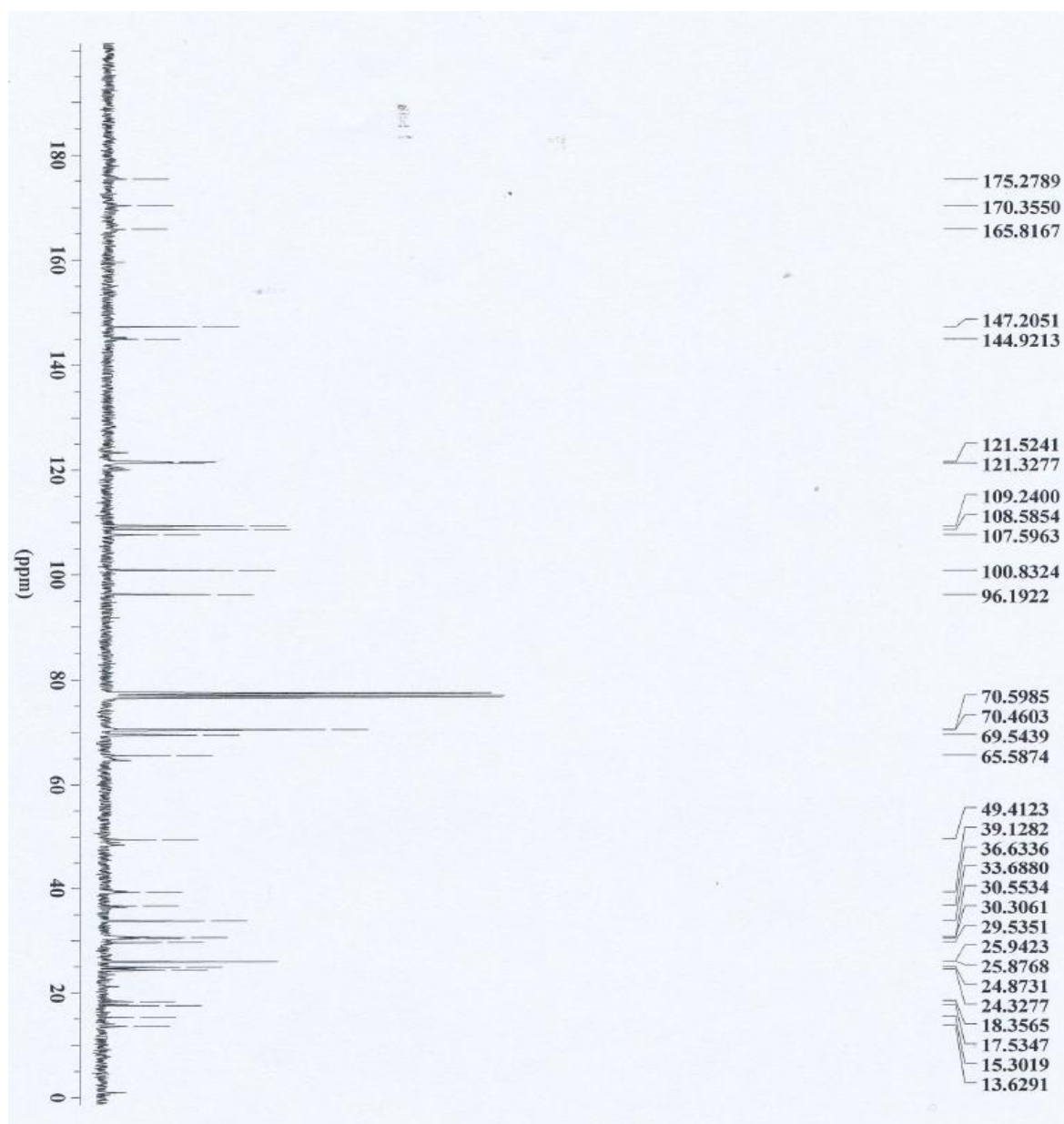
1H -NMR (300MHz, $CDCl_3$): δ =6.75-6.80 (m, 3H), 5.96 (s, 2H), 5.56 (d, 1H, J =4.8 Hz), 4.53-4.71 (m, 3H), 4.28-4.51 (m, 4H), 4.12 (brs, 1H), 3.84 (brs, 1H), 3.64 (brs, 1H), 2.85 (s, 1H), 1.87-2.14 (m, 6H), 1.50 (d, 6H, J =10.5 Hz), 1.26-1.38 (m, 10H); ^{13}C -NMR (75MHz) δ =175.3, 170.4, 165.8, 147.2, 144.9, 121.5, 109.2, 108.6, 107.6, 100.8, 96.2, 70.6, 69.5, 65.6, 49.4, 39.1, 36.6, 33.7, 30.6, 30.3, 29.5, 25.9, 25.8, 24.9, 24.3, 18.4, 17.5, 15.3, 13.6 ppm; UV λ_{max} ($CHCl_3$): 283 nm; HRMS (m/z): $[M+H]^+$ calcd. for $C_{29}H_{40}N_5O_9$: 602.2826, found 602.2821.

HPLC chromatogram of **D2** (5-95% CH_3CN - H_2O) over 10 min.

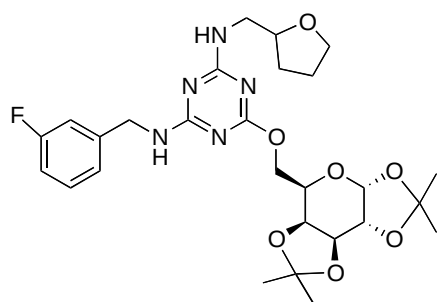
<¹H-NMR Spectral data of **D2**>



< ^{13}C -NMR Spectral data of **D2**>



E3

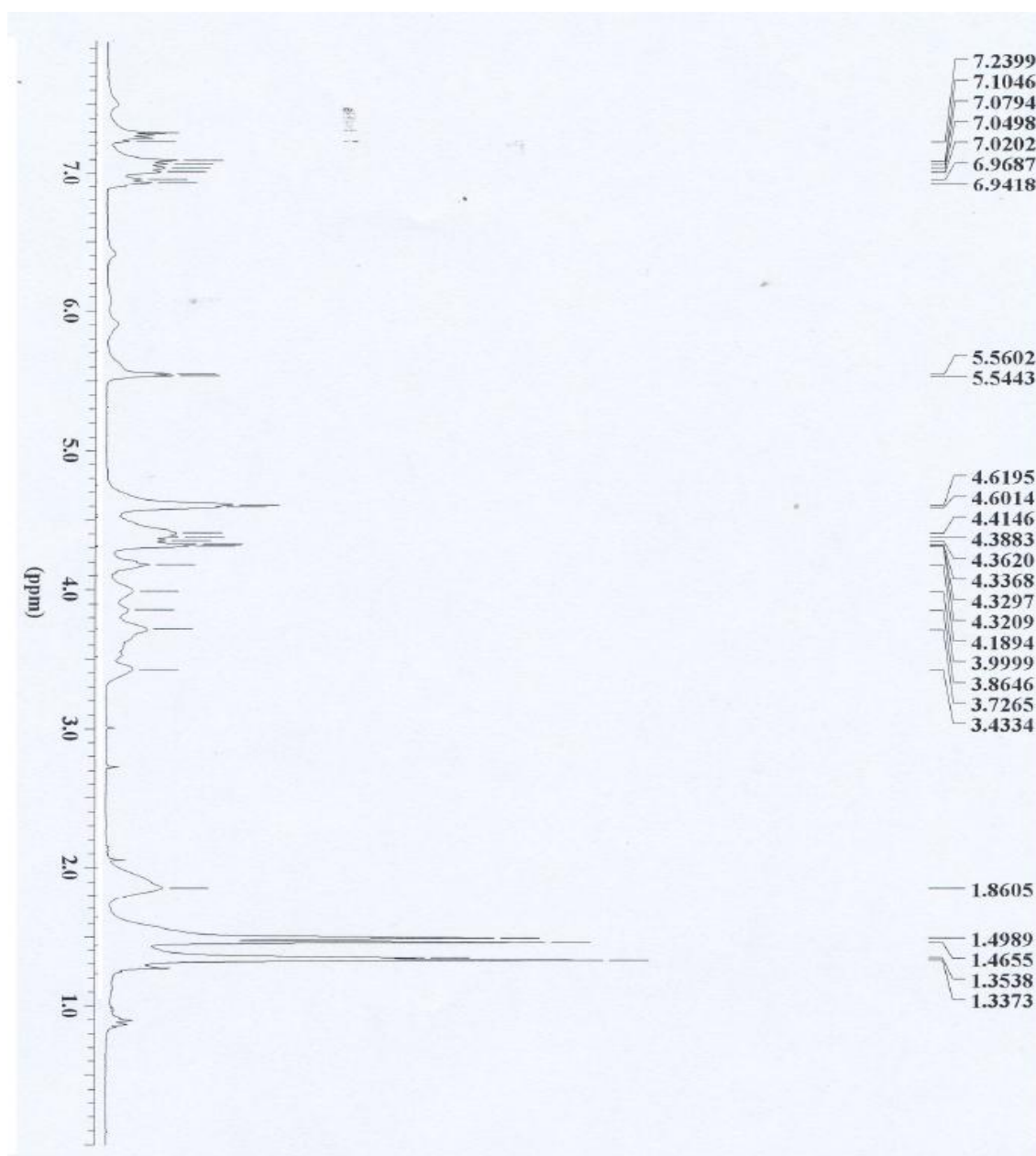


Chemical Formula: $C_{27}H_{36}FN_5O_7$
Exact Mass: 561.26

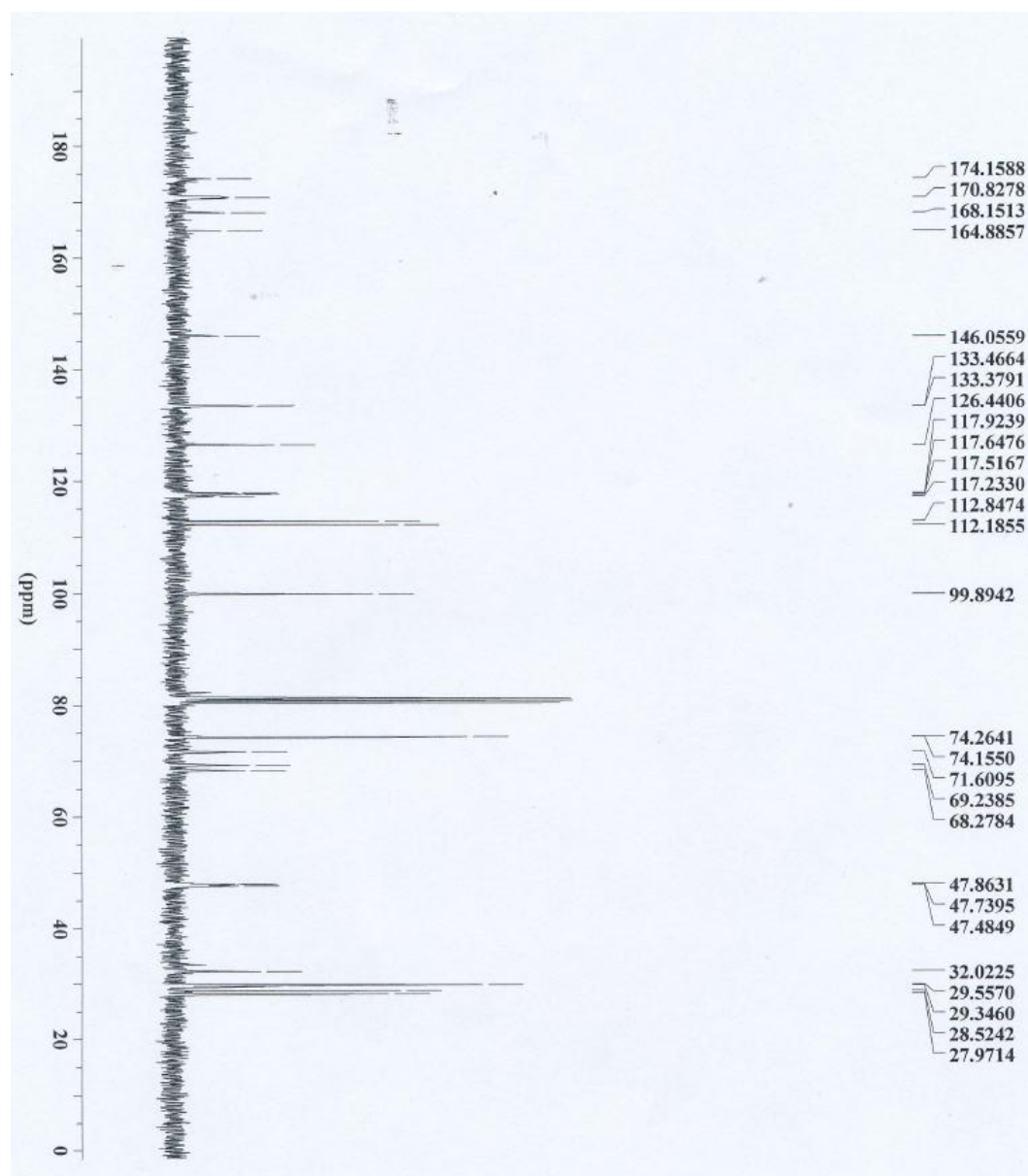
1H -NMR (300MHz, $CDCl_3$): δ =7.02-7.10 (m, 1H), 6.94-7.01 (m, 3H), 5.56 (d, 1H, J =4.8 Hz), 4.62 (brs, 3H), 4.32-4.41 (m, 4H), 4.19 (brs, 1H), 4.00 (brs, 2H), 3.43-3.86 (m, 5H), 1.86 (brs, 4H), 1.50 (d, 6H, J =10.0 Hz), 1.35 (d, 6H, J =5.0 Hz); ^{13}C -NMR (75MHz) δ = 174.2, 170.8, 168.2, 164.9, 146.0, 133.5, 133.4, 126.4, 117.9, 117.6, 117.5, 117.2, 112.8, 112.2, 99.9, 74.3, 74.1, 71.6, 69.2, 68.3, 47.9, 47.5, 32.0, 29.5, 29.3, 28.5, 28.4, 28.0 ppm; UV λ_{max} ($CHCl_3$): 246 nm; HRMS (m/z): $[M+H]^+$ calcd. for $C_{27}H_{37}FN_5O_7$: 562.2677, found 562.2693.

HPLC chromatogram of **E3** (5-95% CH_3CN - H_2O) over 10 min.

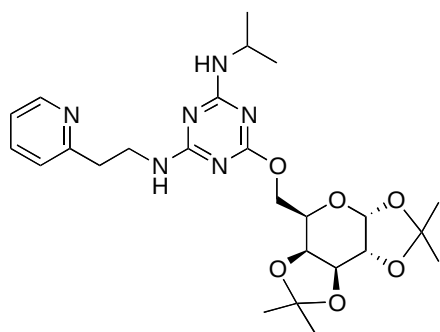
<¹H-NMR Spectral data of **E3**>



< ^{13}C -NMR Spectral data of **E3**>



F9

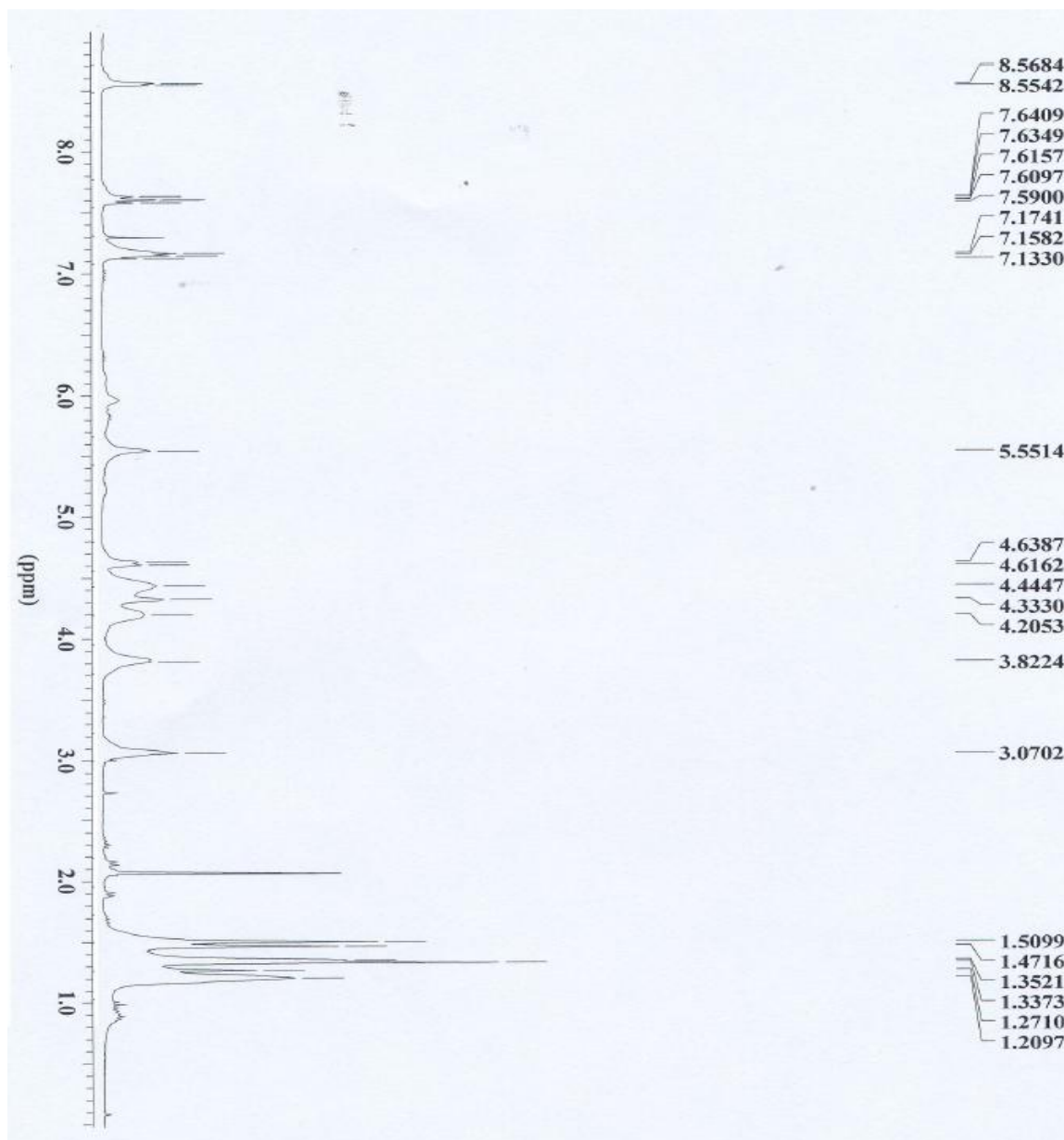


Chemical Formula: C₂₅H₃₆N₆O₆
Exact Mass: 516.27

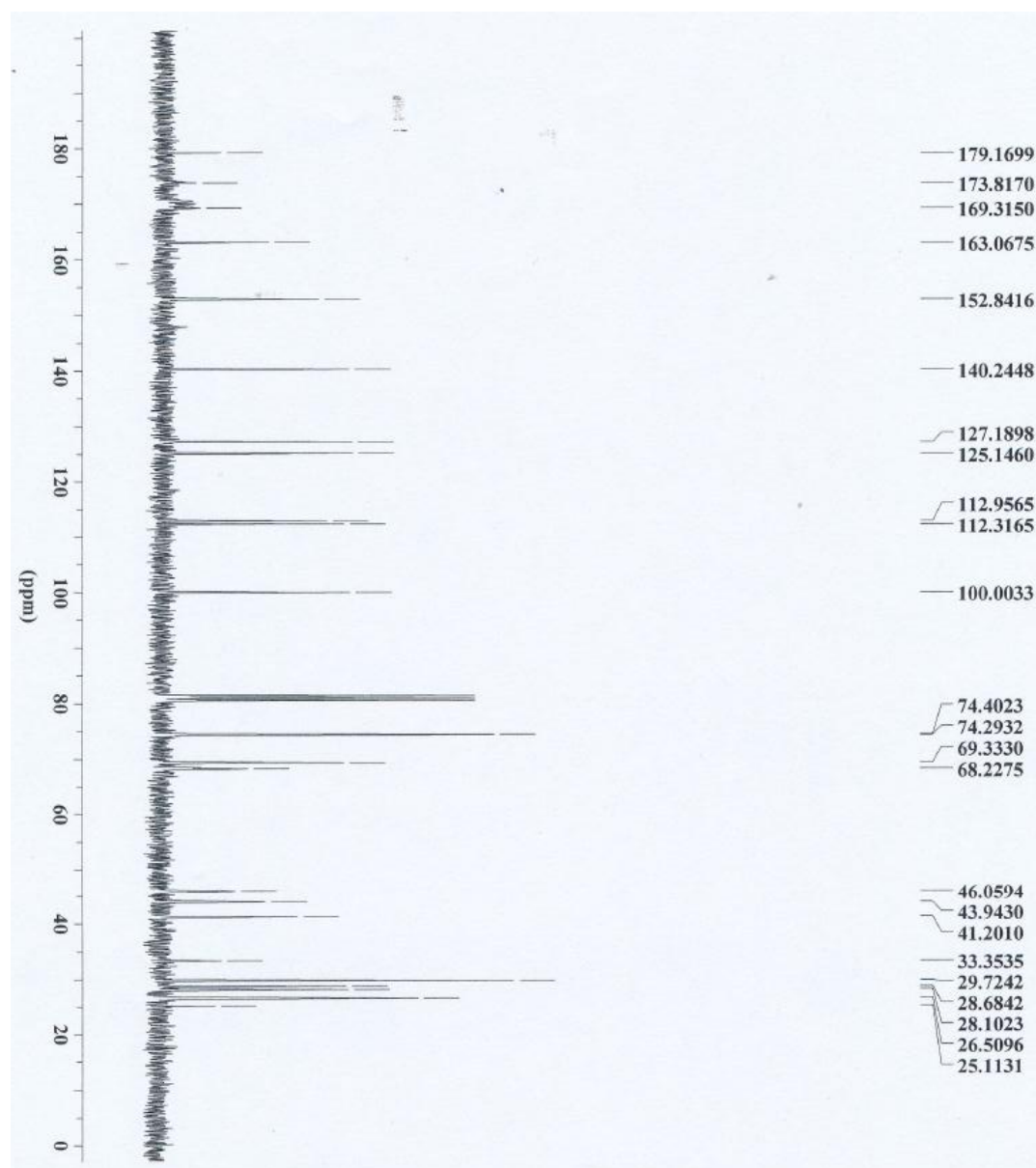
¹H-NMR (300MHz, CDCl₃): δ=8.57 (d, 1H, J=4.3 Hz), 7.64 (td, 1H, J=7.6, 1.8 Hz), 7.13-7.17 (m, 2H), 5.55 (s, 1H), 4.64 (d, 1H, 6.8 Hz), 4.2-4.44 (m, 6H), 3.82 (brs, 3H), 3.07 (s, 2H), 2.12 (s, 1H), 1.51 (d, 6H, J=11.5 Hz), 1.35 (d, 6H, J=4.4), 1.21 (s, 6H); ¹³C-NMR (75MHz) δ= 179.2, 173.8, 169.3, 163.3, 163.1, 152.8, 140.2, 127.2, 125.1, 112.9, 112.3, 100.0, 74.4, 74.3, 69.3, 68.2, 46.0, 43.9, 41.2, 33.4, 29.7, 28.7, 28.1, 26.5, 25.1 ppm; UV λ_{max} (CHCl₃): 260 nm; HRMS (m/z): [M+H]⁺ calcd. for C₂₅H₃₇N₆O₆: 517.2775, found 517.2781.

HPLC chromatogram of **F9** (5-95% CH₃CN-H₂O) over 10 min.

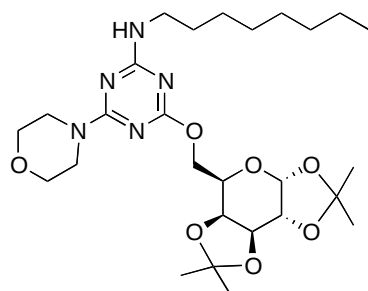
<¹H-NMR Spectral data of **F9**>



< ^{13}C -NMR Spectral data of **F9**>



G4

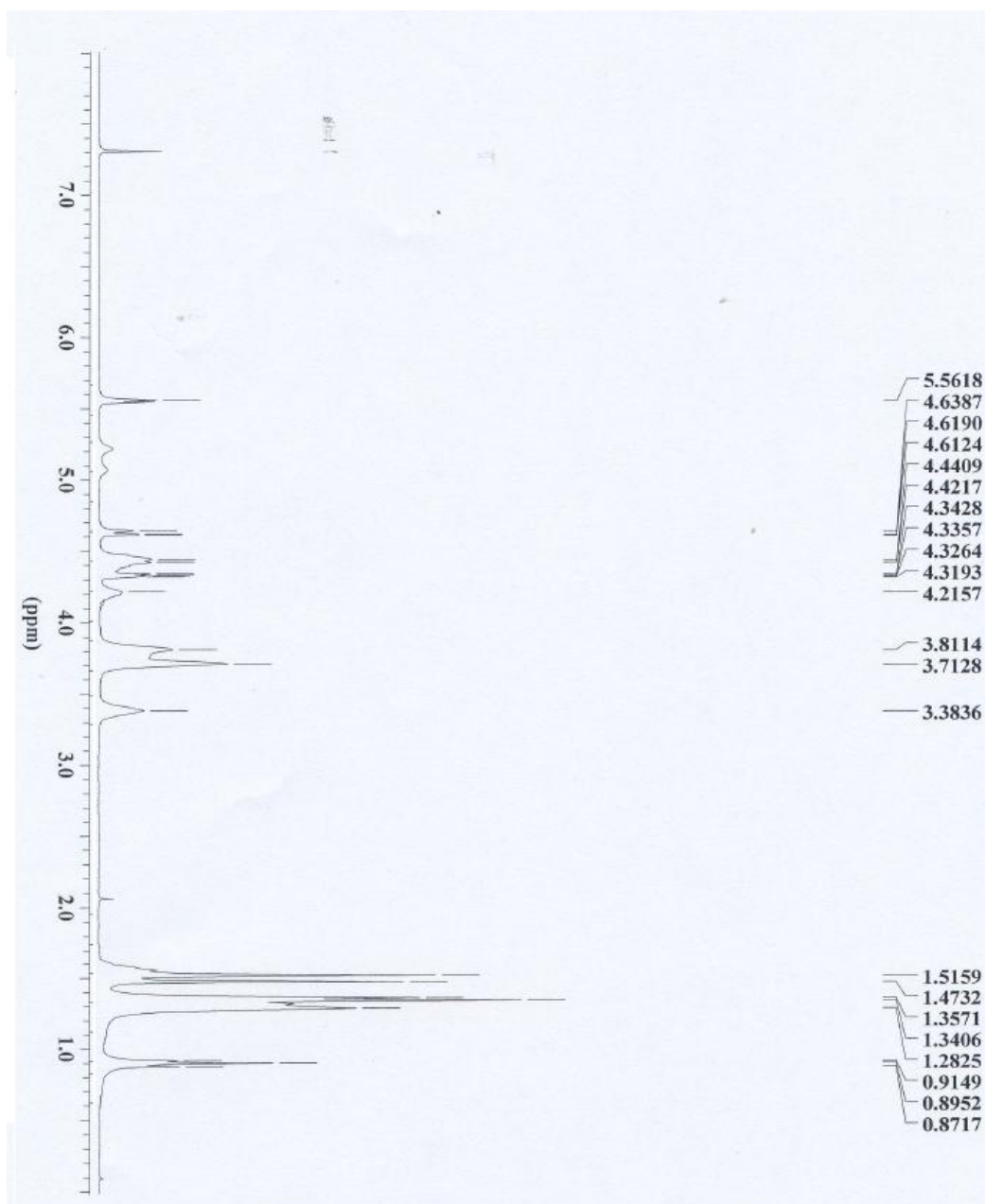


Chemical Formula: C₂₇H₄₅N₅O₇
 Exact Mass: 551.33

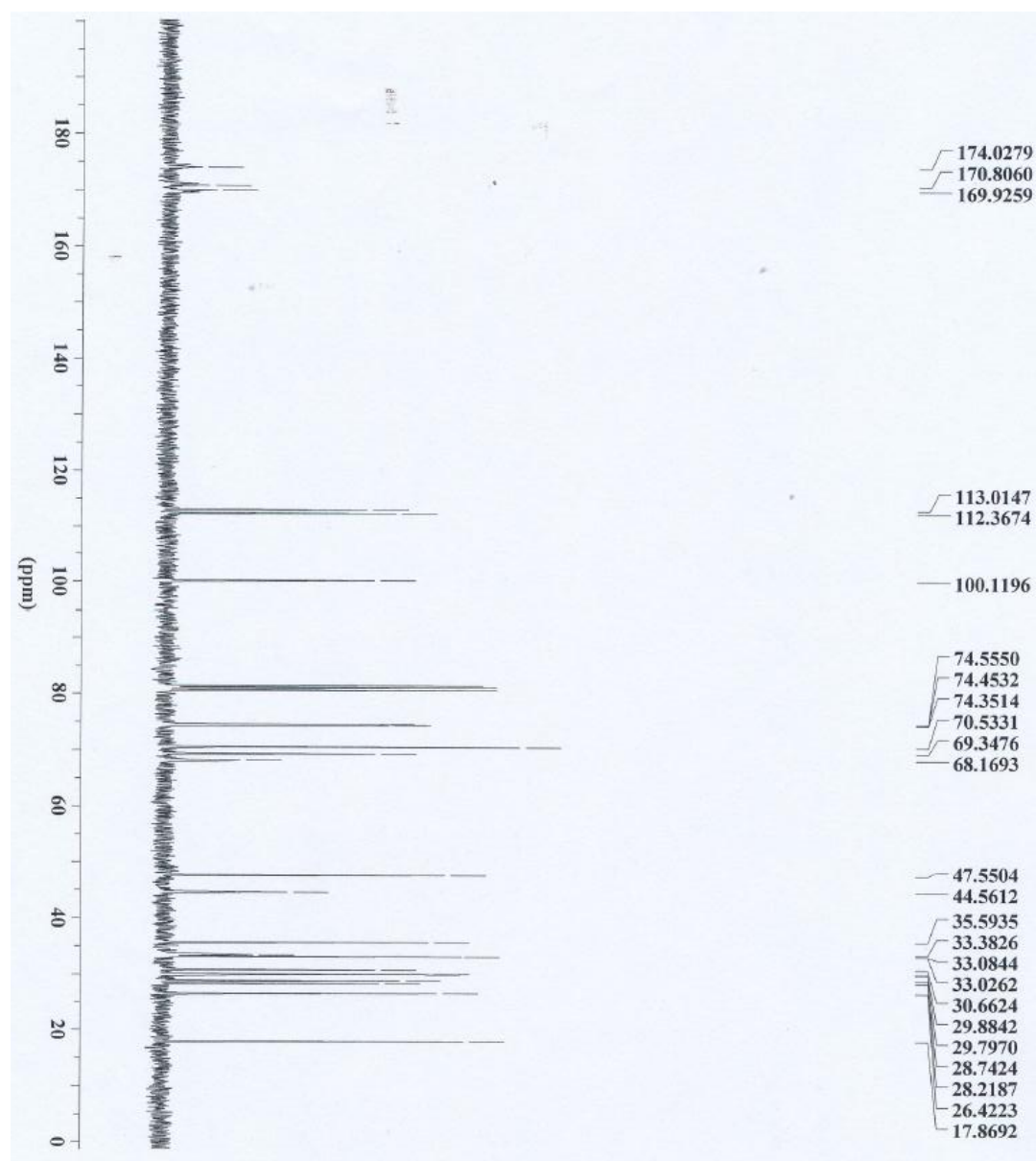
¹H-NMR (300MHz, CDCl₃): δ=5.56 (d, 1H, J=4.6 Hz), 4.64 (dd, 1H, J=7.9, 2.0 Hz), 4.42-4.44 (m, 3H), 4.34 (dd, 3H, J=4.9, 2.1 Hz), 4.22 (brs, 1H), 3.81 (brs, 4H), 3.71 (brs, 4H), 3.38 (brs, 2H), 1.51 (s, 3H), 1.47 (s, 3H), 1.36 (d, 6H, J=5.0 Hz), 1.28 (s, 12H), 0.90 (t, 12H, J=6.5); ¹³C-NMR (75MHz) δ=174.0, 170.8, 169.9, 113.0, 112.4, 100.1, 74.6, 74.4, 74.3, 70.5, 69.3, 68.2, 47.5, 44.6, 35.6, 33.4, 33.1, 33.0, 30.7, 29.9, 29.8, 28.7, 28.2, 26.4, 17.9 ppm; UV λ_{max} (CHCl₃): 247 nm; HRMS (m/z): [M+H]⁺ calcd. for C₂₇H₄₆N₅O₇: 552.3397, found 552.3401.

HPLC chromatogram of **G4** (5-95% CH₃CN-H₂O) over 10 min.

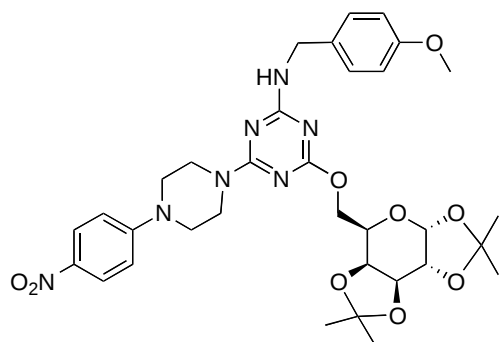
<¹H-NMR Spectral data of **G4**>



< ^{13}C -NMR Spectral data of **G4**>



H6

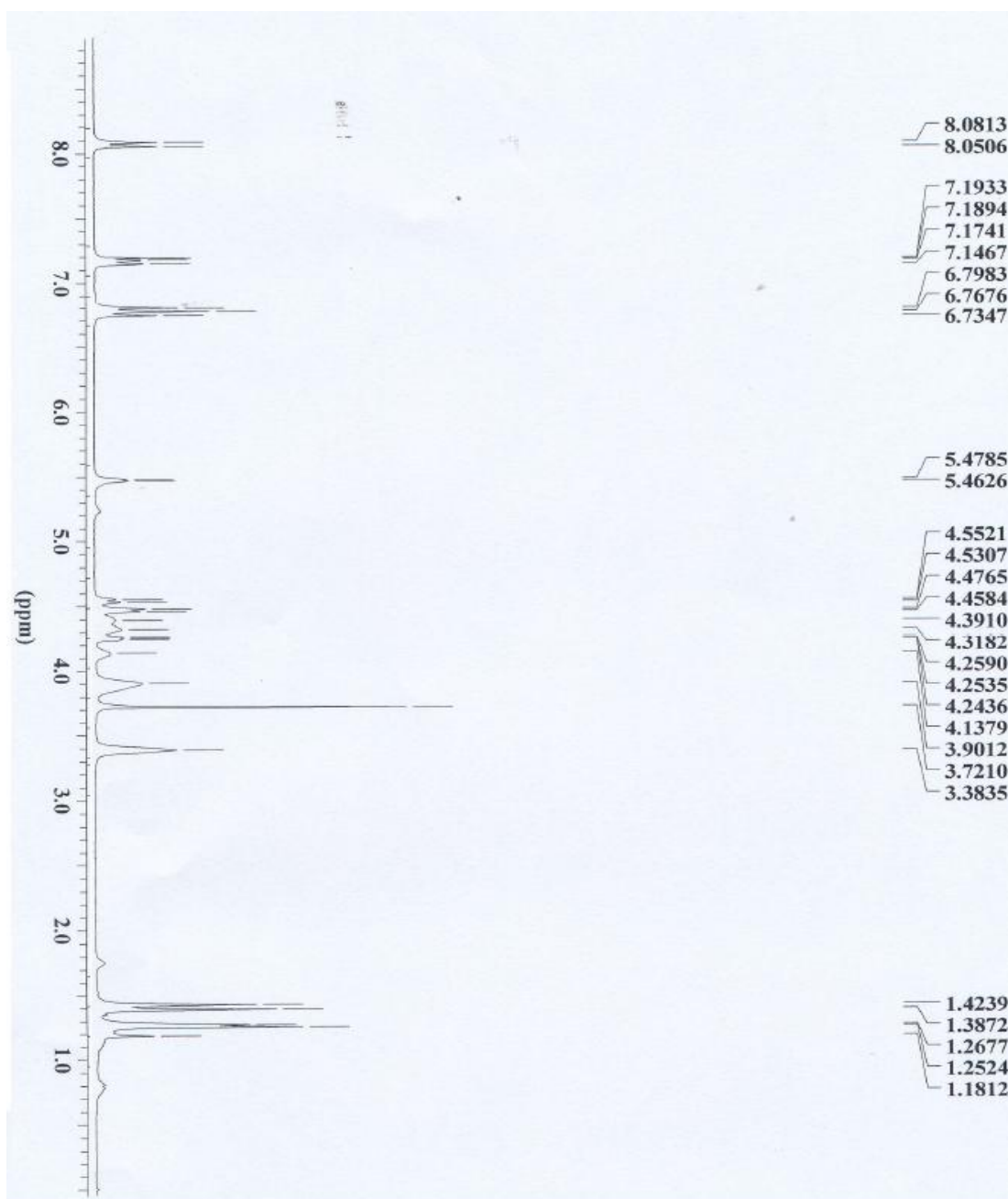


Chemical Formula: C₃₃H₄₁N₇O₉
Exact Mass: 679.30

¹H-NMR (300MHz, CDCl₃): δ=8.08 (d, 1H, J=9.2 Hz), 7.15-7.20 (m, 2H), 6.77 (t, 4H, J=9.9 Hz), 5.48 (d, 1H, J=4.8 Hz), 4.55 (d, 1H, J=6.4 Hz), 4.48 (d, 2H, J=5.4 Hz), 4.32-4.39 (m, 3H), 4.24-4.26 (m, 1H), 4.14 (brs, 1H), 3.90 (brs, 4H), 3.72 (s, 3H), 3.83 (brs, 4H), 1.42 (s, 3H), 1.39 (s, 3H), 1.27 (d, 6H, J=4.6 Hz); ¹³C-NMR (75MHz) δ=173.9, 171.6, 170.3, 169.2, 162.4, 162.1, 157.7, 141.9, 134.0, 131.9, 129.1, 117.1, 115.8, 112.4, 111.8, 99.4, 73.8, 68.7, 67.9, 67.8, 58.4, 49.9, 47.6, 45.7, 32.9, 29.2, 28.0, 27.5, 22.2 ppm; UV λ_{max} (CHCl₃): 382 nm; HRMS (m/z): [M+H]⁺ calcd. for C₃₃H₄₂N₇O₉: 680.3044, found 680.3048.

HPLC chromatogram of **H6** (5-95% CH₃CN-H₂O)

<¹H-NMR Spectral data of **H6**>



< ^{13}C -NMR Spectral data of **H6**>

