

# **New Seco-limonoids from *Cipadessa baccifera*: Isolation, Structure Determination, Synthesis and Their Antiproliferative Activities.**

*Bandi Siva,<sup>a</sup> A. Venkanna,<sup>a</sup> B. Poornima,<sup>a</sup> S. Divya Reddy,<sup>a</sup> J. Boustie,<sup>b</sup> Schnell Bastien,<sup>a,b</sup> Nishant Jain,<sup>c</sup> P.Usha Rani,<sup>d</sup> K.Suresh Babu,<sup>a,\*</sup>*

*<sup>a</sup>Natural Products Laboratory, Division of Natural Product Chemistry, CSIR-Indian Institute of Chemical Technology, Hyderabad 500 607, India*

*<sup>b</sup>UMR CNRS 6226 ISCR PNSCM, Université de Rennes 1, 2 Avenue du Professeur Léon Bernard, 35043 Rennes, France.*

*<sup>c</sup>Centre for Chemical Biology, CSIR-Indian Institute of Chemical Technology, Hyderabad 500 007, India*

*<sup>d</sup> Biology division, CSIR-Indian Institute of Chemical Technology, Hyderabad-500 007.*

---

## **Table of Contents**

Experimental values of **9-13**

FIGURE1: HRESIMS,IR AND <sup>1</sup>HNMR SPECTRUM OF COMPOUND 1

FIGURE2: <sup>13</sup>C NMR & DEPT135° SPECTRUM OF COMPOUND 1

FIGURE3: HSQC SPECTRUM OF COMPOUND 1

FIGURE4: HMBC SPECTRUM OF COMPOUND 1

FIGURE5: COSY SPECTRUM OF COMPOUND 1

FIGURE6: NOESY SPECTRUM OF COMPOUND 1

FIGURE7: HRESIMS,IR AND <sup>1</sup>HNMR SPECTRUM OF COMPOUND 2

FIGURE8: <sup>13</sup>C NMR & DEPT135° SPECTRUM OF COMPOUND 2

FIGURE9: HSQC SPECTRUM OF COMPOUND 2

FIGURE10: HMBC SPECTRUM OF COMPOUND 2

FIGURE11: COSY SPECTRUM OF COMPOUND 2

FIGURE12: NOESY SPECTRUM OF COMPOUND 2

FIGURE13: HRESIMS,  $^1\text{H}$ NMR &  $^{13}\text{C}$  NMR SPECTRUM OF COMPOUND **9**  
FIGURE14: HRESIMS,  $^1\text{H}$ NMR &  $^{13}\text{C}$  NMR SPECTRUM OF COMPOUND **10a**  
FIGURE15: HRESIMS,  $^1\text{H}$ NMR &  $^{13}\text{C}$  NMR SPECTRUM OF COMPOUND**10b**  
FIGURE16: HRESIMS,  $^1\text{H}$ NMR &  $^{13}\text{C}$  NMR SPECTRUM OF COMPOUND **10c**  
FIGURE17: HRESIMS,  $^1\text{H}$ NMR &  $^{13}\text{C}$  NMR SPECTRUM OF COMPOUND **11a**  
FIGURE18: HRESIMS,  $^1\text{H}$ NMR &  $^{13}\text{C}$  NMR SPECTRUM OF COMPOUND **11b**  
FIGURE19: HRESIMS,  $^1\text{H}$ NMR &  $^{13}\text{C}$  NMR SPECTRUM OF COMPOUND **11c**  
FIGURE20: HRESIMS,  $^1\text{H}$ NMR &  $^{13}\text{C}$  NMR SPECTRUM OF COMPOUND **11d**  
FIGURE21:  $^1\text{H}$ NMR &  $^{13}\text{C}$  NMR SPECTRUM OF COMPOUND **11e**  
FIGURE22: HRESIMS,  $^1\text{H}$ NMR &  $^{13}\text{C}$  NMR SPECTRUM OF COMPOUND **12**  
FIGURE23: HRESIMS,  $^1\text{H}$ NMR &  $^{13}\text{C}$  NMR SPECTRUM OF COMPOUND **13a**  
FIGURE24: HRESIMS,  $^1\text{H}$ NMR &  $^{13}\text{C}$  NMR SPECTRUM OF COMPOUND **13b**  
FIGURE25: HRESIMS,  $^1\text{H}$ NMR &  $^{13}\text{C}$  NMR SPECTRUM OF COMPOUND **13c**  
FIGURE26:  $^1\text{H}$ NMR &  $^{13}\text{C}$  NMR SPECTRUM OF COMPOUND **13d**  
FIGURE27: HRESIMS,  $^1\text{H}$ NMR &  $^{13}\text{C}$  NMR SPECTRUM OF COMPOUND **13e**  
FIGURE28: HRESIMS,  $^1\text{H}$ NMR &  $^{13}\text{C}$  NMR SPECTRUM OF COMPOUND **13f**  
FIGURE29: HRESIMS,  $^1\text{H}$ NMR &  $^{13}\text{C}$  NMR SPECTRUM OF COMPOUND **13g**  
FIGURE30: HRESIMS,  $^1\text{H}$ NMR &  $^{13}\text{C}$  NMR SPECTRUM OF COMPOUND **13h**  
FIGURE31: HRESIMS,  $^1\text{H}$ NMR &  $^{13}\text{C}$  NMR SPECTRUM OF COMPOUND **13i**

## 1. Experimental

**1.1. Methyl 2-((4S,4aS,7aS,8S,10S,11aS,12aS)-4-(furan-3-yl)-10-hydroxy-4a,7a,9,9-tetramethyl-13-methylene-2-oxododecahydro-1H-7,12a-methanobenzo[b]pyrano[3,4-g]oxocin-8-yl)acetate (9).** Yield: 70%, time: 4h; white amorphous powder;  $[\alpha]_D^{25} - 26.1$  (c 1.1, CHCl<sub>3</sub>) IR(KBr):  $\nu_{\max}$  3426, 2978, 1732, 1728, 1683, 1372, 1245, 1037 cm<sup>-1</sup>; <sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>)  $\delta$ : 7.46 (1H, s, H-21), 7.39 (1H, s, H-23), 6.41(1H, s, H-22), 5.79 (1H, s, H-17), 5.09 (1H, s, H<sub>a</sub>-30), 4.84 (1H, s, H<sub>b</sub>-30), 3.69 (1H, d,  $J = 10.9$  Hz, H-3), 3.70(3H, s, OMe), 3.29 (1H, t,  $J = 3.2$  & 3.0 Hz, H-1), 2.90 (1H, d,  $J = 17.9$  Hz, H<sub>a</sub>-15), 2.59 (1H, d,  $J = 17.9$  Hz, H<sub>b</sub>-15), 2.55 (1H, dd,  $J = 11.8$  & 5.0 Hz, H-5), 2.50 (1H, OL, H<sub>a</sub>-6), 2.09 (1H, d,  $J = 15.2$  Hz, H<sub>b</sub>-6), 2.18 (1H, br s, H-9), 2.07 (1H, m, H-11), 1.84 (2H, m, H-2), 1.85(1H, m, H<sub>a</sub>-12) & 1.15 (1H, m, H<sub>b</sub>-12), 1.53 (1H, m), 0.95 (1H, s, H-29), 0.89 (3H, s, H-18), 0.87(3H, s, H-19), 0.80 (1H, s, H-28); <sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>)  $\delta$ : 174.5(C-7), 170.4 (C-16), 146.4 (C-8), 142.7 (C-23), 140.6 (C-21), 120.9 (C-20), 110.8 (C-22), 109.8 (C-30), 79.9 (C-14), 77.5 (C-17), 74.9(C-3), 72.6 (C-1), 51.9 (C-9), 50.4 (C-10), 43.8 (C-12), 41.4 (C-13), 39.7 (C-4), 33.9 (C-15), 32.6 (C-6), 32.4 (C-6), 30.9 (C-2), 29.5 (C-11), 27.0 (C-28), 23.8 (C-5), 21.9(C-19), 14.38 (C-29), 13.8 (C-18); HRMS (ESI+)  $m/z$ : 473.2527 [M+H]<sup>+</sup> (calcd for C<sub>27</sub>H<sub>37</sub>O<sub>7</sub>[M+H]<sup>+</sup>, 473.2533).

**1.2.(7aS,8S,10S,11aS,12aS)-4-(furan-3-yl)-8-(2-methoxy-2-oxoethyl)-4a,7a,9,9-tetramethyl-13-methylene-2-oxododecahydro-1H-7,12a-methanobenzo[b]pyrano[3,4-g]oxocin-10-yl butyrate (10a):** Yield: 90%, time: 3h, colorless gum;  $[\alpha]_D^{25} - 34.2$  (c 1.1, CHCl<sub>3</sub>); IR (KBr):  $\nu_{\max}$  2968, 1737, 1718, 1685, 1325, 1235, 1027 cm<sup>-1</sup>; <sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>)  $\delta$ : 7.49 (1H, s, H-21), 7.39 (1H, s, H-23), 6.43 (1H, s, H-22), 5.80 (1H, s, H-17), 5.00 (1H, dd,  $J = 10.0$  & 6.6

Hz, H-3), 5.09 (1H, s, H<sub>a</sub>-30), 4.85 (H, s, H<sub>b</sub>-30), 3.69 (3H, s, OMe), 3.24 (1H, t,  $J = 3.2$  &  $2.8$  Hz, H-1), 2.90 (1H, d,  $J = 18.1$  Hz, H<sub>a</sub>-15) & 2.57 (1H, d,  $J = 18.1$  Hz, H<sub>b</sub>-15), 2.54 (1H, dd,  $J = 11.6$  &  $5.1$  Hz, H-5), 2.51 (1H, overlapping, H<sub>a</sub>-6) & 2.15 (1H, d,  $J = 15.1$  Hz, H<sub>b</sub>-6), 2.23 (2H, m, butyryl -2'), 2.08 (1H, br s, H-9), 2.02 (1H, m, H-11<sub>a</sub>) & 1.54 (1H, m, H-11<sub>b</sub>), 1.89 (2H, m, H-2), 1.87 (2H, m, butyryl -3<sup>1</sup>), 1.86 (1H, m, H<sub>a</sub>-12) & 1.31 (1H, m, H<sub>b</sub>-12), 1.15 (3H, t,  $J = 7.5$  Hz, butyryl -4'), 0.95 (1H, s, H-29), 0.87 (3H, s, H-18), 0.83 (3H, s, H-19), 0.80 (1H, s, H-28); <sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>)  $\delta$ : 174.2 (C-7), 172.7 (C- butyryl-1'), 170.3 (C-16), 146.4 (C-8), 142.5 (C-23), 140.8 (C-21), 120.9 (C-20), 110.9 (C-22), 110.0 (C-30), 79.97 (C-14), 79.79 (C-17), 74.70 (C-3), 74.14 (C-1), 51.91 (C-9), 50.43 (C-10), 43.8 (C-12), 41.5 (C-13), 38.7 (C-4), 33.8 (C-15), 32.3 (C-6), 30.9 (butyryl -2<sup>1</sup>), 29.6 (C-2), 29.3 (C-11), 26.9 (C-28), 23.8 (C-5), 22.6 (butyryl -3<sup>1</sup>), 21.8 (C-19), 18.5 (butyryl -4<sup>1</sup>), 15.6 (C-29), 13.8 (C-18); HRMS (ESI+)  $m/z$ : 565.2781 [M+Na]<sup>+</sup> (calcd for C<sub>31</sub>H<sub>42</sub>O<sub>8</sub>Na [M+Na]<sup>+</sup>, 565.2771).

**1.3 (7aS,8S,10S,11aS,12aS)-4-(furan-3-yl)-8-(2-methoxy-2-oxoethyl)-4a,7a,9,9-tetramethyl-13-methylene-2-oxododecahydro-1H-7,12amethanobenzo[b]pyrano[3,4-g]oxocin-10-yl**

**propionate (10b).** Yield: 85%, time: 2h, colorless gum;  $[\alpha]_D^{25} - 48.5$  ( $c$  0.9, CHCl<sub>3</sub>); IR(KBr):  $\nu_{\max}$  2974, 1734, 1728, 1682, 1334, 1238, 1035 cm<sup>-1</sup>; <sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>)  $\delta$ : 7.49 (1H, s, H-21), 7.39 (1H, s, H-23), 6.43 (1H, s, H-22), 5.80 (1H, s, H-17), 5.09 (1H, s, H<sub>a</sub>-30), 5.00 (1H, dd,  $J = 10.0$  &  $6.6$ , H-3), 4.85 (1H, s, H<sub>b</sub>-30), 3.69 (3H, s, OMe), 3.23 (1H, t,  $J = 3.28$  &  $2.8$  Hz, H-1), 2.90 (1H, d,  $J = 18.1$  Hz, H<sub>a</sub>-15) & 2.57 (1H, d,  $J = 18.1$  Hz, H<sub>b</sub>-15), 2.54 (1H, dd,  $J = 11.6$  &  $5.1$  Hz, H-5), 2.51 (1H, overlapping, H<sub>a</sub>-6) & 2.15 (1H, d,  $J = 15.1$  Hz, H<sub>b</sub>-6), 2.23 (2H, q,  $J = 7.5$  &  $15.1$  Hz, propionyl H-2'), 2.08 (1H, br s, H-9), 2.02 (1H, m, H<sub>a</sub>-11) & 1.54 (1H, m, H<sub>b</sub>-11), 1.88 (2H, m, H-2), 1.86 (1H, m, H<sub>a</sub>-12) & 1.31 (1H, m, H<sub>b</sub>-12), 1.15 (3H, t,  $J = 7.5$  Hz, propionyl H-3'), 0.95 (1H, s, H-29), 0.87 (3H, s, H-18), 0.83 (3H, s, H-19), 0.80 (1H, s, H-28); <sup>13</sup>C NMR

(75 MHz, CDCl<sub>3</sub>)  $\delta$ : 174.2 (C-7), 173.6 (propionyl C-1'), 170.4 (C-16), 146.4 (C-8), 142.5 (C-23), 140.8 (C-21), 120.8 (C-20), 110.9 (C-22), 110.0 (C-30), 79.9 (C-14), 79.7 (C-17), 74.7 (C-3), 74.2 (C-1), 51.9 (C-9), 50.4 (C-10), 43.8 (C-12), 41.5 (C-13), 38.7 (C-4), 33.8 (C-15), 32.3 (C-6), 29.5 (C-2), 29.4 (C-11), 27.8 (propionyl C-2'), 26.9 (C-28), 23.8 (C-5), 21.8 (C-19), 15.6 (C-28), 13.8 (C-18), 9.21 (propionyl C-3'); HRMS (ESI+)  $m/z$ : 529.2774 [M+H]<sup>+</sup> (calcd for C<sub>30</sub>H<sub>41</sub>O<sub>8</sub> [M+H]<sup>+</sup>, 529.2795).

**1.4 (7aS,8S,10S,11aS,12aS)-4-(furan-3-yl)-8-(2-methoxy-2-oxoethyl)-4a,7a,9,9-tetramethyl-13-methylene-2-oxododecahydro-1H-7,12a-methanobenzo[b]pyrano[3,4-g]oxocin-10-yl**

**isobutyrate (10c)**: Yield: 90%, time: 3h; colorless gum,  $[\alpha]_D^{25} - 54.2$  ( $c$  0.7, CHCl<sub>3</sub>); IR(KBr):  $\nu_{\max}$  2994, 1737, 1722, 1692, 1324, 1231, 1031 cm<sup>-1</sup>; <sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>)  $\delta$ : 7.50 (1H, s, H-21), 7.39 (1H, s, H-23), 6.43(1H, s, H-22), 5.81 (1H, s, H-17), 5.09 (1H, s, H<sub>a</sub>-30), 4.98 (1H, dd,  $J = 10.9$  &  $5.6$ Hz, H-3), 4.85 (1H, s, H<sub>b</sub>-30), 3.69(3H, s, OMe), 3.23 (1H, t,  $J = 3.28$  &  $2.8$  Hz, H-1), 2.55(1H, dd,  $J = 13.6$  &  $6.1$  Hz, H-5), 2.91 (1H, d,  $J = 18.1$ Hz, H<sub>a</sub>-15), 2.58 (1H, d,  $J = 18.1$ Hz, H<sub>b</sub>-15), 2.51(1H, OL, H<sub>a</sub>-6) & 2.14 (1H, d,  $J = 15.1$ Hz, H<sub>b</sub>-6), 2.05 (1H, m, H-2<sup>1</sup>), 2.04 (1H, m, H<sub>a</sub>-11) & 1.56 (1H, m, H<sub>b</sub>-11), 2.03 (1H, br s, H-9), 1.90 (2H, m, H-2), 1.88 (1H, m, H<sub>a</sub>-12) & 1.32 (1H, m, H<sub>b</sub>-12), 1.18 (6H, d,  $J = 6.9$  Hz, isobutyryl -3' & 4'), 0.97 (1H, s, H-29), 0.87 (3H, s, H-18), 0.83 (3H, s, H-19), 0.80 (3H, s, H-28); <sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>)  $\delta$ : 176.1 (C-7), 174.2 (isobutyryl -1'), 170.3 (C-16), 146.4(C-8), 142.5 (C-23), 140.8 (C-21), 120.9 (C-20), 110.9 (C-22), 110.0 (C-30), 79.9 (C-14), 79.8 (C-17), 74.7 (C-3), 73.9 (C-1), 51.9 (C-9), 50.4 (C-10), 43.8 (C-12), 41.5 (C-13), 38.8 (C-4), 33.8 (C-15), 32.3 (C-6), 31.9 (isobutyryl -2'), 29.6 (C-2), 29.5 (C-11), 26.8 (C-26), 23.8 (C-5), 21.8 (C-21.90), 19.1 (C-3'), 18.8 (isobutyryl -3', 4'), 15.6 (C-29), 13.84 (C-18); HRMS (ESI+)  $m/z$ : 543.2934 [M+H]<sup>+</sup> (calcd for C<sub>31</sub>H<sub>43</sub>O<sub>8</sub> [M+H]<sup>+</sup>, 543.2952).

**1. 5. (7aS,8S,10S,11aS,12aS)-4-(furan-3-yl)-8-(2-methoxy-2-oxoethyl)-4a,7a,9,9-tetramethyl-13-methylene-2-oxododecahydro-1H-7,12a-methanobenzo[b]pyrano[3,4-g]oxocin-10-yl 2-chloroacetate (12).** Yield: 79%, time: 3h, colorless oil;  $[\alpha]_D^{25} - 32.7$  (*c* 1.2, CHCl<sub>3</sub>); IR(KBr):  $\nu_{\max}$  2992, 1731, 1725, 1698, 1324, 1237, 1034 cm<sup>-1</sup>; <sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>)  $\delta$ : 7.49 (1H, bs, H-21), 7.39 (1H, bs, H-23), 6.43( 1H, bs, H-22), 5.79 (1H, s, H-17), 5.11(1H, H<sub>b</sub>-30), 5.05 (1H, dd, *J* = 10.5 & 5.8Hz, H-3), 4.87(1H, s, H<sub>a</sub>-30), 4.06 (2H, chloroacetyl-H-2<sup>1</sup>), 3.69(3H, s, OMe), 3.25 (1H, t, *J* = 3.2 & 6.0 Hz, H-1), 2.91 (1H, d, *J* = 18.3Hz, H<sub>a</sub>-15) & 2.5 (1H, d, *J* = 18.3Hz, H<sub>b</sub>-15), 2.59(1H, d, *J* = 15.1Hz, H<sub>a</sub>-6) & 2.12 (1H, d, *J* = 15.1Hz, H<sub>b</sub>-6), 2.54 (1H, m, H-5), 2.22 (1H, m, H<sub>a</sub>-12)& 1.18 (1H, m, H<sub>b</sub>-12), 2.09 (1H, br s,H-9), 2.07 (2H, m, H-2), 1.94 (1H, m, H<sub>a</sub>-11) & 1.52 (1H, m, H<sub>b</sub>-11), 0.99 (1H, s, H-29), 0.87 (3H, s, H-18), 0.83 (1H, s, H-19), 0.83(1H, s, ol, H-28); <sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>)  $\delta$ : 174.1 (C-7), 170.6 (C-16), 166.5 (chloroacetyl-1<sup>1</sup>), 146.1 (C-8), 142.6(C-23), 140.8 (C-21), 120.7 (C-20), 111.1 (C-22), 109.9 (C-30), 80.0 (C-14), 79.8 (C-17), 77.5 (C-3), 74.5 (C-1), 52.0(C-9), 43.8(C-10), 41.4(C-12), 41.0(C-13), 40.4(chloroacetyl-C-2<sup>1</sup>), 38.9(C-14), 33.82 (C-15), 32.28 (C-6), 29.41 (C-2), 29.31 (C-11), 26.87 (C-28), 23.82 (C-5), 21.89 (C-19), 15.5(C-29), 13.8 (C-18); HRMS (ESI+) *m/z*: 571.2094[M+Na]<sup>+</sup> (calcd for C<sub>29</sub>H<sub>37</sub>Cl O<sub>8</sub>Na [M+Na]<sup>+</sup>, 571.2069).

**1. 6.(7aS,8S,10S,11aS,12aS)-4-(furan-3-yl)-8-(2-methoxy-2-oxoethyl)-4a,7a,9,9-tetramethyl-13-methylene-2-oxododecahydro-1H-7,12a-methanobenzo[b]pyrano[3,4-g]oxocin-10-yl 4-cyanobenzoate (11a).** Yield: 70%, time: 11h; light yellow gum;  $[\alpha]_D^{25} - 19.2$  (*c* 0.6, CHCl<sub>3</sub>); IR(KBr):  $\nu_{\max}$  3094, 1736, 1723, 1698, 1336, 1239, 1036 cm<sup>-1</sup>; <sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>)  $\delta$ : 8.11 (2H, d, *J* = 8.5 Hz, Ar-3'' & Ar-5''), 7.75 (2H, d, *J* = 8.5Hz, Ar-2'' & Ar-6''), 7.52(1H, s, H-21), 7.41 (1H, s, H-23), 6.45( 1H, s, H-22), 5.84 (1H, s, H-17), 5.12(1H, H<sub>b</sub>-30), 5.24 (1H, dd, *J* = 10.5 & 6.2 Hz, H-3), 4.87(1H, s, H<sub>a</sub>-30), 3.70(3H, s, OMe), 3.30 (1H, t, *J* = 3.2 & 2.8 Hz, H-

1), 2.92 (1H, d,  $J = 18.1\text{Hz}$ , H<sub>a</sub>-15) & 2.59 (1H, d,  $J = 18.1\text{Hz}$ , H<sub>b</sub>-15), 2.54 (1H, dd,  $J = 13.6$  &  $6.1\text{Hz}$ , H-5), 2.63 (1H, d,  $J = 15.1\text{Hz}$ , H<sub>a</sub>-6), 2.01 (2H, m), 2.24 (1H, m, H<sub>a</sub>-12) & 1.32 (1H, m, H<sub>b</sub>-12), 2.12 (1H, d,  $J = 15.1$ , H<sub>b</sub>-6), 2.05 (1H, m, H<sub>a</sub>-11) & 1.24 (1H, m, H<sub>b</sub>-11), 2.02 (1H, br s, H-9), 0.89 (3H, s, H-18), 0.88 (3H, s, H-19), 0.88 (3H, s, ol, H-28), 1.10 (1H, s, H-29); <sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>)  $\delta$ : 174.1 (C-7), 170.2 (C-16), 164.0 (ester carbonyl C-1'), 146.2 (C-8), 142.6 (C-23), 140.8 (C-21), 134.28 (Ar-4"), 132.26 (Ar-1"), 127.04 (Ar-3" & Ar-5"), 120.9 (C-20), 116.36 (Ar-2" & Ar-6"), 111.1 (C-22), 109.9 (C-30), 80.1 (C-14), 79.8 (C-17), 77.4 (C-3), 74.6 (C-1), 52.0 (C-9), 50.4 (C-10), 43.9 (C-12), 41.5 (C-13), 39.0 (C-4), 33.8 (C-15), 32.3 (C-6), 29.41 (C-2), 29.68 (C-11), 27.08 (C-28), 23.88 (C-5), 21.94 (C-19), 15.9 (C-29), 13.8 (C-18); MS (ESI+)  $m/z$ : 602.2 [M+H]<sup>+</sup>.

**1.7.(7aS,8S,10S,11aS,12aS)-4-(furan-3-yl)-8-(2-methoxy-2-oxoethyl)-4a,7a,9,9-tetramethyl-13-methylene-2-oxododecahydro-1H-7,12a-methanobenzo[b]pyrano[3,4-g]oxocin-10-yl 4-chlorobenzoate (11b).** Yield: 65%, Time:12h; light yellow gum;  $[\alpha]_{\text{D}}^{25} - 24.1$  (c 0.8, CHCl<sub>3</sub>) IR(KBr):  $\nu_{\text{max}}$  3097, 1731, 1721, 1694, 1335, 1232, 1031 cm<sup>-1</sup>; <sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>)  $\delta$ : 7.95 (4H, d,  $J = 8.6$  Hz, Ar H-3" & H-5"), 7.42 (4H, d,  $J = 8.5\text{Hz}$ , Ar H-2" & H-6"), 7.52 (1H, s, H-21), 7.40 (1H, s, H-23), 6.45(1H, s, H-22), 5.12(1H, H<sub>b</sub>-30), 5.85 (1H, s, H-17), 5.21 (1H, dd,  $J = 10.5$  &  $6.2$  Hz, H-3), 4.87(1H, s, H<sub>a</sub>-30), 3.70(3H, s, OMe), 3.29 (1H, t,  $J = 3.28$  &  $2.30$  Hz, H-1), 2.92 (1H, d,  $J = 18.1\text{Hz}$ , H<sub>b</sub>-15), 2.58 (1H, d,  $J = 18.1\text{Hz}$ , H<sub>a</sub>-15), 2.64(1H, d,  $J = 15.1\text{Hz}$ , H<sub>a</sub>-6) & 2.14 (1H, d,  $J = 15.1\text{Hz}$ , H<sub>b</sub>-6), 2.53 (1H, dd,  $J = 13.6$  &  $6.1\text{Hz}$ , H-5), 2.26 (1H, m, H<sub>a</sub>-12) & 1.31 (1H, m, H<sub>b</sub>-12), 2.06 (1H, m, H<sub>a</sub>-11) & 1.22 (1H, m, H<sub>b</sub>-11), 2.01 (1H, br s, H-9), 2.00 (2H, m, H-2), 1.09 (1H, s, H-29), 0.88 (3H, s, H-18), 0.87 (3H, s, H-19), 0.87(3H, s, ol, H-28); <sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>)  $\delta$ : 174.2 (C-7), 170.3 (C-16), 164.8 (ester carbonyl- C-1'), 146.3 (C-8), 142.6 (C-23), 140.8 (C-21), 139.3 (Ar-4"), 130.8 (Ar-3" & 5"), 128.8 (Ar-2" & 6"), 127.8 (Ar-

1"), 120.9 (C-20), 111.0 (C-21), 110.0 (C-22), 80.0 (C-14), 79.8 (C-17), 75.6 (C-3), 74.7 (C-1), 51.9 (C-9), 50.4 (C-10), 43.8 (C-12), 41.5 (C-13), 39.0 (C-4), 33.8 (C-15), 32.3 (C-6), 29.6 (C-2), 29.3 (C-11), 27.0 (C-28), 23.8 (C-5), 21.9 (C-19), 15.9 (C-29), 13.8 (C-18); HRMS (ESI+)  $m/z$  633.2249  $[M+Na]^+$  (calcd for  $C_{34}H_{39}O_8ClNa [M+Na]^+$ , 633.2225).

**1. 8. (7aS,8S,10S,11aS,12aS)-4-(furan-3-yl)-8-(2-methoxy-2-oxoethyl)-4a,7a,9,9-tetramethyl-13-methylene-2-oxododecahydro-1H-7,12a-methanobenzo[b]pyrano[3,4-g]oxocin-10-yl 4-(trifluoromethyl)benzoate (11c).** Yield: 70%, time: 12h, Yellow gum;  $[\alpha]_D^{25}$  - 41.3 (*c* 0.9,  $CHCl_3$ ); IR(KBr):  $\nu_{max}$  3087, 1734, 1728, 1691, 1331, 1233, 1033  $cm^{-1}$ ;  $^1H$  NMR (300 MHz,  $CDCl_3$ )  $\delta$ : 8.13 (2H, d,  $J = 8.1$ , Ar-3" & Ar-5"), 7.72 (2H, d,  $J = 8.1$  Hz, Ar-2" & Ar-6"), 7.53 (1H, s, H-21), 7.41 (1H, s, H-23), 6.45 (1H, s, H-22), 5.86 (1H, s, H-17), 5.12 (1H, H<sub>b</sub>-30), 5.25 (1H, dd,  $J = 9.1$  & 7.5 Hz, H-3), 4.87 (1H, s, H<sub>a</sub>-30), 3.69 (3H, s, OMe), 3.30 (1H, t,  $J = 3.2$  & 2.8 Hz, H-1), 2.92 (1H, d,  $J = 18.1$  Hz, H<sub>a</sub>-15), 2.60 (1H, d,  $J = 18.1$  Hz, H<sub>b</sub>-15), 2.57 (1H, d,  $J = 16.0$  Hz, H<sub>a</sub>-6) & 2.12 (1H, d,  $J = 16$  Hz, H<sub>b</sub>-6), 2.54 (1H, dd,  $J = 17.3$  & 7.1 Hz, H-5), 2.22 (1H, m, H<sub>a</sub>-12) & 1.33 (1H, m, H<sub>b</sub>-12), 2.04 (1H, br s, H-9), 2.04 (2H, m, H-2), 2.03 (1H, m, H<sub>a</sub>-11), 1.41 (1H, m, H<sub>b</sub>-11), 1.11 (1H, s, H-29), 0.89 (3H, s, H-18), 0.88 (3H, s, H-19), 0.88 (3H, s, OL, H-28);  $^{13}C$  NMR (75 MHz,  $CDCl_3$ )  $\delta$ : 174.1 (C-7), 170.2 (C-16), 164.4 (ester carbonyl-C-1<sup>1</sup>), 146.2 (C-8), 142.6 (C-23), 140.8 (C-21), 133.7 (Ar-4"), 129.8 (Ar-3" & Ar-5"), 125.4 (Ar-2" & Ar-6"), 125.4 (Ar-1"), 120.9 (C-20), 111.0 (C-22), 110.0 (C-30), 80.1 (C-14), 79.8 (C-17), 76.0 (C-3), 74.7 (C-1), 57.8 (C-9), 51.9 (C-10), 43.9 (C-12), 41.5 (C-13), 39.0 (C-4), 33.8 (C-15), 32.3 (C-6), 31.9 (C-2), 29.4 (C-11), 27.0 (C-28), 23.9 (C-5), 21.9 (C-19), 15.9 (C-29), 13.8 (C-18); HRMS (ESI+)  $m/z$ : 667.2519  $[M+Na]^+$  (calcd for  $C_{35}H_{39}F_3O_8Na [M+Na]^+$ , 667.2489).

**1. 9. (7aS,8S,10S,11aS,12aS)-4-(furan-3-yl)-8-(2-methoxy-2-oxoethyl)-4a,7a,9,9-tetramethyl-13-methylene-2-oxododecahydro-1H-7,12a-methanobenzo[b]pyrano[3,4-g]oxocin-10-yl 2,4-**



**dinitrobenzoate (11d)**. Yield: 85%, time: 10h; yellow gum  $[\alpha]_D^{25} - 21.3$  (*c* 0.8, CHCl<sub>3</sub>); IR(KBr):  $\nu_{\max}$  2997, 1741, 1732, 1701, 1337, 1237, 1033cm<sup>-1</sup>; <sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>)  $\delta$ : 9.24 (1H, t, *J* = 2.2Hz, Ar-3"), 9.13 (1H, bs, Ar-5"), 9.13 (1H, bs, Ar-6"), 7.53 (1H, s, H-21), 7.42 (1H, s, H-23), 6.46( 1H, s, H-22), 5.83(1H, s, H-17), 5.34 (1H, dd, *J* = 12 & 4.5 Hz, H-3), 5.14 (1H, H<sub>b</sub>-30), 4.89 (1H, s, H<sub>a</sub>-30), 3.70 (3H, s, OMe), 3.34 (1H, t, *J* = 3.28 & 2.3Hz, H-1), 2.94 (1H, d, *J* = 18.1Hz, H<sub>a</sub>-15)& 2.61 (1H, d, *J* = 18.1Hz, H<sub>b</sub>-15), 2.62(1H, d, *J* = 15.1Hz, H<sub>a</sub>-6) & 2.14 (1H, d, *J* = 15.1Hz, H<sub>b</sub>-6), 2.55 (1H, dd, *J* = 13.6 & 6 Hz, H-5), 2.28 (1H, m, H<sub>a</sub>-12) & 1.35 (1H, m, H<sub>b</sub>-12), 2.07 (2H, m, H-2), 2.06 (1H, m, H<sub>a</sub>-11) & 1.23 (1H, m, H<sub>b</sub>-11), 2.05 (1H, br s H-9), 1.09 (1H, s, H<sub>b</sub>-29), 0.88 (3H, s, H<sub>a</sub>-18), 0.87 (3H, s, H<sub>b</sub>-19), 0.87(1H, s, ol, H<sub>a</sub>-28), <sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>)  $\delta$ : 174.0(C-7), 170.2(C-16), 161.6 (ester carbonyl C-1), 153.1(Ar-4"), 148.6 (Ar-2"), 145.9(C-8), 142.7 (C-23), 140.0 (C-21), 134.08 (Ar-1"), 131.5 (Ar-6"), 129.3 (Ar-5"), 122.3 (Ar-3"), 120.8 (C-20), 111.3 (C-22), 109.9 (C-30), 80.2 (C-14), 79.8 (C-17), 77.9 (C-3), 74.5 (C-1), 52.0 (C-9), 50.3 (C-10), 43.8 (C-12), 41.4 (C-13), 39.1 (C-4), 33.8 (C-15), 32.2 (C-6), 29.6 (C-2), 29.4 (C-11), 27.1(C-28), 23.8 (C-5), 21.9 (C-19), 16.0 (C-29), 13.9 (C-18). HRMS (ESI+) *m/z*: 667.2475 [M+H]<sup>+</sup> (calcd for C<sub>34</sub>H<sub>39</sub>N<sub>2</sub>O<sub>12</sub> [M+H]<sup>+</sup>, 667.2497).

**1.10.(7aS,8S,10S,11aS,12aS)-4-(furan-3-yl)-8-(2-methoxy-2-oxoethyl)-4a,7a,9,9-tetramethyl-13-methylene-2-oxododecahydro-1H-7,12a-methanobenzo[b]pyrano[3,4-g]oxocin-10-yl**

**thiophene-2-carboxylate (11e)**. Yield: 80%, time:12h; light brown gum;  $[\alpha]_D^{25} - 54.5$  (*c* 0.6, CHCl<sub>3</sub>); IR(KBr):  $\nu_{\max}$  3097, 1721, 1715, 1699, 1329, 1237, 1033cm<sup>-1</sup>; <sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>)  $\delta$ : 7.79 (1H, dd, *J* = 0.9, 3.5, Ar-4") , 7.55 ( 1H, dd, *J* = 1.1, 5.0 Hz, Ar-2") , 7.11 (1H, m, Ar-3"), 7.51(1H, bs, H-21), 7.39 (1H, bs, H-23), 6.44(1H, bs, H-22), 5.85 (1H, s, H-17), 5.14 (1H, dd, *J* = 16.8 & 9.4 Hz, H-3), 5.11 (1H, H<sub>b</sub>-30), 4.86 (1H, s, H<sub>a</sub>-30), 3.69 (3H, s, OMe), 3.29 (1H, t, *J* = 3.2 & 6.0 Hz, H-1), 2.91 (1H, d, *J* = 18.1Hz, H<sub>a</sub>-15)& 2.61 (1H, d, *J* = 18.1Hz, H<sub>b</sub>-

15), 2.54 (1H, dd,  $J = 10$  & 4.9 Hz, H-5), 2.62 (1H, d,  $J = 15.1$ Hz, H<sub>a</sub>-6) & 2.14 (1H, d,  $J = 15.1$ Hz, H<sub>b</sub>-6), 2.28 (1H, m, H<sub>a</sub>-12) & 1.35 (1H, m, H<sub>b</sub>-12), 2.07 (2H, m, H-2), 2.06 (1H, m, H<sub>a</sub>-11) & 1.23 (1H, m, H<sub>b</sub>-11), 2.05 (1H, br s H-9), 1.07 (3H, s, H-29), 0.89 (3H, s, H-18), 0.86 (3H, s, H-19), 0.8(3H, s, ol, H-28); <sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>) δ: 174.2 (C-7), 170.2(C-16), 161.4 (ester carbonyl- C-1), 146.3 (C-8), 142.6(C-23), 140.9 (C-21), 134.0 (Ar-1") 133.24 (Ar-2"), 132.20 (Ar-4"), 127.76 (Ar-3"), 120.9 (C-20), 110.9 (C-22), 110.0 (C-30), 80.0 (C-14), 79.7 (C-17), 75.6 (C-3), 74.7 (C-1), 51.9 (C-9), 50.4 (C-10), 43.8 (C-12), 41.5 (C-13), 39.0 (C-4), 33.8 (C-15), 32.3 (C-6), 29.2 (C-2), 29.6 (C-11), 27.0 (C-28), 23.9 (C-5), 21.9 (C-19), 15.8 (C-29), 13.84 (C-18); ESI-MS:  $m/z$  605.2 [M+Na]<sup>+</sup>.

**1.11.(7aS,8S,10S,11aS,12aS)-4-(furan-3-yl)-8-(2-methoxy-2-oxoethyl)-4a,7a,9,9-tetramethyl-13-methylene-2-oxododecahydro-1H-7,12a-methanobenzo[b]pyrano[3,4-g]oxocin-10-yl 2-morpholinoacetate (13a).** Yield: 81%, Time: 4h; oil;  $[\alpha]_D^{25} - 65.1$  ( $c$  0.6, CHCl<sub>3</sub>); IR(KBr):  $\nu_{\max}$  2983, 1742, 1731, 1689, 1331, 1241, 1031cm<sup>-1</sup>. <sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>) δ: 7.48 (1H, bs, H-21), 7.39 (1H, bs, H-23), 6.43 (1H, bs, H-22), 5.79 (1H, s, H-17), 5.06 (1H, d,  $J = 11.7$  & 5.7 Hz, H-3), 5.10 (1H, s, H<sub>a</sub>-30), 4.86 (1H, s, H<sub>b</sub>-30), 3.76(4H, m, morpholine -5"&3"), 3.69(3H, s, OMe), 3.26 (2H, s, chloroacetyl-H-2'), 3.24 (1H, t,  $J = 3.2$  & 3.0 Hz, H-1), 2.90 (1H, d,  $J = 18.1$ Hz, H<sub>a</sub>-15) & 2.56 (1H, d,  $J = 18.1$ Hz, H<sub>b</sub>-15), 2.60 (4H, m, morpholine H-2"& H-6"), 2.56 (1H, m, H-5), 1.84 (2H, m, H-2), 2.54 (1H, OL, H<sub>a</sub>-6) & 2.10 (1H, d,  $J = 15.2$  Hz, H<sub>b</sub>-6), 2.21 (1H, br s, H-9), 2.07 (1H, m, H<sub>a</sub>-11) & 1.54 (1H, m, H<sub>b</sub>-11), 1.86(1H, m, H<sub>a</sub>-12) & 1.16 (1H, m, H<sub>b</sub>-12), 0.95 (1H, s, H-29), 0.88 (3H, s, H-18), 0.83 (3H, s, H-19), 0.80 (3H, s, H-28); <sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>) δ: 174.21(C-7), 170.3(C-16), 169.3(chloroacetyl-1'), 146.2 (C-8), 142.6 (C-23), 140.9 (C-21), 120.8 (C-20), 111.0 (C-22), 109.9 (C-30), 80.0 (C-14), 79.7 (C-17), 74.9 (C-3), 74.6 (C-1), 66.77 (morpholine -3"& 5"), 59.1 (C-2'), 53.21(morpholine -2"& 6"), 51.9 (C-9),

50.3 (C-10), 43.8 (C-12), 41.5 (C-13), 38.7 (C-4), 33.8 (C-15), 32.3 (C-6), 29.7 (C-2), 29.3 (C-11), 27.0 (C-28), 23.8 (C-5), 21.9 (C-19), 15.6 (C-29), 13.8 (C-18). HRMS (ESI+)  $m/z$ : 600.3167  $[M+H]^+$  (calcd for  $C_{33}H_{46}NO_9Na [M+Na]^+$ , 600.3167)

**1.12.(7aS,8S,10S,11aS,12aS)-4-(furan-3-yl)-8-(2-methoxy-2-oxoethyl)-4a,7a,9,9-tetramethyl-13-methylene-2-oxododecahydro-1H-7,12a-methanobenzo[b]pyrano[3,4-g]oxocin-10-yl-2-**

**(pyrrolidin-1-yl)acetate (13b).** Yield: 85%, time: 4h; yellow gum;  $[\alpha]_D^{25} - 54.8$  ( $c$  0.4,  $CHCl_3$ ); IR(KBr):  $\nu_{max}$  2992, 1732, 1734, 1699, 1321, 1241, 1034 $cm^{-1}$ ;  $^1H$  NMR (300 MHz,  $CDCl_3$ )  $\delta$ :  $^1H$  NMR (300MHz,  $CDCl_3$ ): 7.50 (1H, bs, H-21), 7.39 (1H, bs, H-23), 5.80 (1H, s, H-17), 6.43 (1H, bs, H-22), 5.10 (1H, s,  $H_a$ -30), 5.06 (1H, d,  $J = 11.7$  &  $5.7$  Hz, H-3), 4.85 (1H, s,  $H_b$ -30), 3.69(3H, s, OMe), 3.43 (4H, m, pyrrolidine H-2" & H-5"), 3.26 (2H, s, chloroacetyl H-2'), 3.23 (1H, t,  $J = 3.2$  &  $3.0$  Hz, H-1), 2.90 (1H, d,  $J = 18.1$ Hz,  $H_a$ -15), 2.58 (1H, d,  $J = 18.1$ Hz,  $H_b$ -15), 2.54 (1H, m, H-5), 2.50 (1H, d,  $J = 15.6$  Hz,  $H_a$ -6) & 2.09 (1H, d,  $J = 15.6$  Hz,  $H_b$ -6), 2.18 (1H, br s, H-9), 2.06 (1H, m,  $H_a$ -11)&1.55 (1H, m,  $H_b$ -11), 2.86(4H, m, pyrrolidine H-3" & H-4"), 1.85(1H, m,  $H_a$ -12) & 1.15 (1H, m,  $H_b$ -12), 1.84 (2H, m, H-2), 0.95 (3H, s, H-19), 0.87 (3H, s, H-18), 0.82 (3H, s, H-19), 0.81 (3H, s, H-28);  $^{13}C$  NMR (75 MHz,  $CDCl_3$ )  $\delta$ : 174.2(C-7), 170.4(C-16), 174.5 (chloroacetyl C-1'), 146.3 (C-8), 142.6 (C-23), 140.9 (C-21), 120.8 (C-20), 110.9 (C-22), 110.0 (C-30), 79.9 (C-14), 79.7 (C-17), 74.6 (C-3), 72.6 (C-1), 57.2 (chloroacetyl C-2'), 51.94 (pyrrolidine C-2" & C-5"), 50.3 (C-9), 47.3 (C-10), 43.8 (C-12), 41.5 (C-13), 38.7 (C-4), 33.8 (C-15), 32.3 (C-6), 29.6 (C-2), 29.3 (C-11), 26.9 (C-28), 24.58 (pyrrolidine C-3' & C-4'), 23.8 (C-5), 22.49, 21.8 (C-19), 15.6 (C-29), 13.8 (C-18); HRMS (ESI+)  $m/z$ : 584.3222  $[M+H]^+$  (calcd for  $C_{33}H_{46}NO_8 [M+Na]^+$ , 584.3217).

**1.13.(7aS,8S,10S,11aS,12aS)-4-(furan-3-yl)-8-(2-methoxy-2-oxoethyl)-4a,7a,9,9-tetramethyl-13-methylene-2-oxododecahydro-1H-7,12a-methanobenzo[b]pyrano[3,4-g]oxocin-10-yl 2-**

**(4-methylpiperazin-1-yl)acetate (13c).** Yield: 85%, time: 5h; yellow oil;  $[\alpha]_D^{25} - 52.6$  (*c* 0.6, CHCl<sub>3</sub>); IR(KBr):  $\nu_{\max}$  2988, 1731, 1741, 1698, 1331, 1242, 1038cm<sup>-1</sup>; <sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>)  $\delta$ : 7.48 (1H, bs, H-21), 7.39 (1H, bs, H-23), 5.79 (1H, s, H-17), 6.43 (1H, bs, H-22), 5.10 (1H, s, H<sub>b</sub>-30), 5.05 (1H, d, *J* = 12 & 4.5 Hz, H-3), 4.85 (1H, s, H<sub>a</sub>-30), 3.68 (3H, s, OMe), 3.25 (2H, m, chloroacetyl H-2'), 3.24 (1H, t, *J* = 3.2 & 3.0 Hz, H-1), 3.20 (4H, m, piperazine H-3" & H-5"), 2.90 (1H, d, *J* = 18.1 Hz, H<sub>a</sub>-15), 2.58 (1H, d, *J* = 18.1 Hz, H<sub>b</sub>-15), 2.54 (4H, m, piperazine H-2" & H-6"), 2.53 (1H, dd, *J* = 11.8 & 5.0 Hz, H-5), 2.50 (1H, d, *J* = 16.0 Hz, H<sub>a</sub>-6) & 2.10 (1H, d, *J* = 15.2 Hz, H<sub>b</sub>-6), 2.32 (3H, m), 2.26 (3H, s, N-Methyl) 2.08 (1H, br s, H-9), 2.21 (1H, m, H<sub>a</sub>-12) & 1.14 (1H, m, H<sub>b</sub>-12), 2.01 (1H, m, H<sub>a</sub>-11) & 1.53 (1H, m, H<sub>b</sub>-11), 1.84 (2H, m, H-2), 0.87 (3H, s, H-18), 0.82 (3H, s, H-19), 0.80 (3H, s, H-28), 0.95 (3H, s, H-29); <sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>)  $\delta$ : 174.22 (C-7), 170.38 (C-16), 169.51 (chloroacetyl C-1'), 146.28 (C-8), 142.62 (C-23), 140.89 (C-21), 120.8 (C-20), 110.9 (C-22), 109.9 (C-30), 79.9 (C-14), 79.7 (C-17), 74.6 (C-3), 74.8 (C-1), 59.2 (C-2'), 54 (piperazine C-2" & 6"), 52.68 (piperazine C-3" & C-5"), 51.9 (C-9), 50.3 (C-10), 45.74 (N-Methyl), 43.8 (C-12), 41.5 (C-13), 38.6 (C-4), 33.8 (C-15), 32.3 (C-6), 29.6 (C-2), 29.3 (C-11), 26.9 (C-28), 23.8 (C-5), 21.8 (C-19), 15.6 (C-29), 13.8 (C-18); HRMS (ESI+) *m/z*: 613.3484 [M+H]<sup>+</sup> (calcd for C<sub>34</sub>H<sub>49</sub>N<sub>2</sub>O<sub>8</sub> [M+H]<sup>+</sup>, 613.3483).

**1.14.(7aS,8S,10S,11aS,12aS)-4-(furan-3-yl)-8-(2-methoxy-2-oxoethyl)-4a,7a,9,9-tetramethyl-13-methylene-2-oxododecahydro-1H-7,12a-methanobenzo[b]pyrano[3,4-g]oxocin-10-yl 2-(4-ethylpiperazin-1-yl)acetate (13d).** Yield: 83%, time: 5h; yellow gum.  $[\alpha]_D^{25} - 69.2$  (*c* 0.7, CHCl<sub>3</sub>); IR(KBr):  $\nu_{\max}$  2997, 1737, 1742, 1697, 1327, 1242, 1037cm<sup>-1</sup>; <sup>1</sup>H NMR (300 MHz, in CDCl<sub>3</sub>)  $\delta$  (in ppm): 7.50 (1H, bs, H-21), 7.40 (1H, bs, H-23), 6.43 (1H, bs, H-22), 5.79 (1H, s, H-17), 5.11 (1H, s, H<sub>a</sub>-30), 5.00 (1H, d, *J* = 11.8 & 4.7 Hz, H-3), 4.86 (1H, s, H<sub>b</sub>-30), 3.69 (3H, s, OMe), 3.25 (2H, s, H-2') 3.24 (1H, t, *J* = 3.2 & 3.0 Hz, H-1), 3.32 (2H, s, chloroacetyl H-1'), 2.90

(1H, d,  $J = 18.1\text{Hz}$ , H<sub>a</sub>-15) & 2.58 (1H, d,  $J = 18.1\text{Hz}$ , H<sub>b</sub>-15), 2.55 (1H, dd,  $J = 11.8$  &  $5.0$  Hz, H-5), 2.54 (4H, m, piperazine H-2" & H-6"), 2.51(4H, m, piperazine H-3" & H-5"), 2.50 (1H, OL, H<sub>a</sub>-6) & 2.09 (1H, d,  $J = 15.2\text{Hz}$ , H<sub>b</sub>-6), 2.33(2H, m, ethyl H-1"), 2.18 (1H, br s, H-9), 2.07 (1H, m, H<sub>a</sub>-11) & 1.53 (1H, m, H<sub>b</sub>-11), 1.84 (2H, m, H-2), 1.85(1H, m, H<sub>a</sub>-12) & 1.15 (1H, m, H<sub>b</sub>-12), 1.27 (3H, t,  $J = 7.5$  Hz, ethyl H-2"), 0.94 (1H, s, H-29), 0.87 (3H, s, H-18), 0.83 (3H, s, H-19), 0.80 (1H, s, H-28); <sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>)  $\delta$ : 174.2(C-7), 170.9 (C-16), 170.4 (chloroacetyl C-1'), 146.2 (C-8), 142.6 (C-23), 140.8 (C-21), 120.8 (C-20), 111.0 (C-22), 109.9 (C-30), 80.0(C-14), 80.0 (C-17), 74.6 (C-3), 74.6(C-1), 59.1(C-2'), 52.80 (piperazine C-2" & C-6"), 51.97 (piperazine C-3" & 5"), 51.4 (C-9), 50.3(C-10), 43.8(C-12), 41.4(C-13), 38.7(C-4), 33.8 (C-15), 32.3 (C-6), 31.9 (C-1"), 29.6 (C-2), 29.3 (C-11), 26.9 (C-28), 23.8(C-5), 22.6 (C-2"), 21.9(C-19), 15.7 (C-29), 13.9 (C-18); ESI-MS:  $m/z$  627.3 [M+H]<sup>+</sup>.

**1.15.tert-butyl-4-(2-(((7aS,8S,10S,11aS,12aS)-4-(furan-3-yl)-8-(2-methoxy-2-oxoethyl)-4a,7a,9,9-tetramethyl-13-methylene-2-oxododecahydro-1H-7,12a-methanobenzo[b]pyrano[3,4-g]oxocin-10-yl)oxy)-2-oxoethyl)piperazine-1-carboxylate**

(13e). Yield: 86%, time: 4h; yellow gum;  $[\alpha]_D^{25} - 38.1$  ( $c$  0.5, CHCl<sub>3</sub>); IR(KBr):  $\nu_{\text{max}}$  2995, 1735, 1732, 1695, 1325, 1242, 1035cm<sup>-1</sup>; <sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>)  $\delta$ : 7.49 (1H, bs, H-21), 7.39 (1H, bs, H-23), 6.43 (1H, bs, H-22), 5.78 (1H, s, H-17), 5.10 (1H, s, H<sub>a</sub>-30), 5.04 (1H, d,  $J = 12$  &  $4.5$  Hz, H-3), 4.85 (1H, s, H<sub>b</sub>-30), 3.69 (3H, s, OMe), 3.35 (4H, m, piperazine H-3" & H-5"), 3.24 (1H, t,  $J = 3.2$  &  $3.0$  Hz, H-1), 3.23 (2H, m, chloroacetyl H-1'), 2.90 (1H, d,  $J = 18.1$  Hz, H<sub>a</sub>-15), 2.57 (1H, d,  $J = 18.1$  Hz, H<sub>b</sub>-15), 2.55(1H, m, H-5), 2.50 (1H, d,  $J = 16.0\text{Hz}$ , H<sub>a</sub>-6) & 2.10 (1H, d,  $J = 15.8$  Hz, H<sub>b</sub>-6), 2.28(4H, m, piperazine H-2" & H-6") 2.08 (1H, brs, H-9), 2.21 (1H, m, H<sub>a</sub>-11) & 1.53 (1H, m, H<sub>b</sub>-11), 1.85(1H, m, H<sub>a</sub>-12) & 1.16(1H, m, H<sub>b</sub>-12), 1.84 (2H, m, H-2), 1.47 (9H, s, boc-3Me), 0.94 (3H, s, H-29), 0.87 (3H, s, H-18), 0.82(3H, s, H-19), 0.80

(3H, s, H-28); HRMS (ESI+)  $m/z$ : 721.3672  $[M+Na]^+$  (calcd for  $C_{38}H_{54}N_2O_{10}Na[M+H]^+$ , 721.3670).

**1.16.(7aS,8S,10S,11aS,12aS)-4-(furan-3-yl)-8-(2-methoxy-2-oxoethyl)-4a,7a,9,9-tetramethyl-13-methylene-2-oxododecahydro-1H-7,12a-methanobenzo[b]pyrano[3,4-g]oxocin-10-yl-2-(4-(2-hydroxyethyl)piperazin-1-yl)acetate (13f).** Yield: 75%, time: 6h; yellow gum;  $[\alpha]_D^{25} - 44.6$  ( $c$  0.6,  $CHCl_3$ ); IR(KBr):  $\nu_{max}$  3497, 1731, 1718, 1698, 1328, 1238, 1033 $cm^{-1}$ ;  $^1H$  NMR (300 MHz,  $CDCl_3$ )  $\delta$ : 7.48(1H, bs, H-21), 7.39 (1H, bs, H-23), 6.43(1H, bs, H-22), 5.79 (1H, s, H-17), 5.10 (1H, s,  $H_a$ -30), 5.05 (1H, d,  $J = 11.1$  & 5.2 Hz, H-3), 4.85 (1H, s,  $H_b$ -30), 3.69 (3H, s, OMe), 3.69 (2H, t,  $J = 5.2$ , O- $CH_2$ -2"), 3.24(2H, m, H-2'), 3.26(2H, s, chloroacetyl, H-2') 3.23 (1H, t,  $J = 3.2$  & 3.0 Hz, H-1), 2.4 (1H, m, H-5), 2.90 (1H, d,  $J = 18.1$ Hz,  $H_a$ -15), 2.65 (4H, m, H-3" & H-5"), 2.61(2H, t,  $J = 5.2$  Hz, N- $CH_2$ , H-1"), 2.57 (1H, d,  $J = 18.1$ ,  $H_b$ -15), 2.51 (1H, d,  $J = 15.2$ ,  $H_a$ -6) & 2.09 (1H, d,  $J = 15.2$ Hz,  $H_b$ -6), 2.17 (1H, br, H-9), 2.14 (4H, m, piperazine H-2" & H-6") 2.07 (1H, m,  $H_a$ -11) & 1.56 (1H, m,  $H_b$ -11), 1.98 (1H, m,  $H_a$ -12), 1.86 (2H, m, H-2), 1.16(1H, m,  $H_b$ -12), 0.95 (3H, s, H-29), 0.87 (3H, s, H-18), 0.82 (3H, s, H-19), 0.80 (3H, s, H-28);  $^{13}C$  NMR (75 MHz,  $CDCl_3$ )  $\delta$ : 174.1(C-7), 170.3 (C-16), 169.4 (chloroacetyl C-1<sup>1</sup>), 146.3(C-8), 142.6 (C-23), 140.9 (C-21), 120.8 (C-20), 110.9 (C-22), 109.9 (C-30), 80.0(C-14), 79.7 (C-17), 74.9 (C-3), 74.6(C-1), 59.19 (O- $CH_2$ -2"), 59.1 (C-2'), 57.5 (N- $CH_2$ -1"), 52.5(piperazine C-3" & C-5"), 51.9(C-9), 50.9 (piperazine C-2" & C-6") 50.4(C-10), 43.8 (C-12), 41.5 (C-13), 38.7(C-4), 33.8 (C-15), 32.3 (C-6), 29.6(C-11), 27.0 (C-28), 23.8 (C-5), 21.9 (C-19), 15.6 (C-29), 13.8 (C-18); HRMS (ESI+)  $m/z$ : calcd for  $C_{35}H_{51}N_2O_9$   $[M+H]^+$ : 643.3589; found: 643.3599  $[M+H]^+$ .

**1.17.(7aS,8S,10S,11aS,12aS)-4-(furan-3-yl)-8-(2-methoxy-2-oxoethyl)-4a,7a,9,9-tetramethyl-13-methylene-2-oxododecahydro-1H-7,12a-methanobenzo[b]pyrano[3,4-g]oxocin-10-yl 2-**

**(4-(furan-3-carbonyl)piperazin-1-yl)acetate (13g)**. Yield: 88%, yellow gum;  $[\alpha]_D^{25} - 53.9$  (c 1.0, CHCl<sub>3</sub>); IR(KBr):  $\nu_{\max}$  2997, 1731, 1719, 1698, 1337, 1237, 1034cm<sup>-1</sup>; <sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>)  $\delta$ : 7.48 (1H, bs, H-21), 7.47 (1H, bs, furan-H), 7.39 (1H, bs, H-23), 6.43 (1H, bs, H-22), 6.47 (1H, bs, furan-H), 6.99 (1H, bs, furan-H), 5.79 (1H, s, H-17), 5.07 (1H, d,  $J = 11.5$  & 5.09 Hz, H-3), 5.10 (1H, s, H<sub>a</sub>-30), 4.85 (1H, s, H<sub>b</sub>-30), 3.87 (4H, m, piperazine H-3" & H-5"), 3.69 (3H, s, OMe), 3.26 (2H, s, chloroacetyl C-2'), 3.25 (1H, t,  $J = 3.2$  & 3.0, H-1), 2.90 (1H, d,  $J = 17.9$  Hz, H<sub>a</sub>-15), 2.67 (4H, m, piperazine H-2" & H-6"), 2.57 (1H, d,  $J = 17.9$  Hz, H<sub>a</sub>-15), 2.54 (1H, dd,  $J = 11.2$  & 5.0 Hz, H-5), 2.58 (1H, d,  $J = 14.8$  Hz, H<sub>a</sub>-6) & 2.09 (1H, d,  $J = 14.8$  Hz, H<sub>b</sub>-6), 2.17 (1H, brs, H-9), 2.11 (1H, m, H<sub>a</sub>-11) & 1.53 (1H, m, H<sub>b</sub>-11), 2.21 (1H, m, H<sub>a</sub>-12) & 1.16 (1H, m, H<sub>b</sub>-12), 1.86 (2H, m, H-2), 0.95 (1H, s), 0.87 (3H, s, H-18), 0.82 (3H, s, H-19), 0.81 (1H, s); <sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>)  $\delta$ : 207 (Keto C-1"), 174.1 (C-7), 170.3 (C-16), 169.3 (chloroacetyl-1'), 159.04, 147.82 (furan C), 146.2 (C-8), 143.63 (furan C), 142.6 (C-23), 140.8 (C-21), 120.8 (C-20), 116.37 (furan C), 111.2 (C-22), 109.9 (C-30), 79.9 (C-14), 79.8 (C-17), 74.6 (C-3), 75.05 (C-1), 59.04 (C-2'), 52.9 (piperazine C-3" & 5"), 52.3 (piperazine C-2" & 6"), 51.9 (C-9), 50.3 (C-10), 43.8 (C-12), 38.7 (C-13), 33.8 (C-4), 32.3 (C-15), 30.9 (C-6), 29.6 (C-2), 29.3 (C-11), 27.0 (C-28), 23.8 (C-5), 21.8 (C-19), 15.6 (C-29), 13.8 (C-18); HRMS (ESI+)  $m/z$ : 693.3389 [M+H]<sup>+</sup> (calcd for C<sub>38</sub>H<sub>49</sub>N<sub>2</sub>O<sub>10</sub> [M+H]<sup>+</sup>, 693.3381).

**1.18.(7aS,8S,10S,11aS,12aS)-4-(furan-3-yl)-8-(2-methoxy-2-oxoethyl)-4a,7a,9,9-tetramethyl-13-methylene-2-oxododecahydro-1H-7,12a-methanobenzo[b]pyrano[3,4-g]oxocin-10-yl 2-(4-benzoylpiperazin-1-yl)acetate (13h)**. Yield: 89%, time: 6h; yellow gum;  $[\alpha]_D^{25} - 41.9$  (c 0.4, CHCl<sub>3</sub>); IR(KBr):  $\nu_{\max}$  3097, 1721, 1715, 1699, 1329, 1237, 1033cm<sup>-1</sup>; <sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>)  $\delta$ : 7.49 (1H, bs, H-21), 7.39 (1H, bs, H-23), 7.39 (5H, m, 5Ar-H), 6.39 (1H, Ol, H-22), 5.79 (1H, s, H-17), 5.10 (1H, s, H<sub>a</sub>-30), 5.05 (1H, d,  $J = 11.7$  & 5.05 Hz, H-3), 4.85 (1H, s, H<sub>b</sub>-

30), 3.85(4H, m, piperazine H-3" & H-5"), 3.69 (3H, s, OMe), 3.27(2H, S, chloroacetyl -2'), 3.26 (1H, t,  $J = 3.2$  &  $3.0$  Hz, H-1), 2.91 (1H, d,  $J = 17.9$  Hz, H<sub>a</sub>-15), 2.71 (1H, d,  $J = 17.9$  Hz, H<sub>b</sub>-15), 2.55 (1H, dd,  $J = 11.2$  &  $5.0$  Hz, H-5), 2.52 (1H, d,  $J = 14.8$  Hz, H<sub>a</sub>-6) & 2.15 (1H, d,  $J = 14.8$  Hz, H<sub>b</sub>-6), 2.66(4H, m, piperazine H-2" & H-6"), 2.17 (1H, brs, H-9), 2.11(1H, m, H<sub>a</sub>-11) & 1.86(1H, m, H<sub>b</sub>-11), 2.22(1H, m, H<sub>a</sub>-12) & 1.17 (1H, m, H<sub>b</sub>-12), 1.87 (2H, m, H-2), 0.95 (1H, s, H-29), 0.87 (3H, s, H-18), 0.82 (3H, s, H-19), 0.80 (3H, s, H-28): <sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>) δ: 207.0 (keto C-1"), 174.1(C-7), 176.2 (chloroacetyl C-1'), 170.3 (C-16), 146.2 (C-8), 140.8 (C-21), 135.6 (Ar- C), 129.6 (Ar- C), 128.4 (Ar- C), 127.0 (Ar- C), 120.8 (C-20), 111.0 (C-22), 109.9 (C-30), 79.9 (C-14), 79.8 (C-17), 74.6 (C-3), 75.0(C-1), 58.97 (chloroacetyl C-2'), 52.9 (piperazine C-3" & 5"), 52.4 (piperazine C- 2" & 6"), 51.9 (C-9), 50.3 (C-10), 43.8 (C-12), 43.8 (C-13), 38.6 (C-4), 30.9 (C-15), 27.0 (C-6), 29.3 (C-2), 29.6 (C-11), 21.8 (C-19), 23.8 (C-5), 15.6 (C-29), 13.8 (C-18); HRMS (ESI+)  $m/z$ : 703.3591 [M+H]<sup>+</sup>( calcd for C<sub>40</sub>H<sub>51</sub>N<sub>2</sub>O<sub>9</sub> [M+H]<sup>+</sup>, 703.3589).

**1.19.(7aS,8S,10S,11aS,12aS)-4-(furan-3-yl)-8-(2-methoxy-2-oxoethyl)-4a,7a,9,9-tetramethyl-13-methylene-2-oxododecahydro-1H-7,12a-methanobenzo[b]pyrano[3,4-g]oxocin-10-yl 2-(diethylamino)acetate (13i).** Yield: 90%, Time: 4h; oil;  $[\alpha]_D^{25} - 43.2$  ( $c$  0.9, CHCl<sub>3</sub>); IR(KBr):  $\nu_{\max}$  3087, 1731, 1725, 1698, 1339, 1233, 1034cm<sup>-1</sup>; <sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>) δ: 7.50 (1H, bs, H-21), 7.39 (1H, bs, H-23), 6.43(1H, bs, H-22), 5.81 (1H, s, H-17), 5.10 (1H, s, H<sub>a</sub>-30), 5.04 (1H, d,  $J = 11.5$  &  $5.09$  Hz, H-3), 4.86 (1H, s, H<sub>b</sub>-30), 3.69 (3H, s, OMe), 3.24 (2H, s, chloroacetyl -2'), 3.23 (1H, t,  $J = 3.2$  &  $3.0$ , H-1), 2.90 (1H, d,  $J = 18.1$ Hz, H<sub>a</sub>-15), 2.70 (4H, m, N,N,-Diethyl-2CH<sub>2</sub>), 2.57 (1H, d,  $J = 18.1$ Hz, H<sub>b</sub>-15), 2.55 (1H, m, H-5), 2.50 (1H, d,  $J = 16.0$ Hz, H<sub>a</sub>-6) & 2.09 (1H, d,  $J = 15.2$  Hz, H<sub>b</sub>-6), 2.18 (1H, br s, H-9), 1.87(1H, m, H<sub>a</sub>-11) & 1.53(1H, m, H<sub>b</sub>-11), 2.21(1H, m, H<sub>a</sub>-12), 1.86 (2H, m, H-2), 1.15 (1H, m, H<sub>b</sub>-12), 1.07 (6H, t, t,



J= 7.1 & 14.2 Hz, N,N,-Diethyl 2Me), 0.96 (1H, s, H-29), 0.87 (3H, s, H-18), 0.83 (3H, s, H-19), 0.80 (3H, s, H-28),<sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>) δ:181.1(chloroacetyl C-1<sup>1</sup>), 174.2 (C-7), 170.4 (C-16), 146.2 (C-8), 142.6 (C-23), 140.8 (C-21), 120.8 (C-20), 111.0 (C-22), 109.9 (C-30), 80.0 (C-14), 74.6 (C-17), 59.9 (chloroacetyl-2'), 52.0 (N,N,-Diethyl -2CH<sub>2</sub>-), 51.4 (C-9), 50.3 (C-10), 43.8 (C-12), 41.4 (C-13), 38.7 (C-4), 33.8 (C-15), 32.3 (-6), 31.9 (C-2), 29.3 (C-11), 26.9(C-28), 23.8 (C-5), 21.90 (C-19), 15.73 (C-29), 14.10 (N,N,-Diethyl-2Me), 13.9 (C-18); HRMS (ESI+) *m/z*: 586.3347 [M+H]<sup>+</sup> (calcd for C<sub>33</sub>H<sub>48</sub>NO<sub>8</sub> [M+H]<sup>+</sup>, 586.3374).

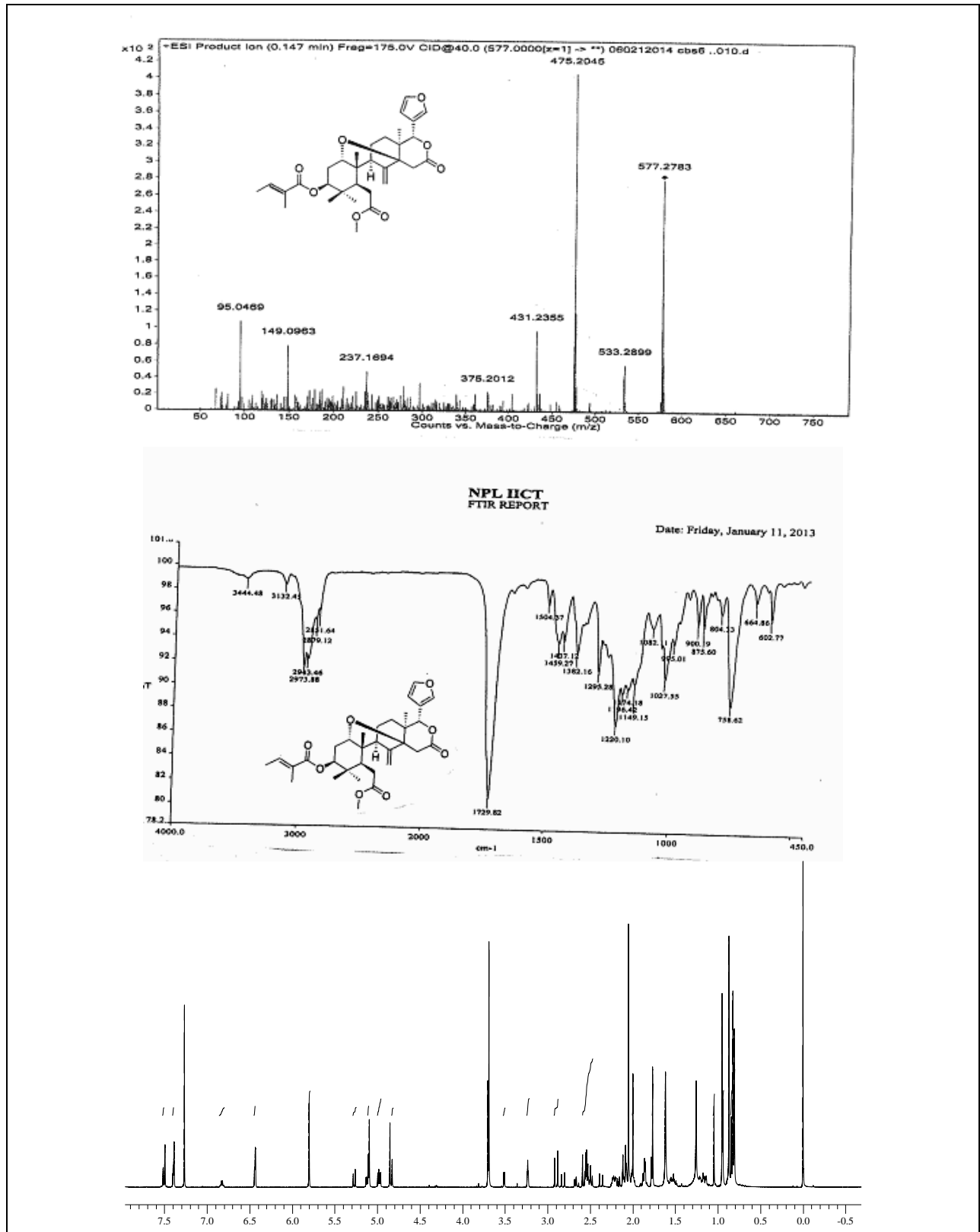


Figure 1: HRESIMS, IR and  $^1\text{H}$  NMR Spectrums of Compound **1**

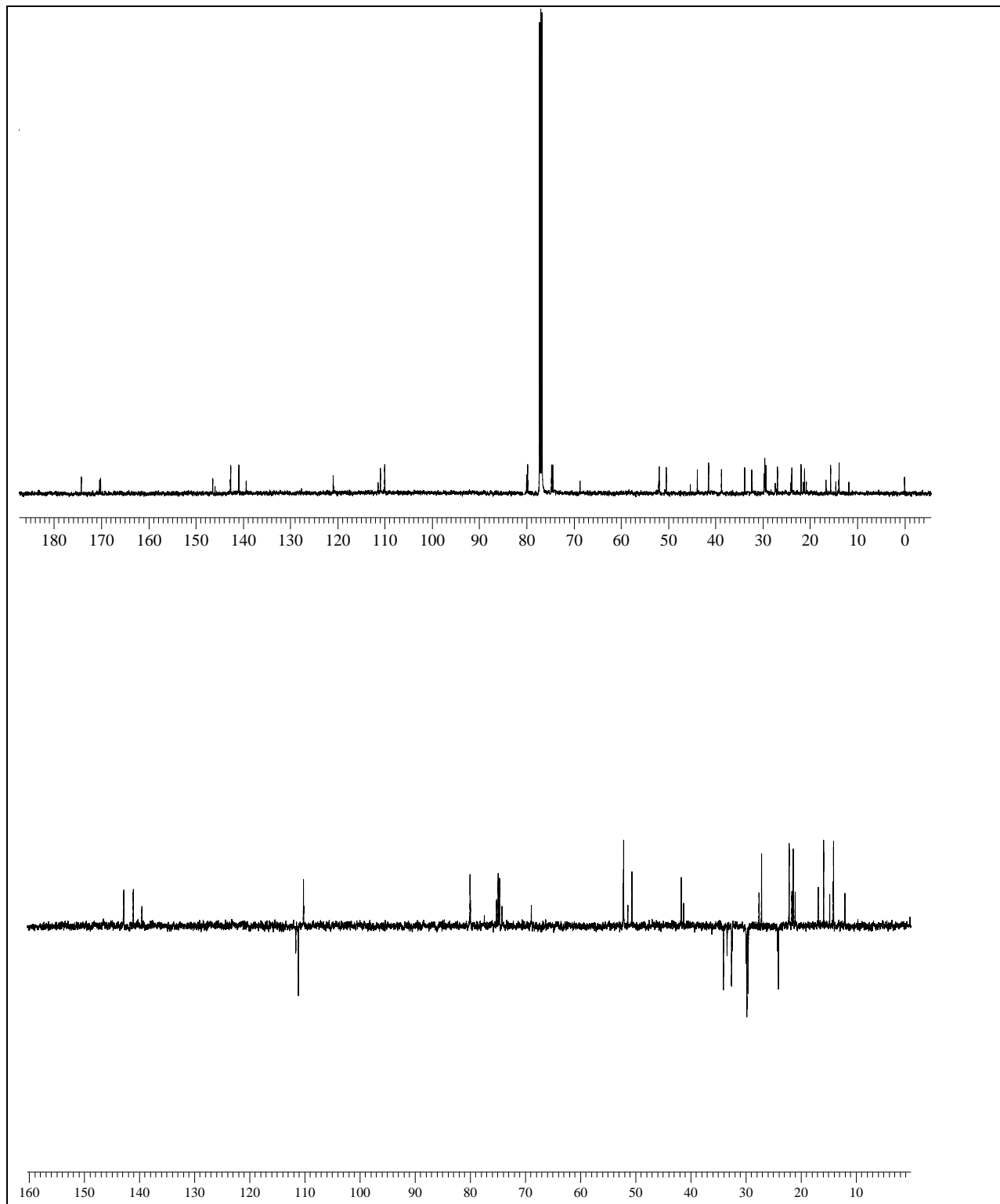


Figure 2:  $^{13}\text{C}$  NMR & DEPT 135° Spectrums of Compound 1

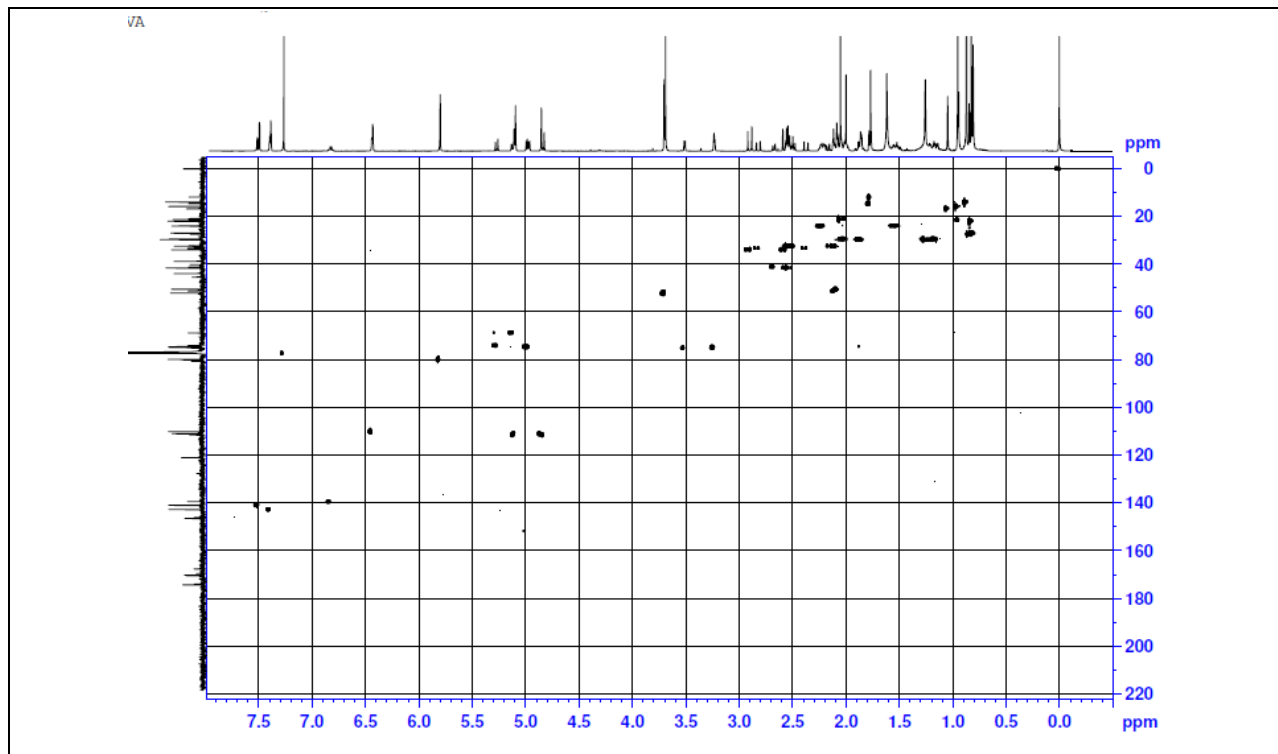


Figure 3: HSQC Spectrum of Compound 1

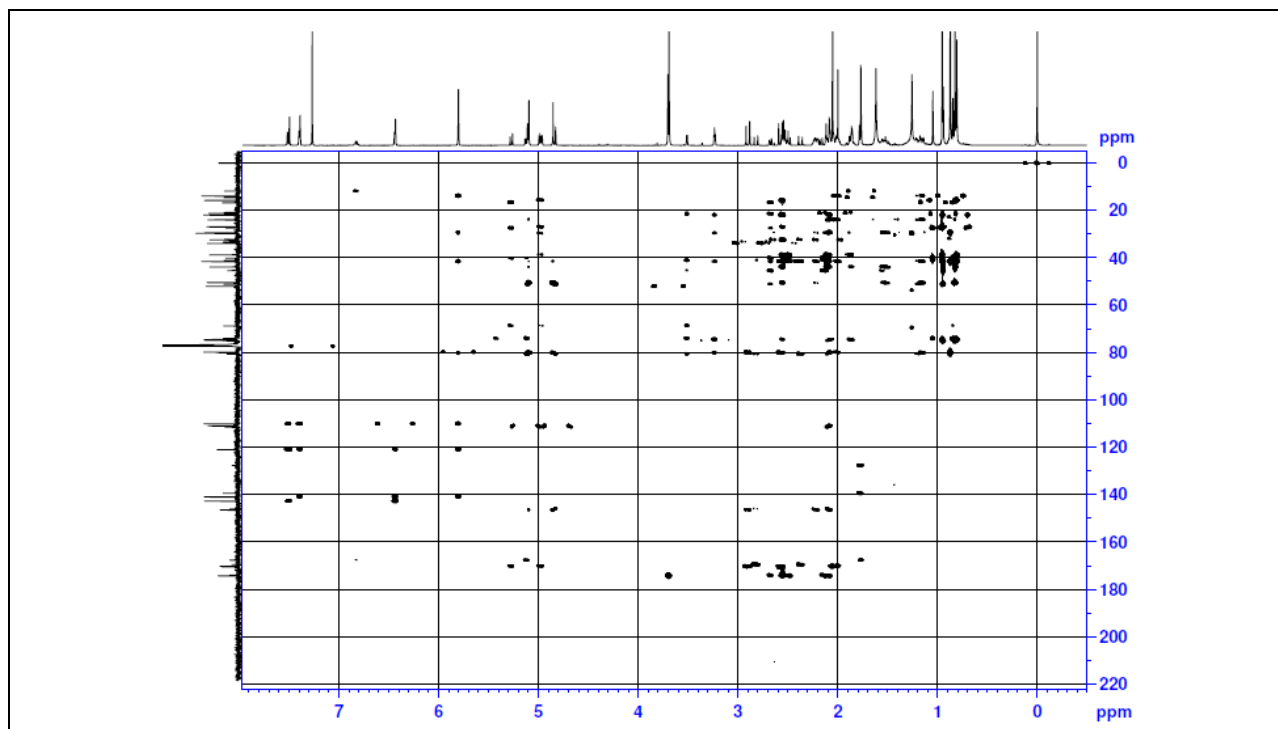


Figure 4: HMBC Spectrum of Compound 1

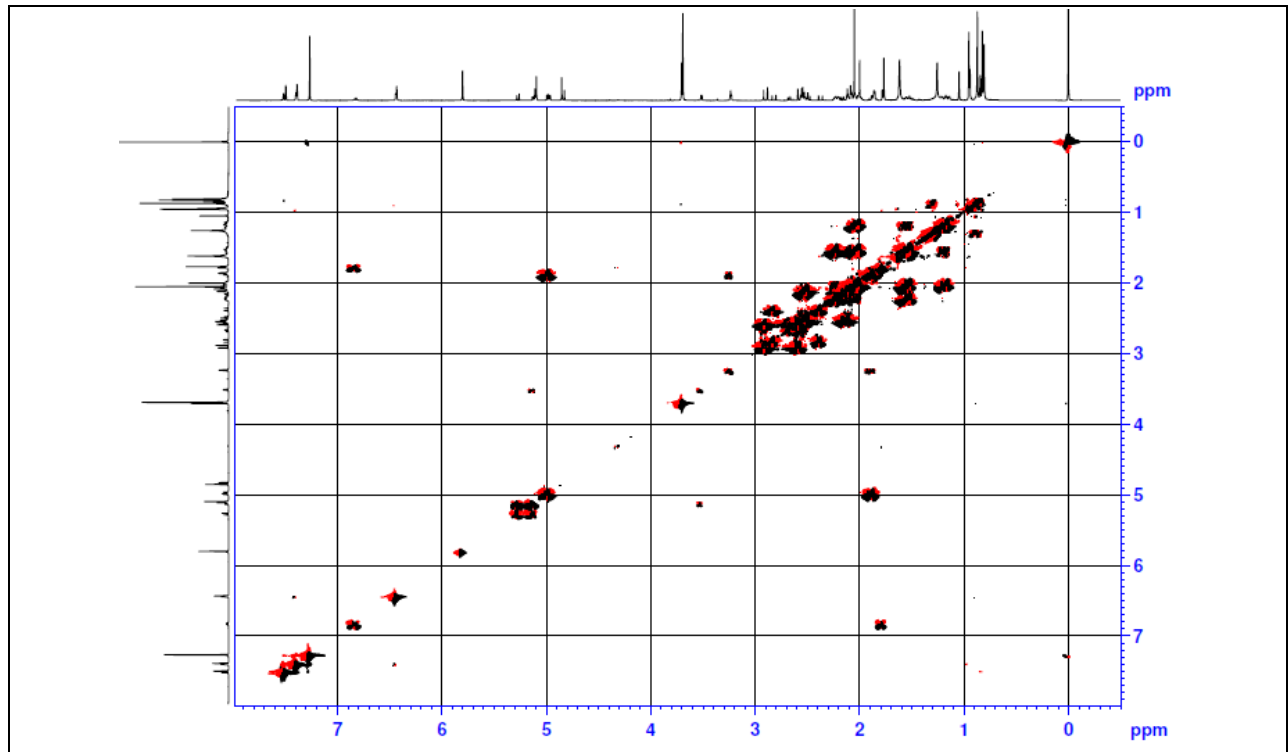


Figure 5: COSY Spectrum of Compound 1

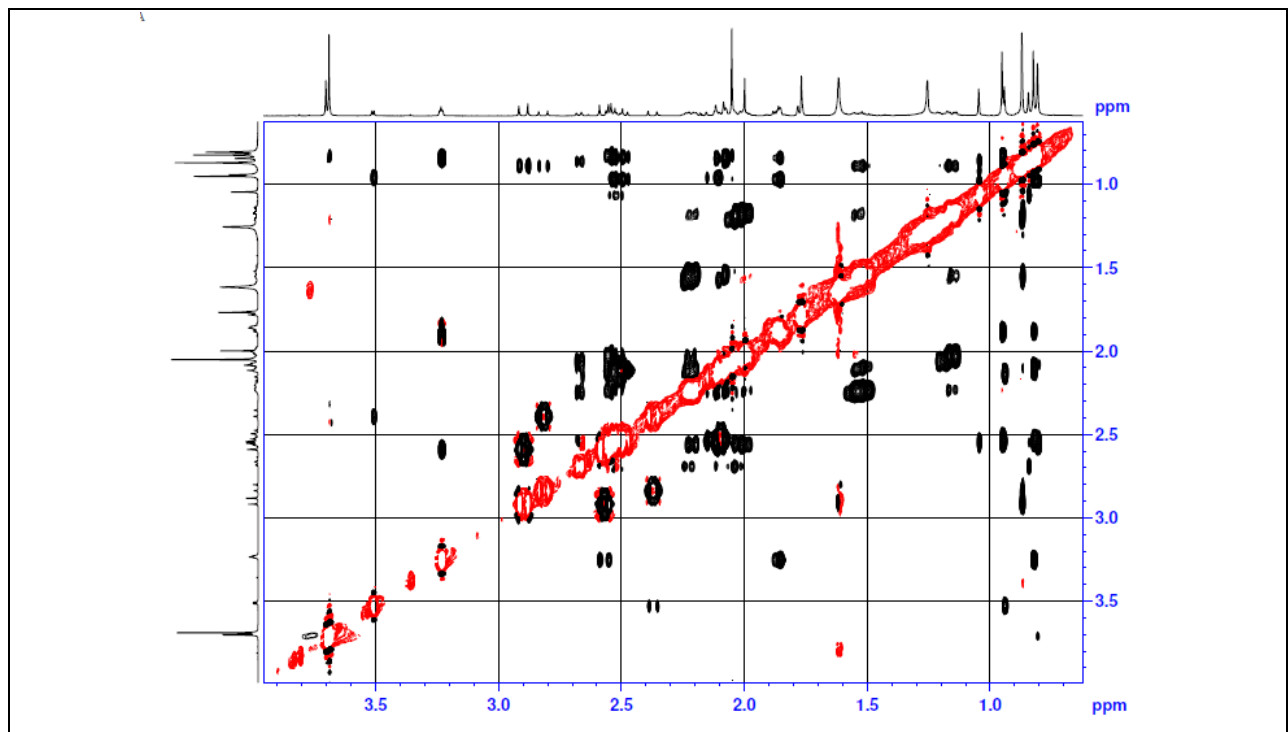
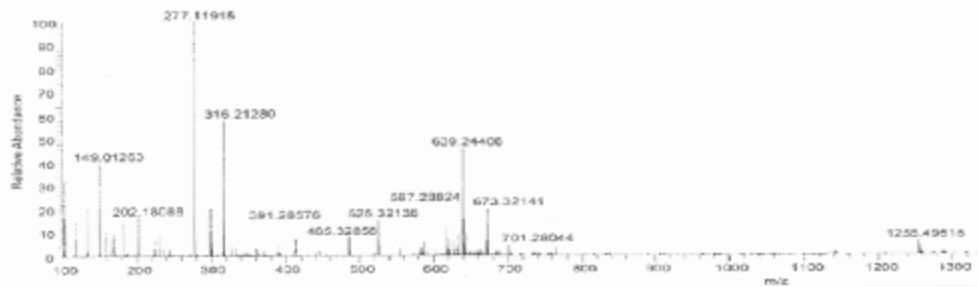


Figure 6: NOESY Spectrum of Compound 1

Sample Name  
 Sample ID B-SIVA  
 Date and Time 09-12-13 19:10:16  
 KSB-CL-P-597-66 RT: 0.03-0.25 AV: 50 NL: 4.555  
 T: FTMS (1,1) + p ESI Full ms [100.00-2000.00]



KSB-CL-P-598-30 RT: 0.03-0.10 AV: 23

T: FTMS (1,1) + p ESI Full ms [100.00-2000.00]

m/s = 629.95-644.36

m/z	Intensity	Relative	Theo. Mass	Delta (ppm)	RDB equiv.	Composition
639.24423	3110953.0	100.00	639.24120	4.74	12.5	C <sub>12</sub> H <sub>40</sub> O <sub>12</sub> Na
641.29337	1242908.0	39.95				

NPL ICT  
 FTIR REPORT

Date: Friday, January 11, 2013

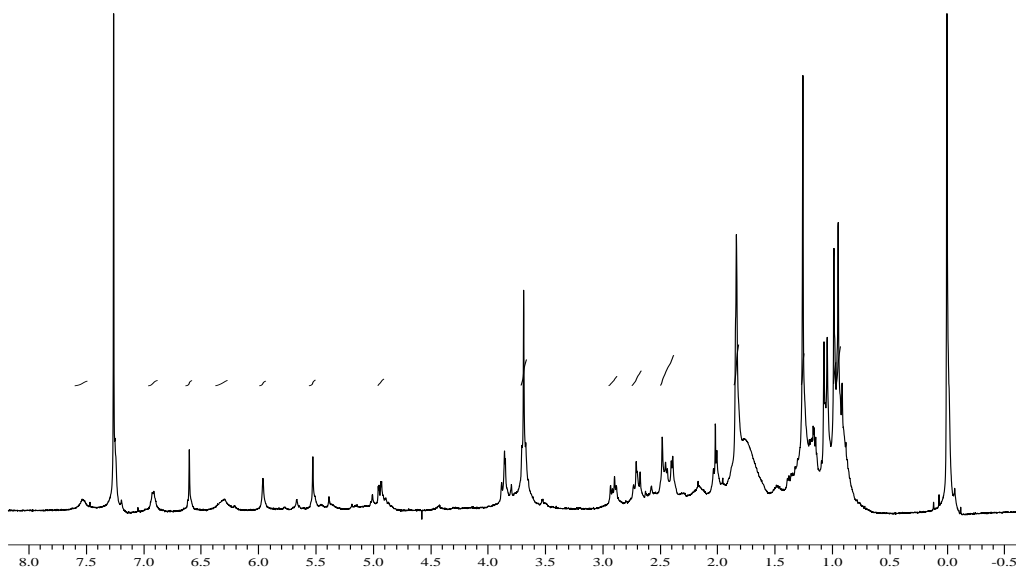
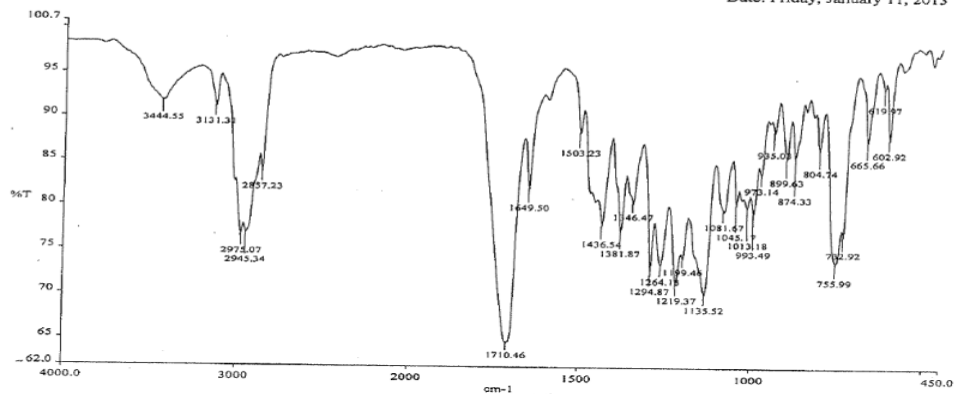


Figure 7: HRESIMS, IR and 1H NMR Spectrums of Compound 2

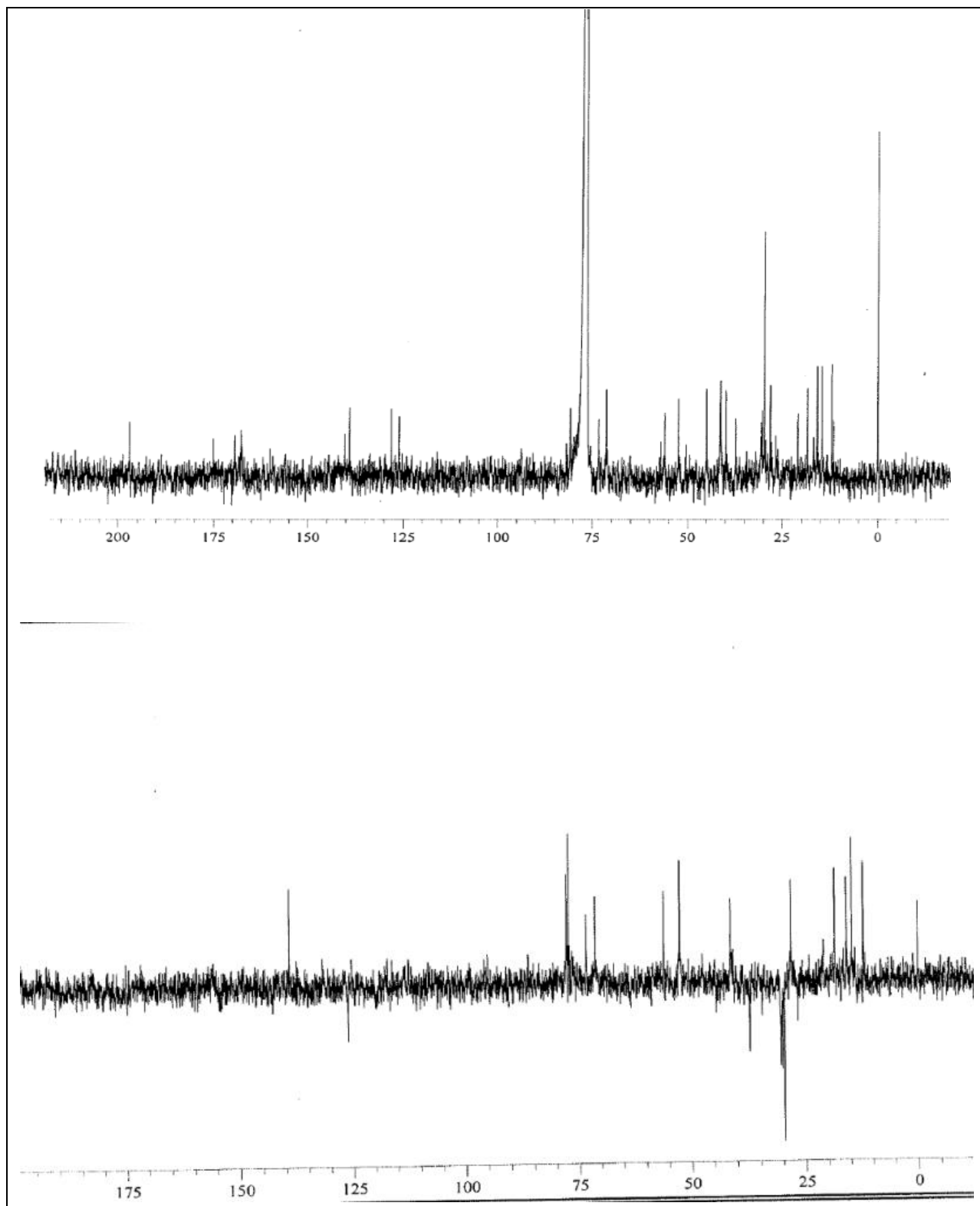


Figure 8:  $^{13}\text{C}$  NMR & DEPT 135° Spectrums of Compound 2

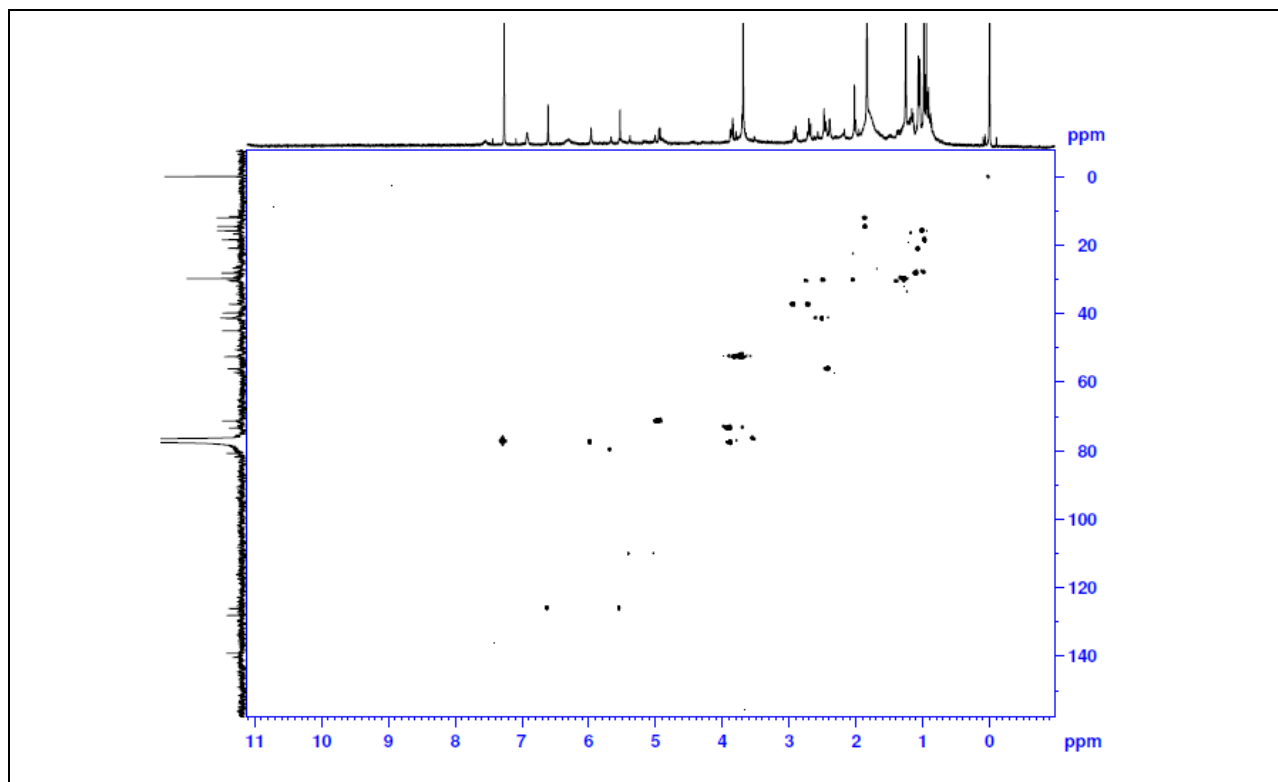


Figure 9: HSQC Spectrum of Compound 2

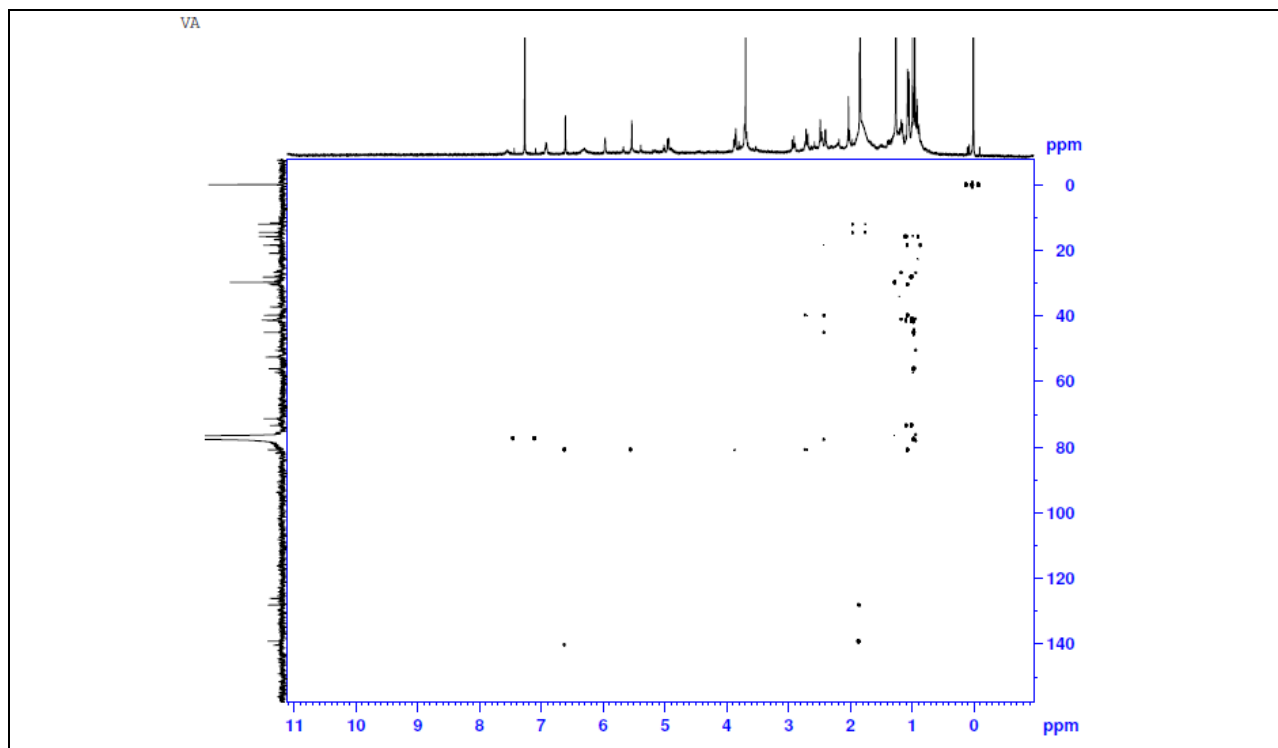


Figure 10: HMBC Spectrum of Compound 2



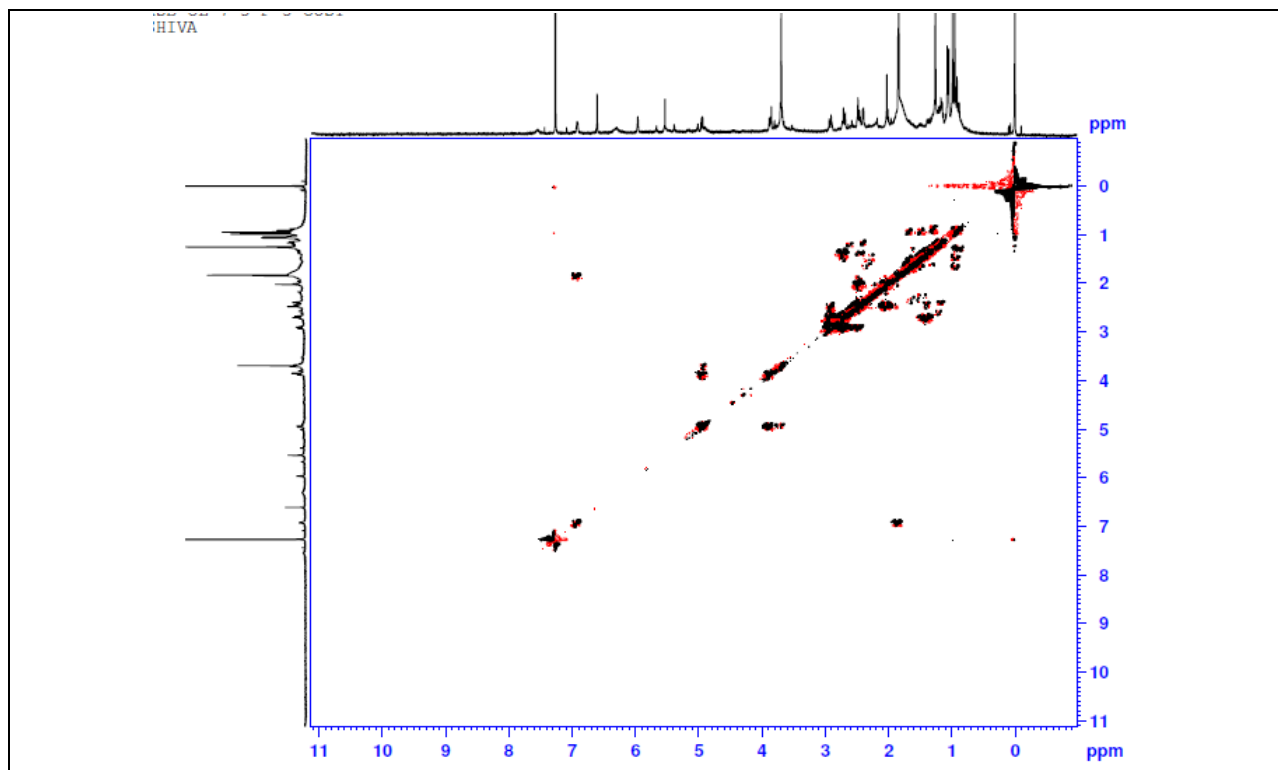


Figure 11: COSY Spectrum of Compound 2

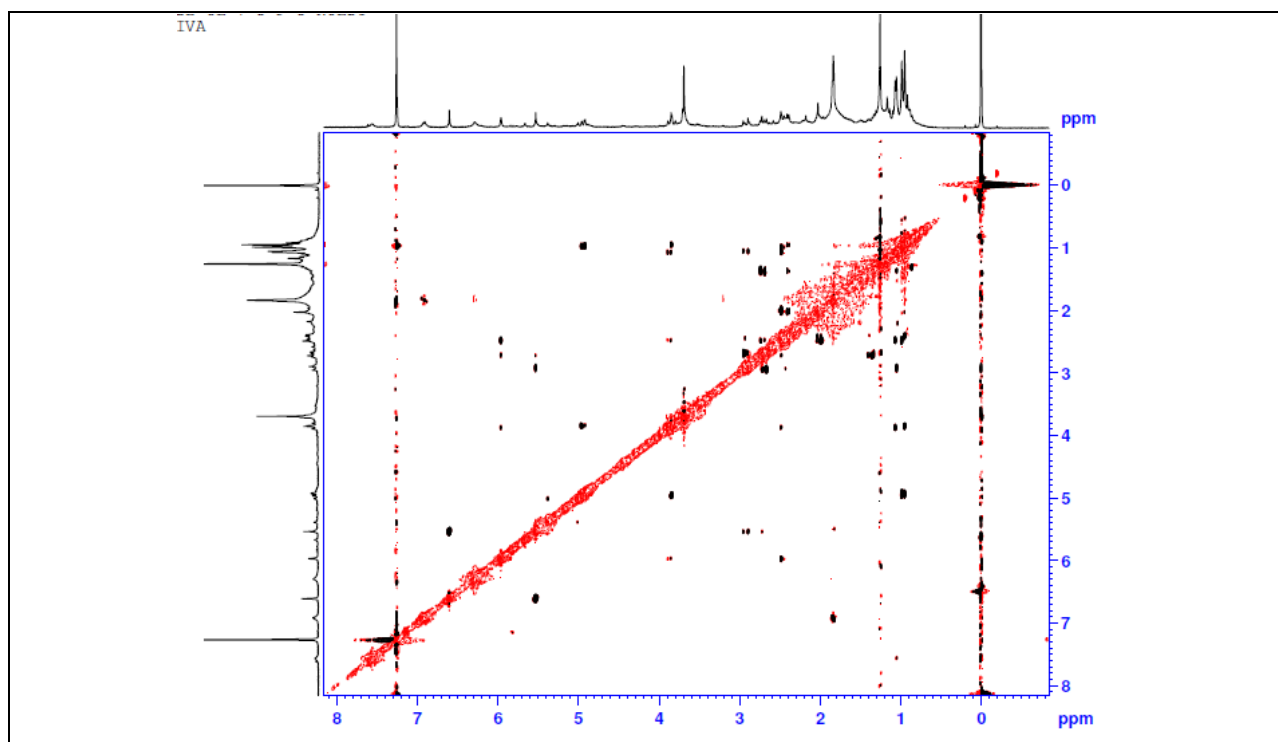


Figure 12: NOESY Spectrum of Compound 2

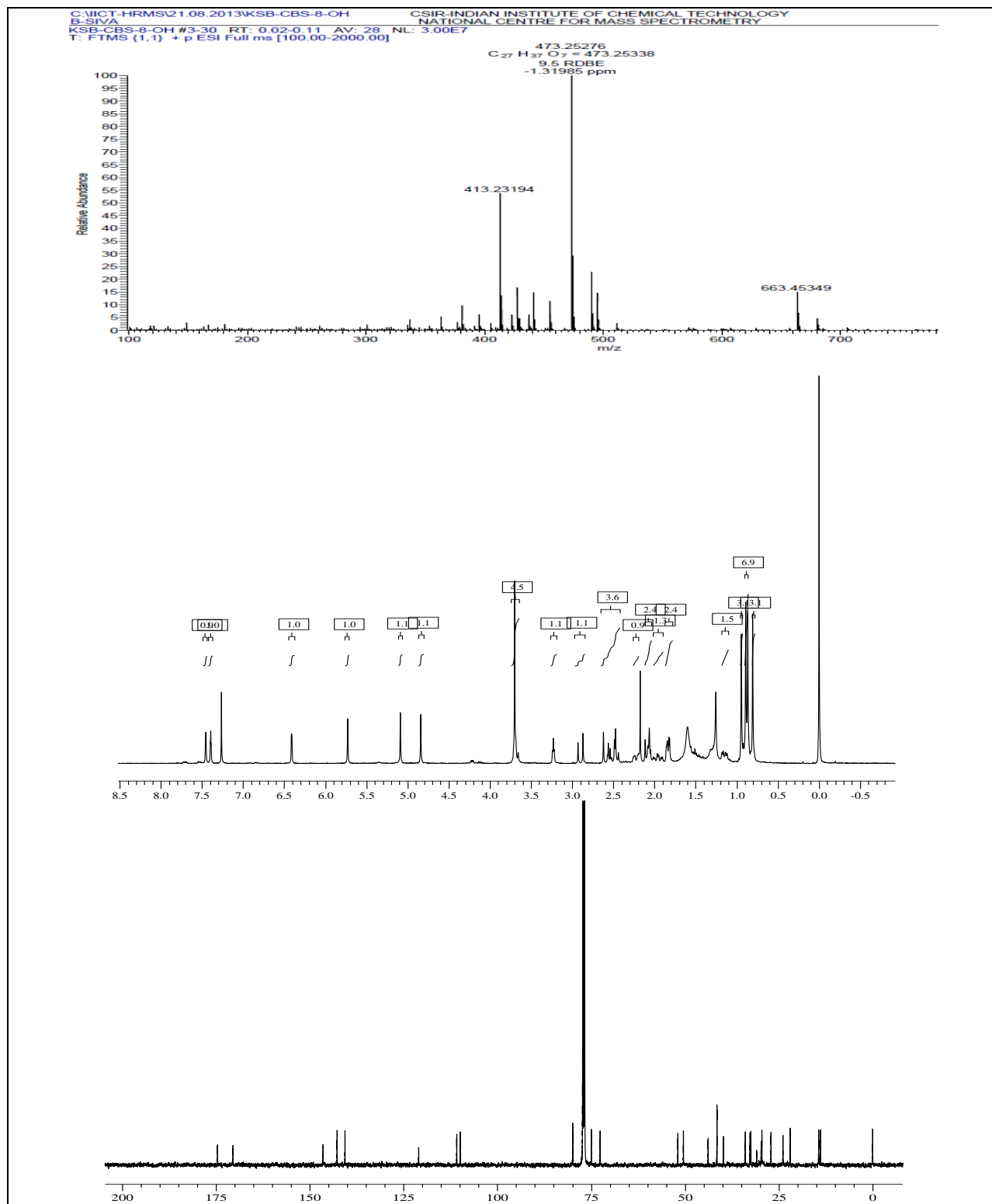


Figure 13: HRESIMS, <sup>1</sup>H & <sup>13</sup>C NMR of Compound 9

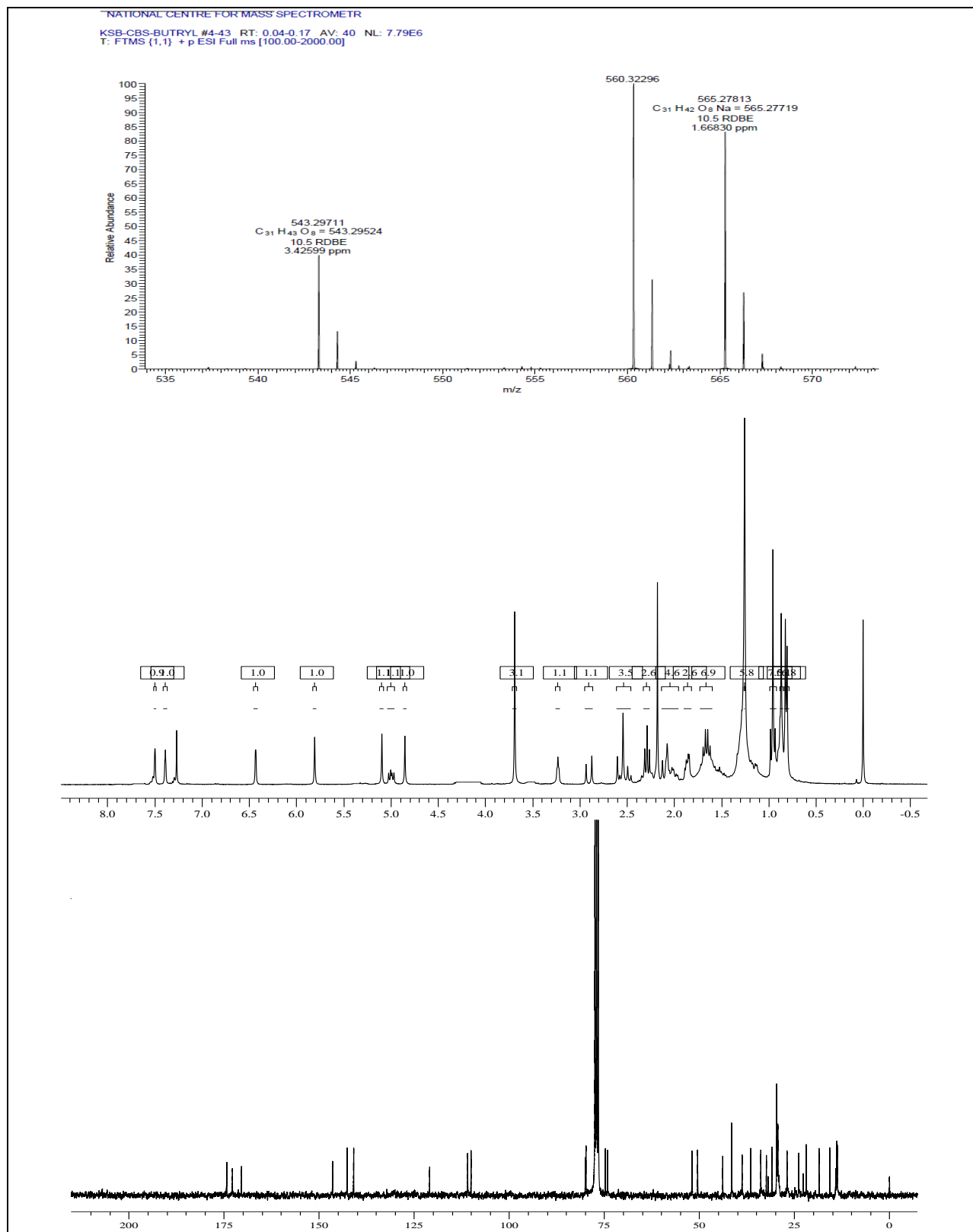


Figure 14: HRESIMS, <sup>1</sup>H & <sup>13</sup>C NMR of Compound 10a

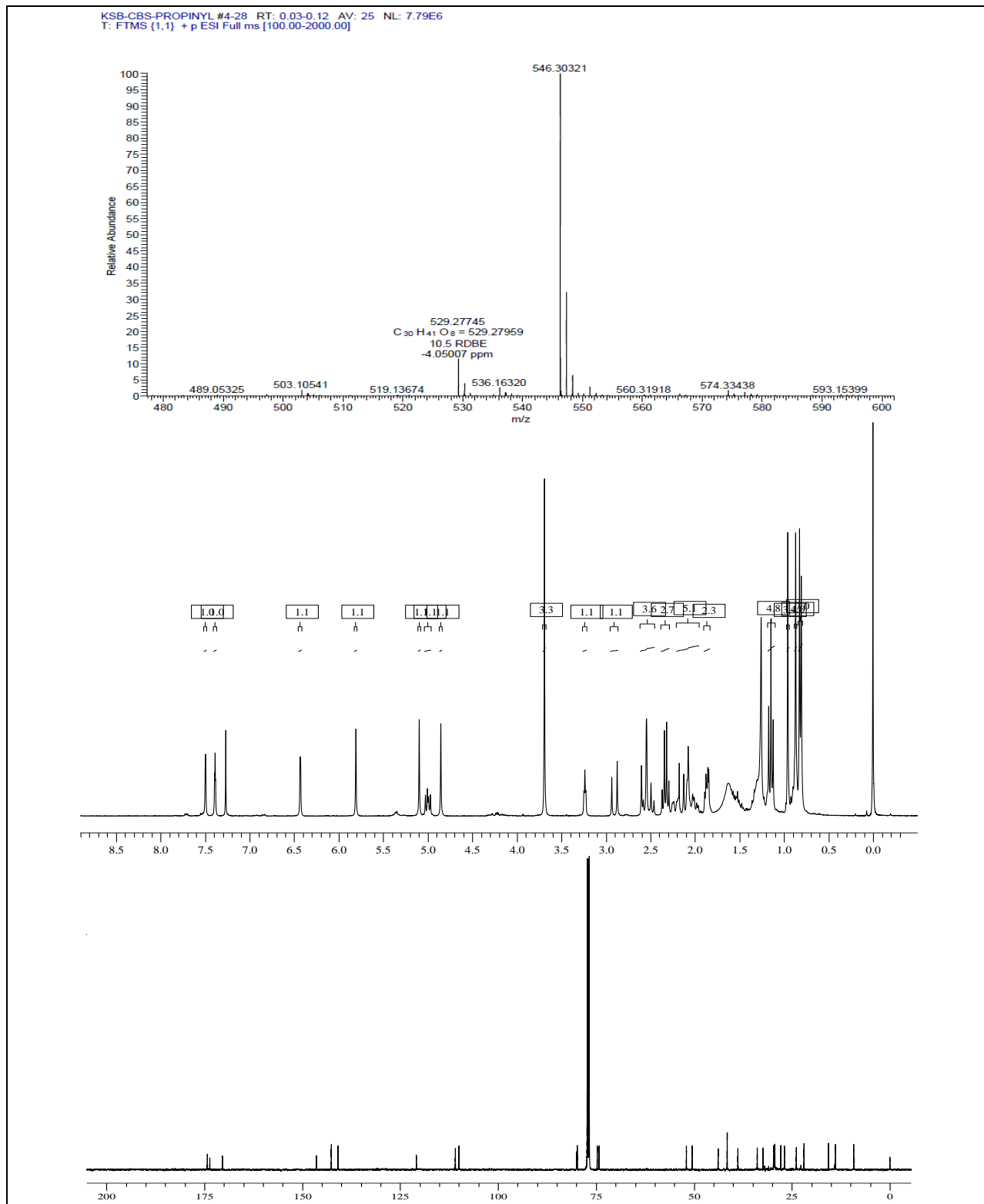


Figure 15: HRESIMS,  $^1H$  &  $^{13}C$  NMR of Compound 10b

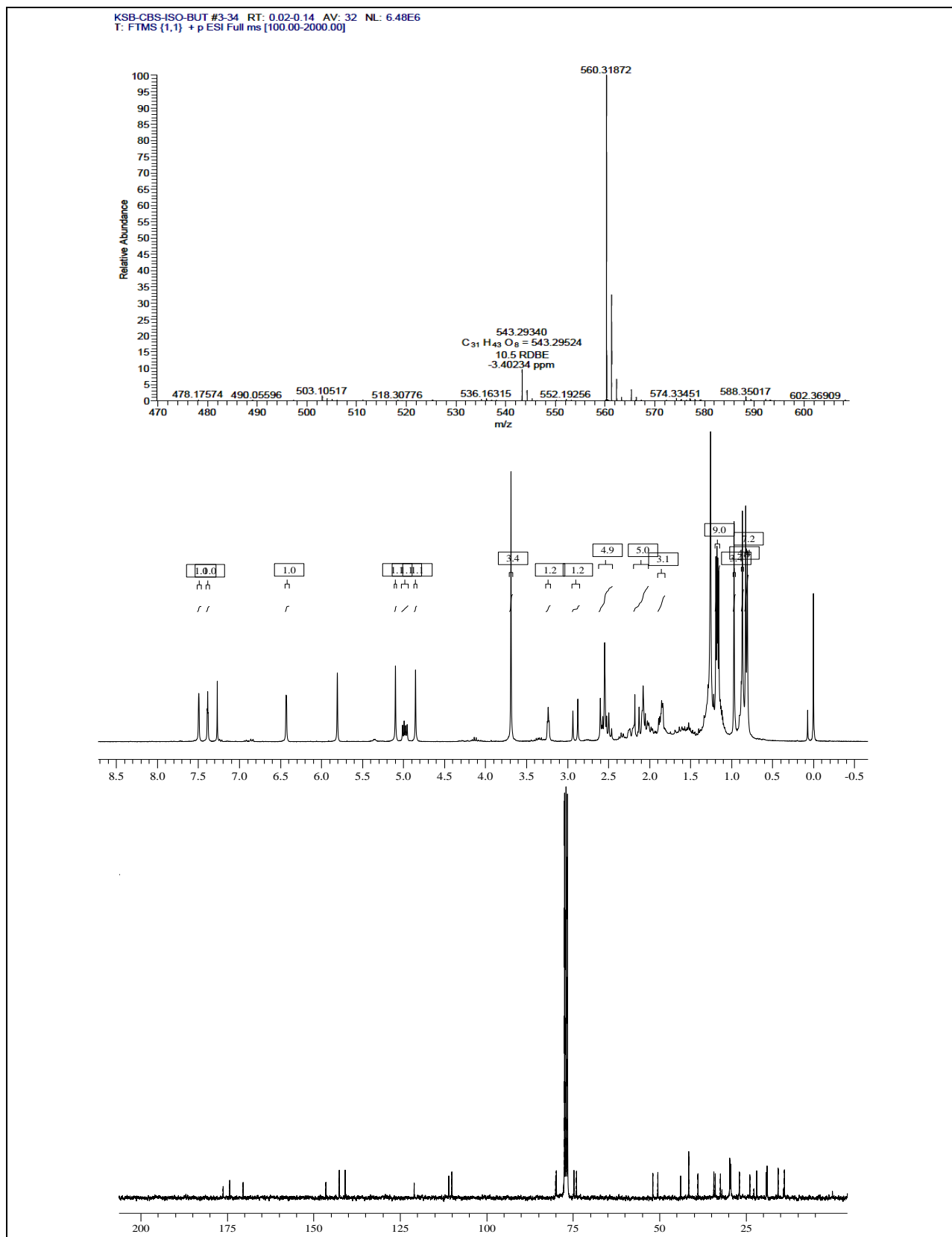


Figure 16: HRESIMS,  $^1H$  &  $^{13}C$  NMR of Compound **10c**

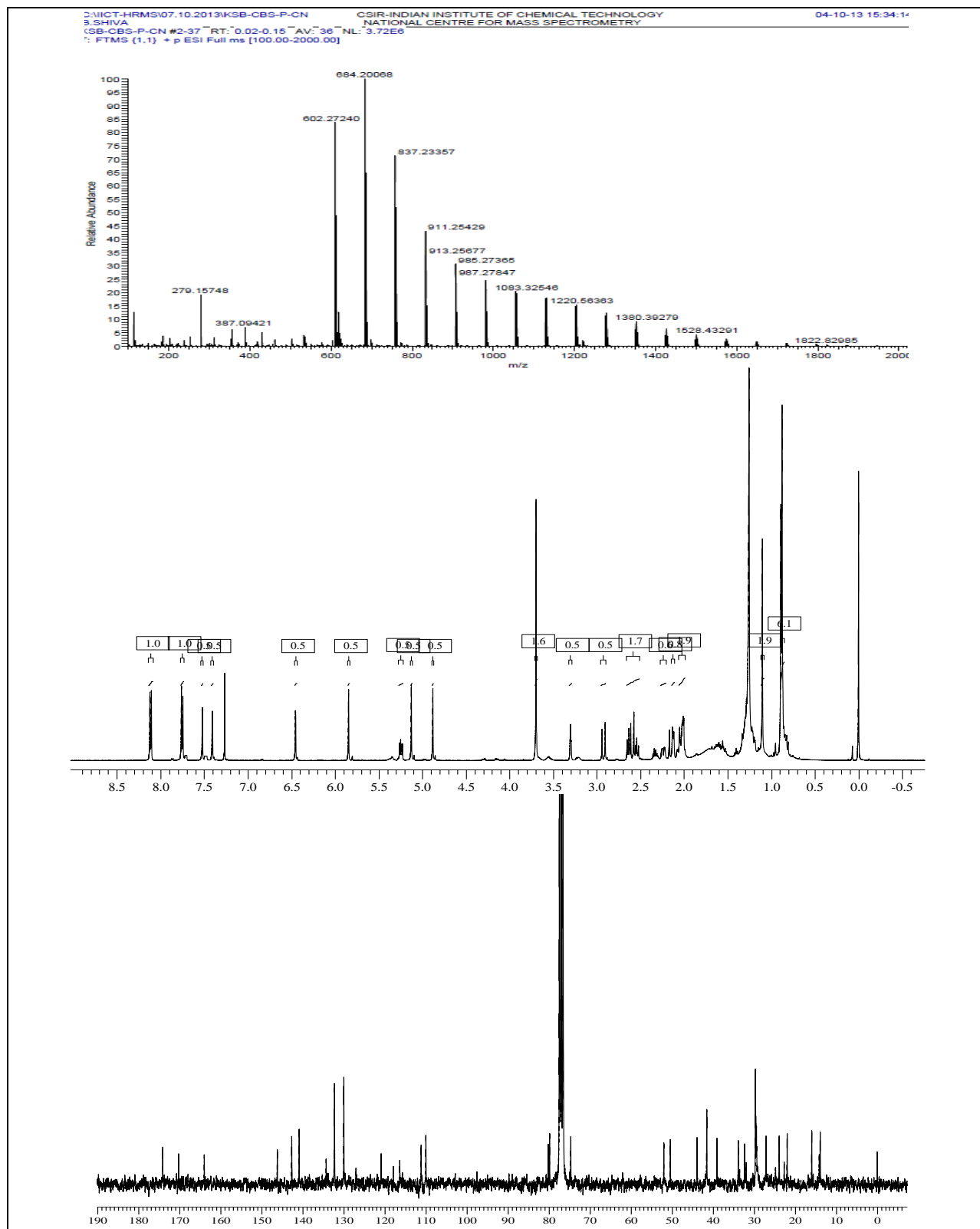


Figure 17: HRESIMS, <sup>1</sup>H & <sup>13</sup>C NMR of Compound 11a

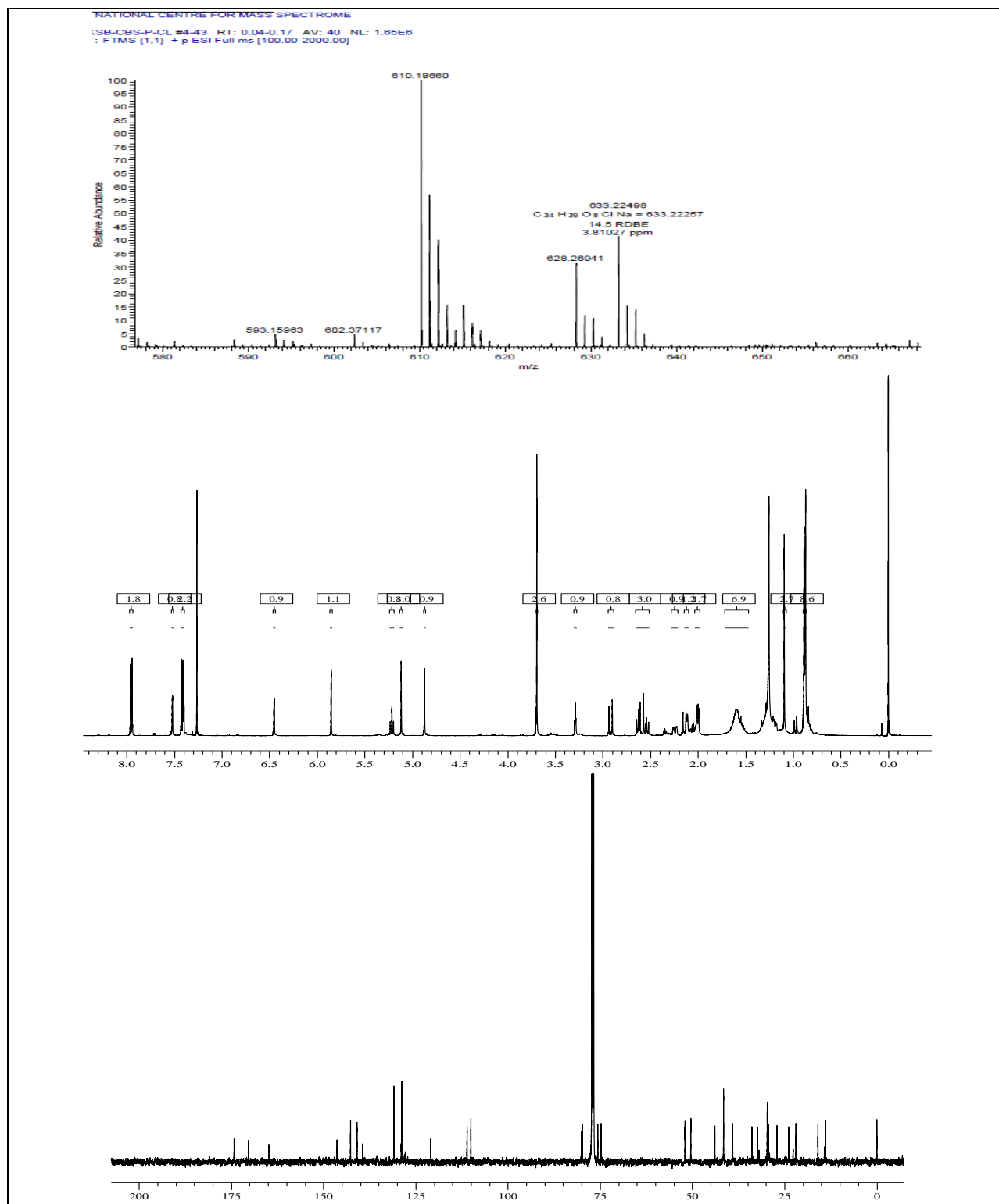


Figure 18: HRESIMS,  $^1H$  &  $^{13}C$  NMR of Compound **11b**

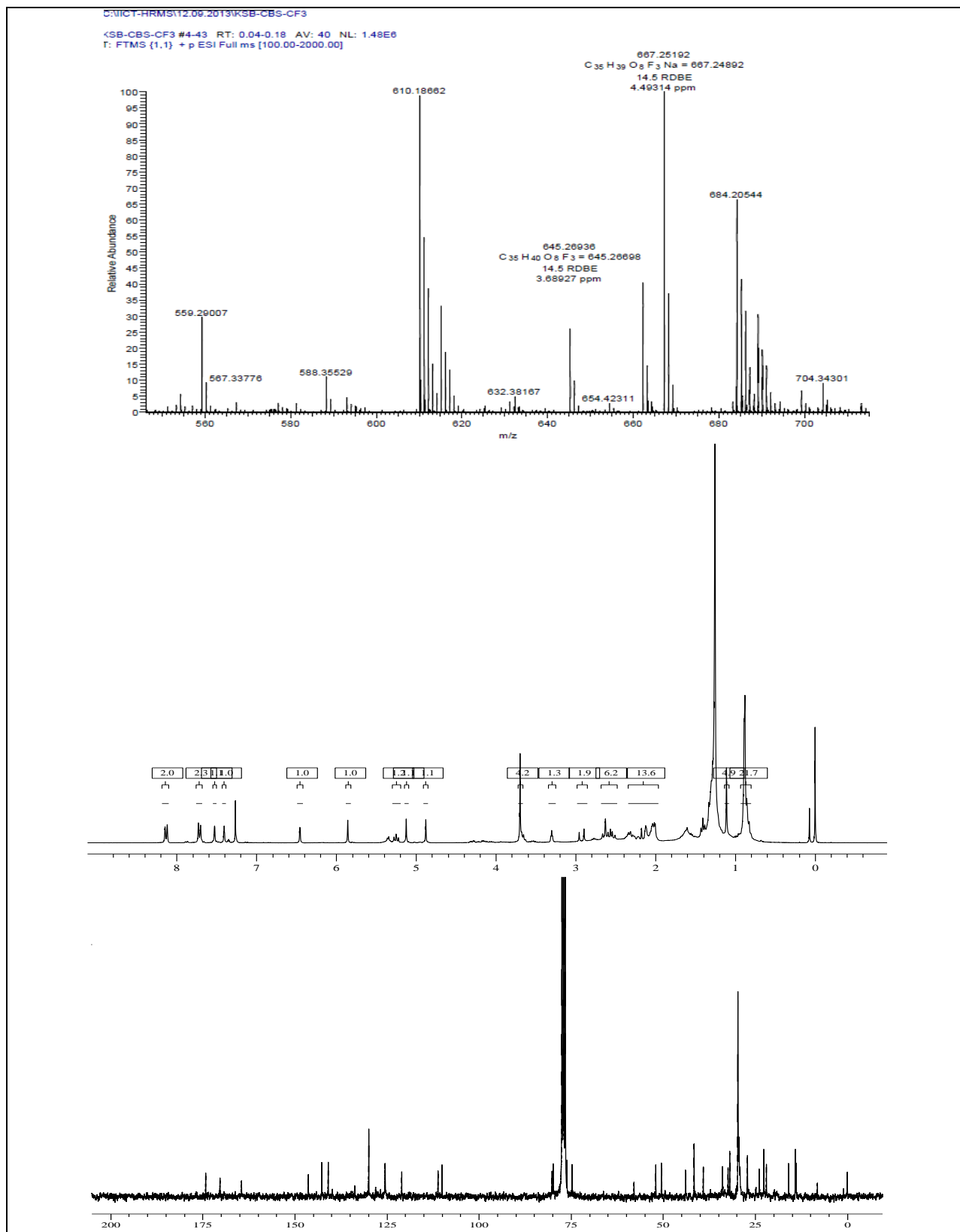


Figure 19: HRESIMS,  $^1H$  &  $^{13}C$  NMR of Compound **11c**



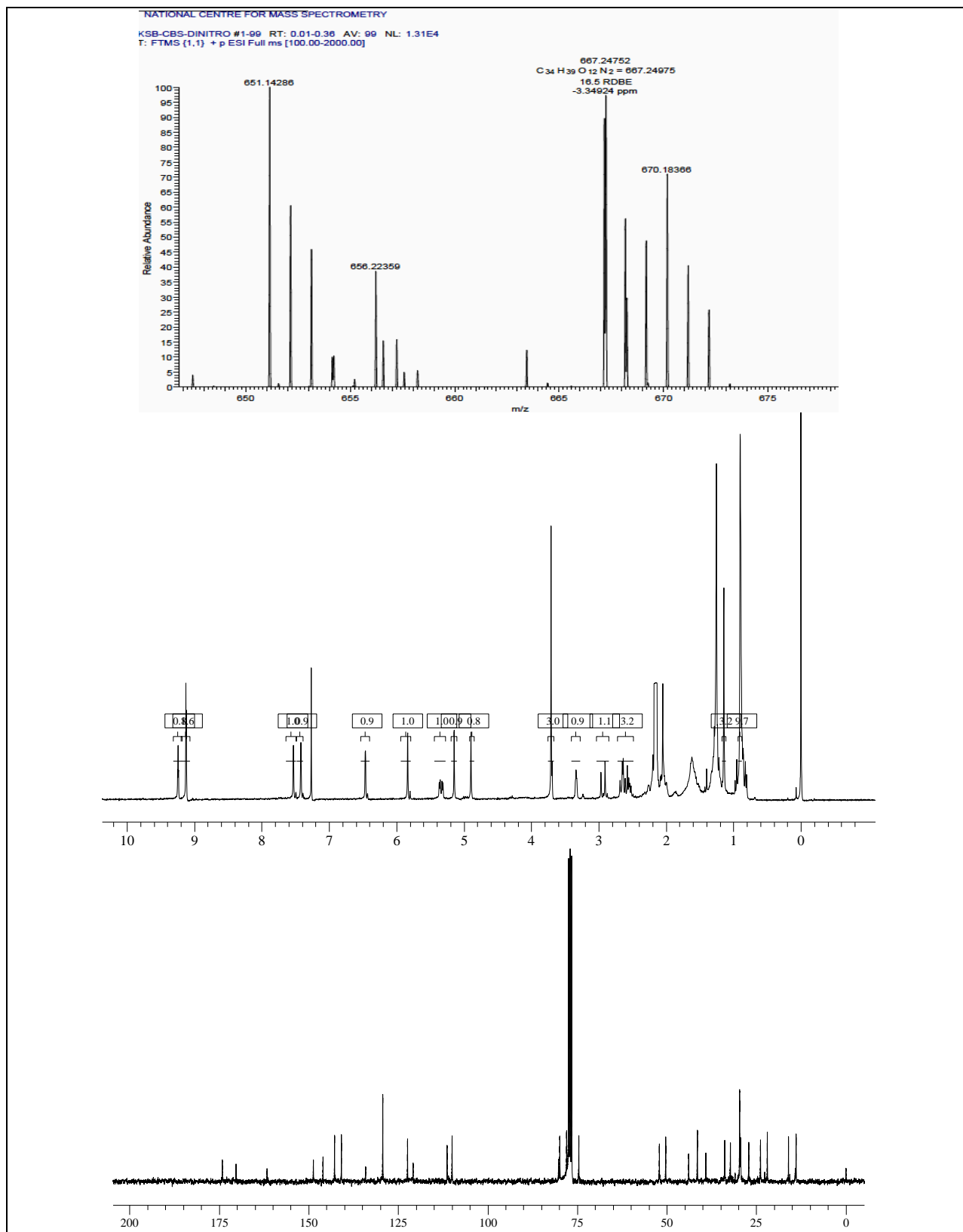


Figure 20: HRESIMS, <sup>1</sup>H & <sup>13</sup>C NMR of Compound **11d**

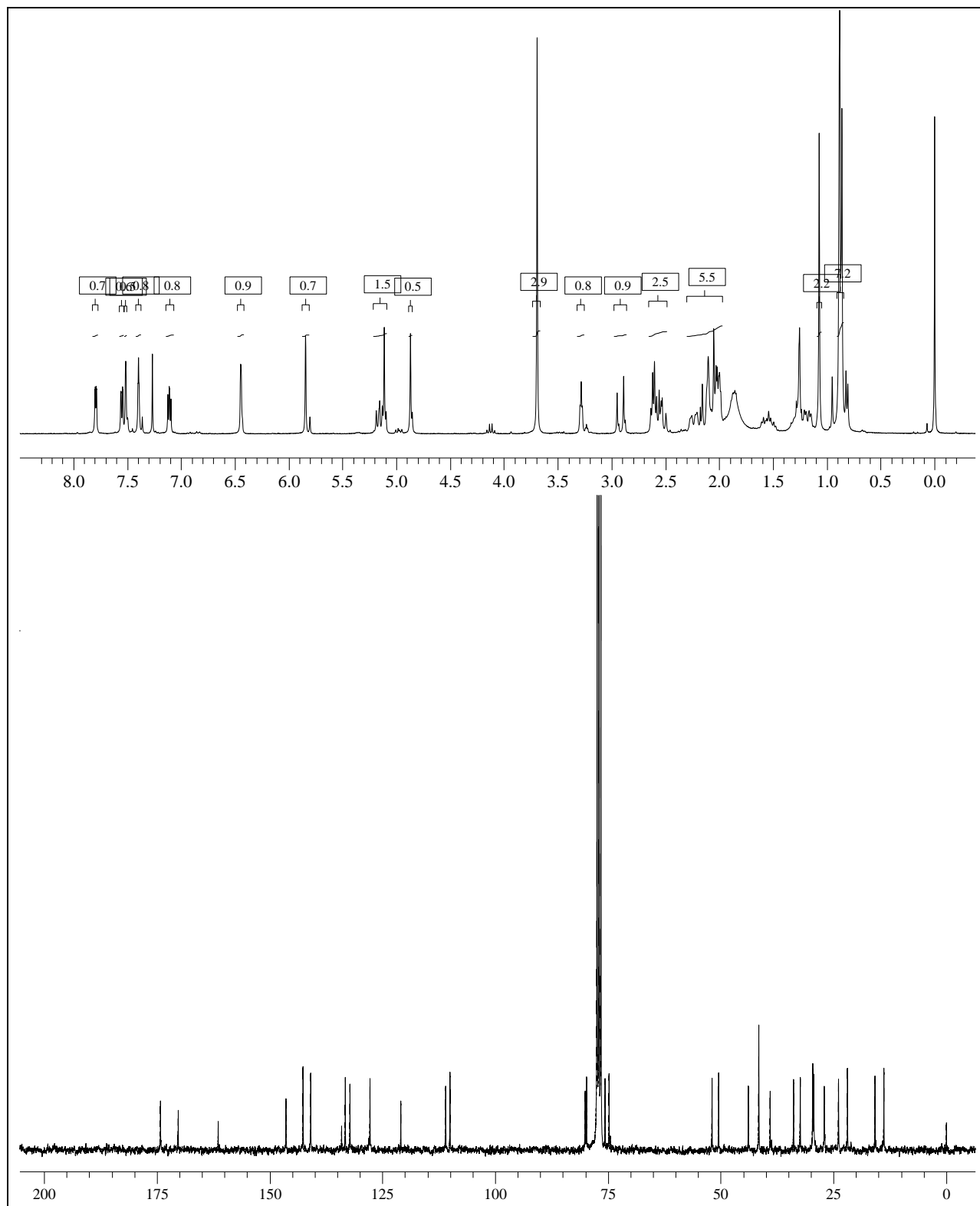
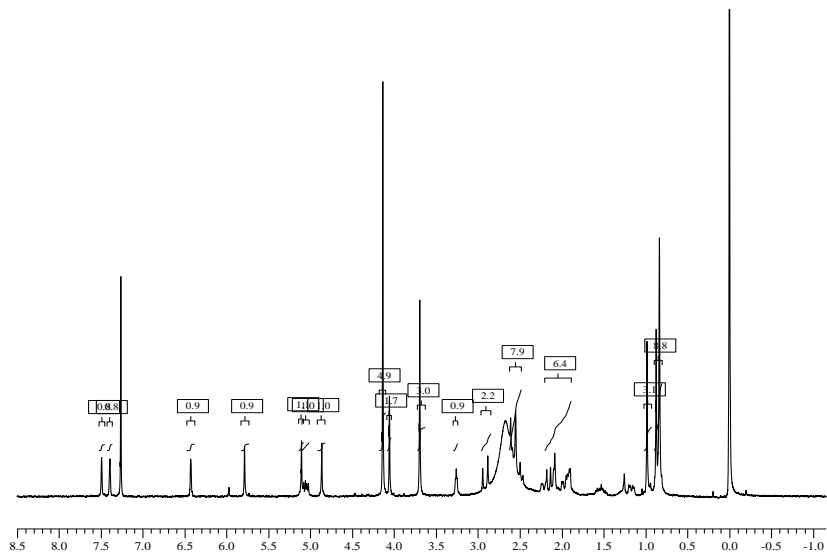
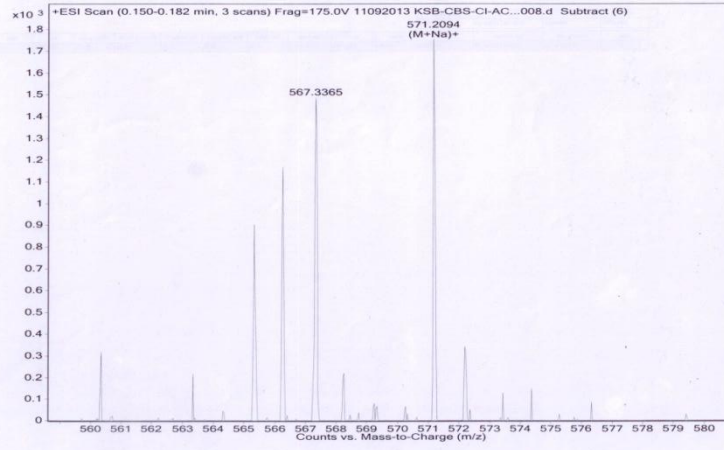


Figure 21:  $^1\text{H}$  &  $^{13}\text{C}$  NMR of Compound **11e**

Sample Name	KSB-CBS-C-AC	Position	Vial 11	Instrument Name	Instrument 1	User Name	
Inj Vol	5	InjPosition		SampleType	Sample	IRM Calibration Status	Success
Data Filename	11092013 KSB-CBS-C-	ACQ Method		Comment		Acquired Time	9/11/2013 2:23:30 PM



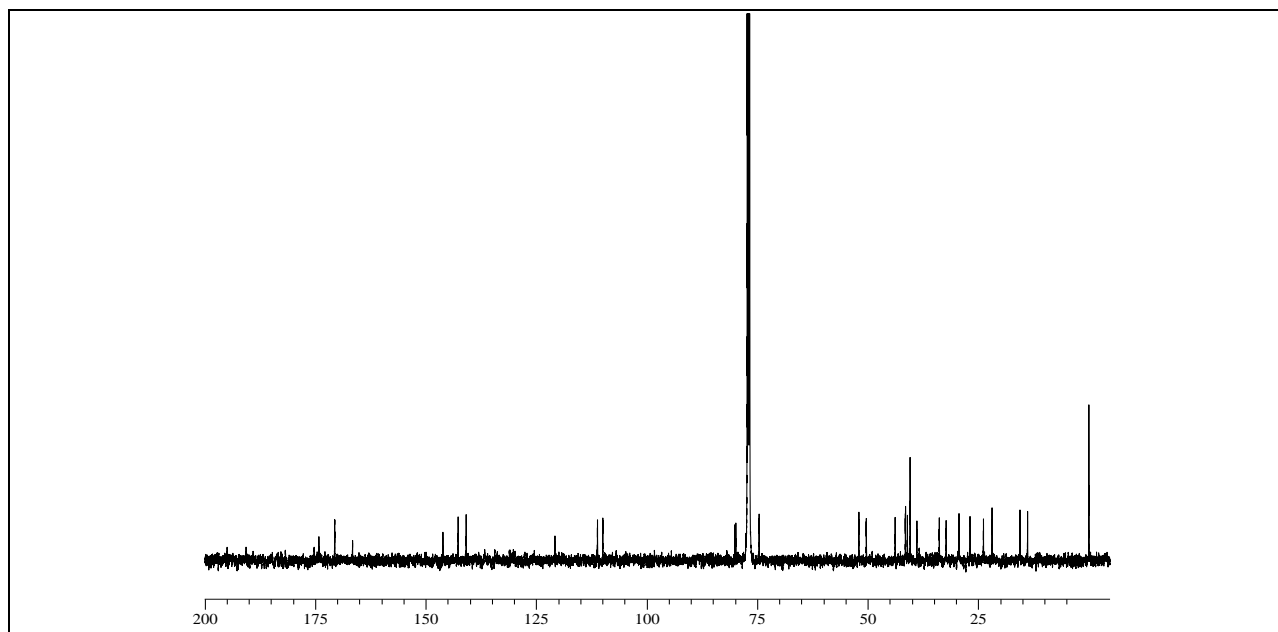


Figure 22: HRESIMS,  $^1\text{H}$  &  $^{13}\text{C}$  NMR of Compound **12**

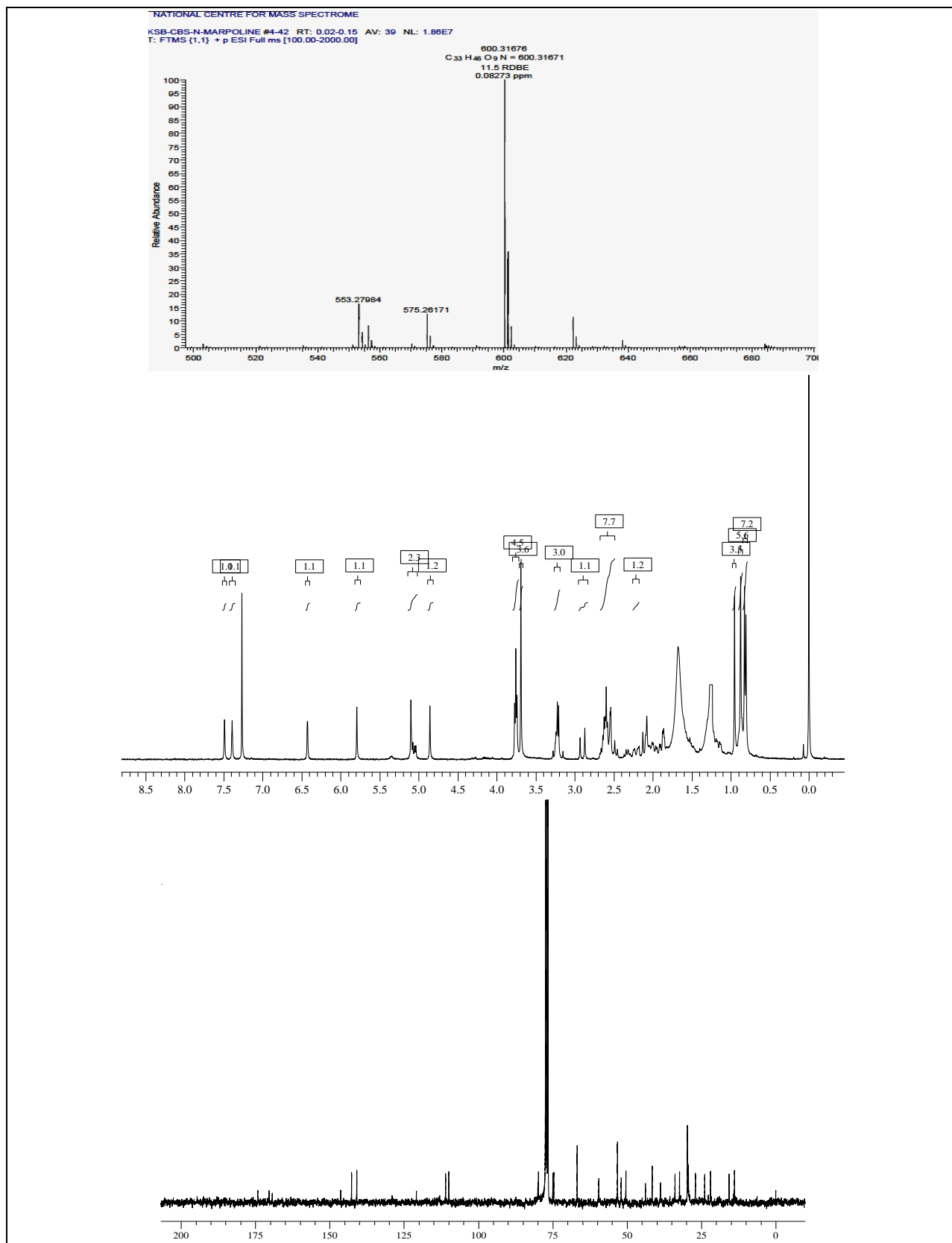


Figure 23: HRESIMS,  $^1\text{H}$  &  $^{13}\text{C}$  NMR of Compound **13a**

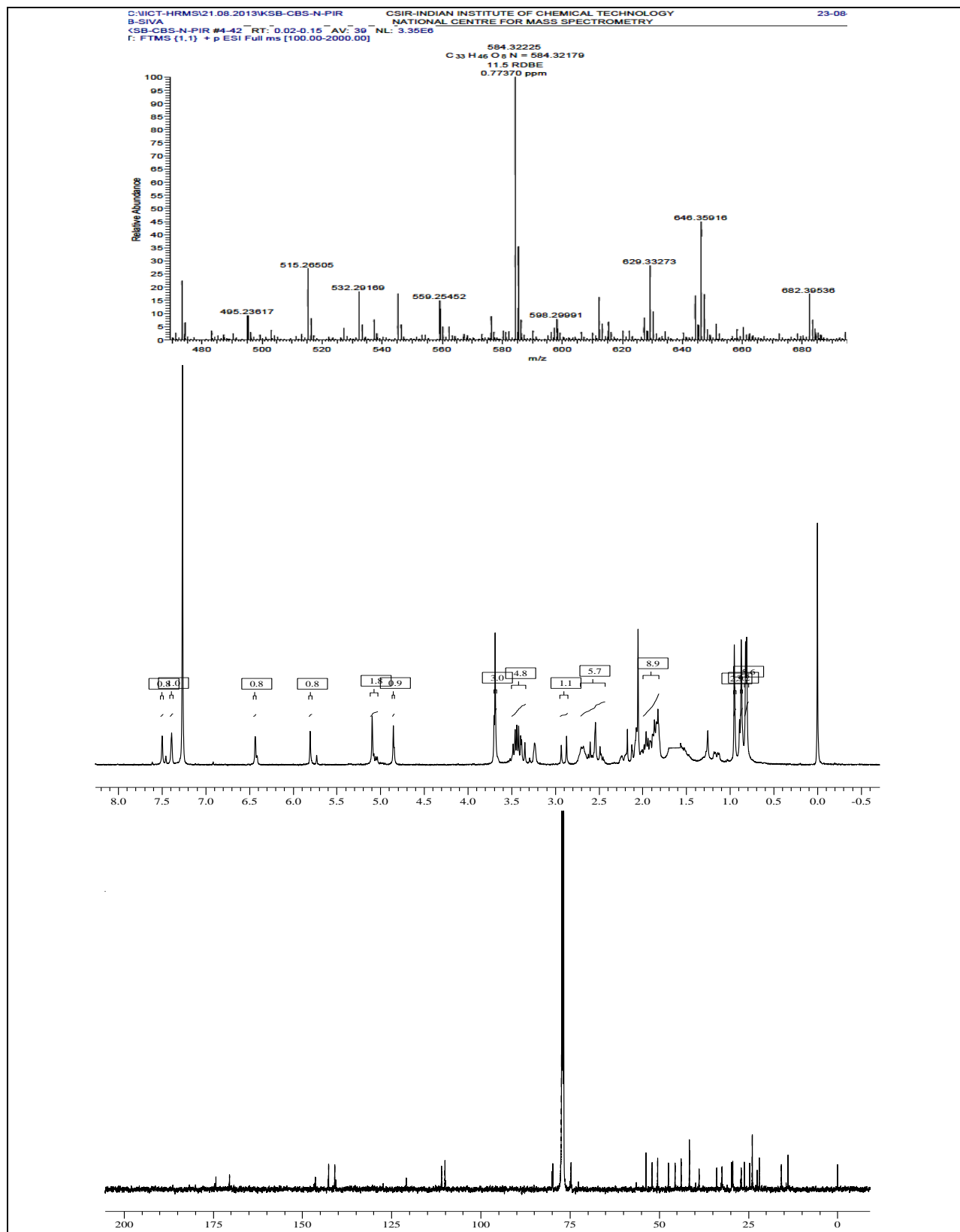


Figure 24: HRESIMS,  $^1\text{H}$  &  $^{13}\text{C}$  NMR of Compound **13b**

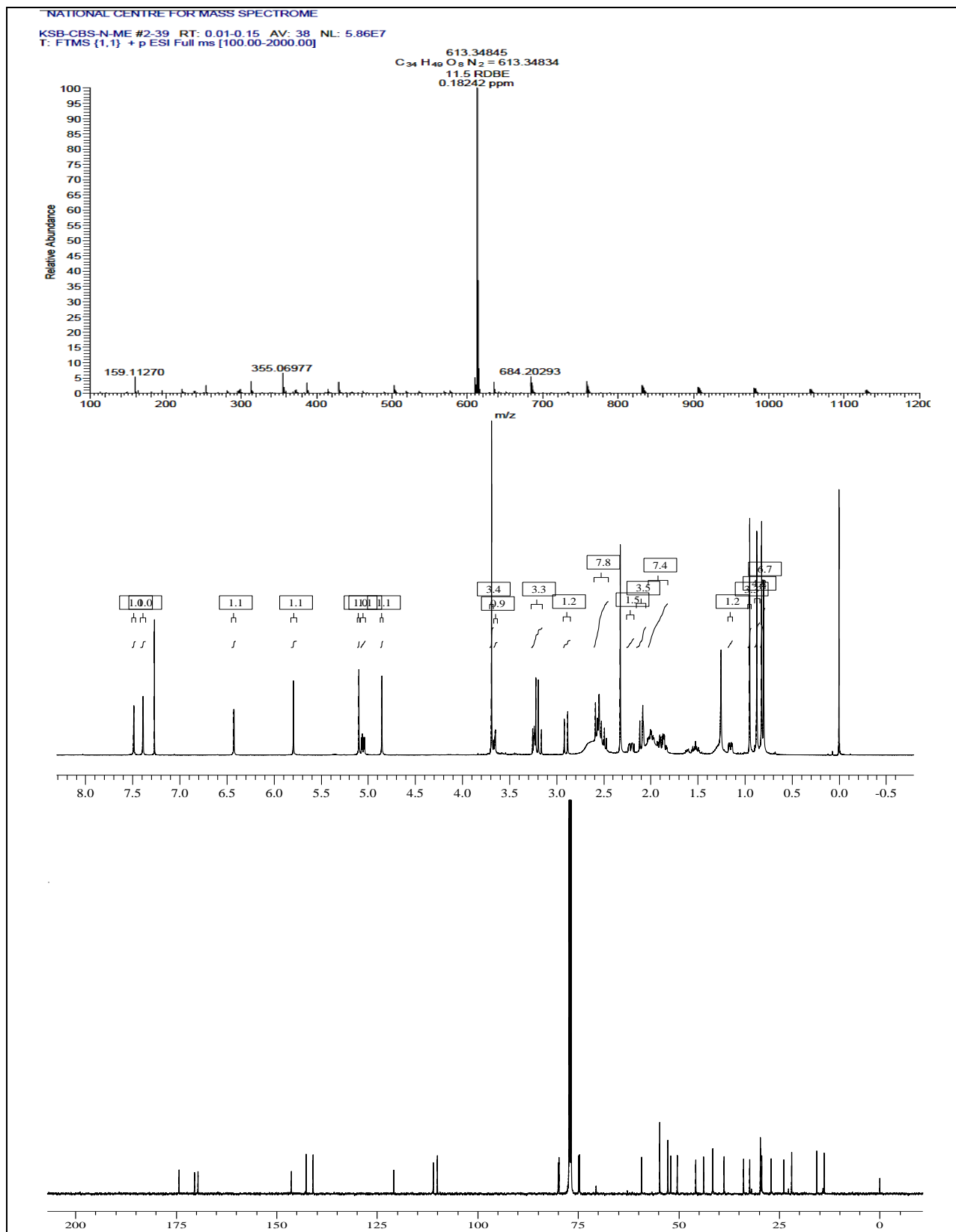


Figure 25: HRESIMS,  $^1H$  &  $^{13}C$  NMR of Compound **13c**

Elemental Composition Report

Single Mass Analysis

Tolerance = 20.0 PPM / DBE: min = -1.5, max = 30.0

Element prediction: Off

Number of isotope peaks used for i-FIT = 3

Monoisotopic Mass, Odd and Even Electron Ions

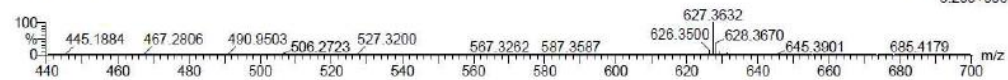
31 formula(e) evaluated with 1 results within limits (all results (up to 1000) for each mass)

Elements Used:

C: 0-35 H: 0-52 N: 0-2 O: 0-10

20160904\_02.4 (0.323)

1: TOF MS627.31ES+  
3.20e+006



Minimum: -1.5  
Maximum: 30.0

Mass	Calc. Mass	mDa	PPM	DBE	i-FIT	Norm	Conf (%)	Formula
627.3632	627.3645	-1.3	-2.1	11.5	520.1	n/a	n/a	C35 H51 N2 O8

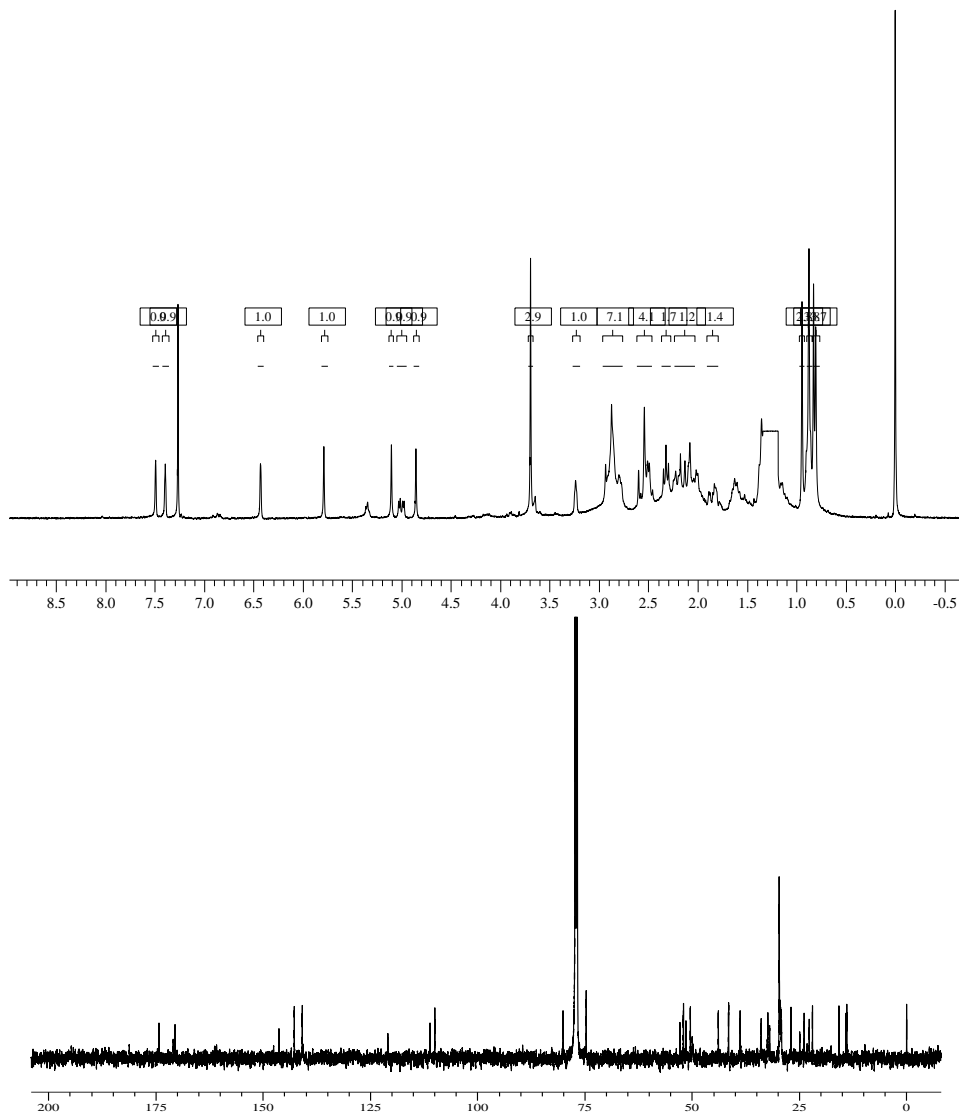


Figure 26: <sup>1</sup>H & <sup>13</sup>C NMR of Compound 13d



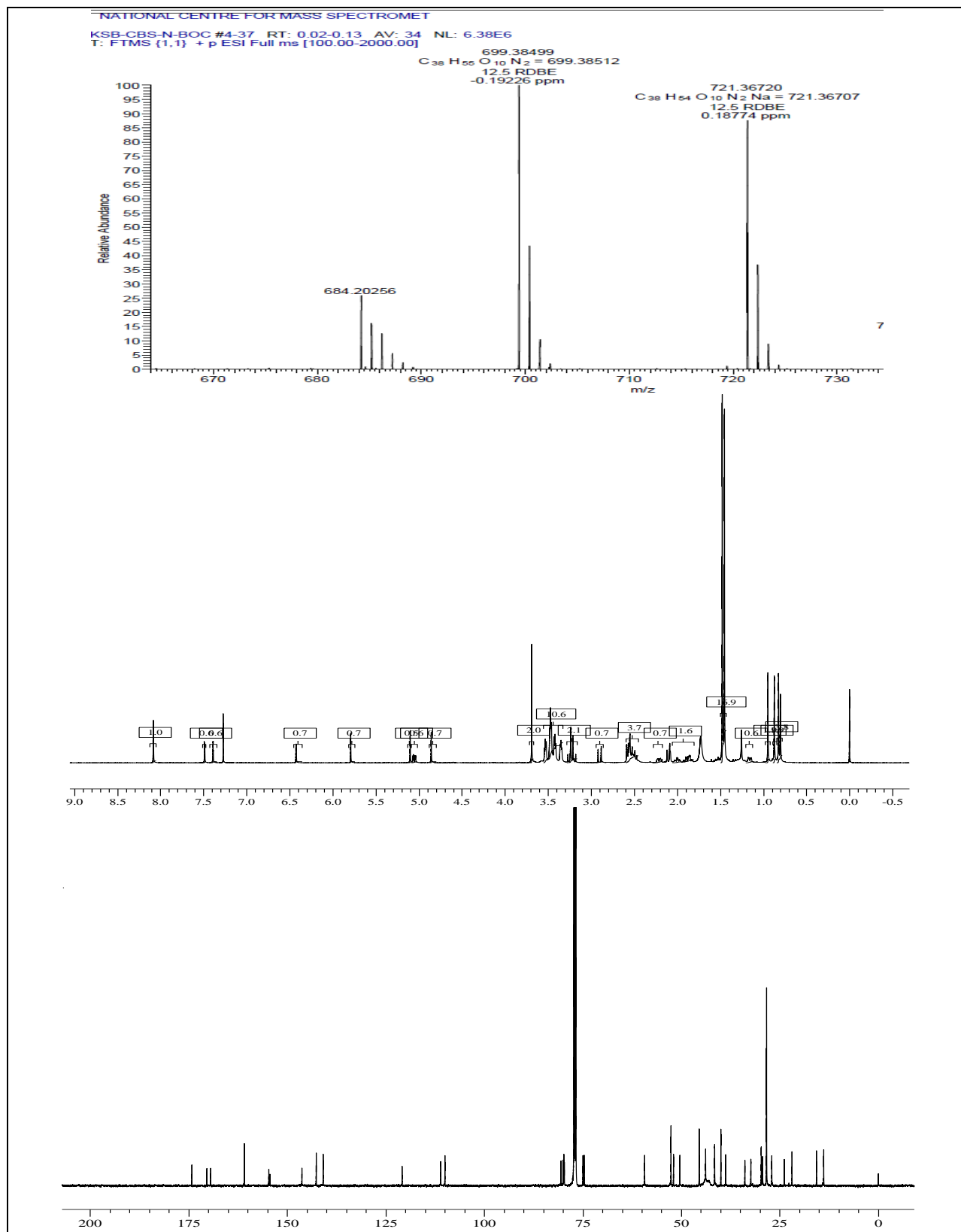


Figure 27: HRESIMS,  $^1H$  &  $^{13}C$  NMR of Compound **13e**

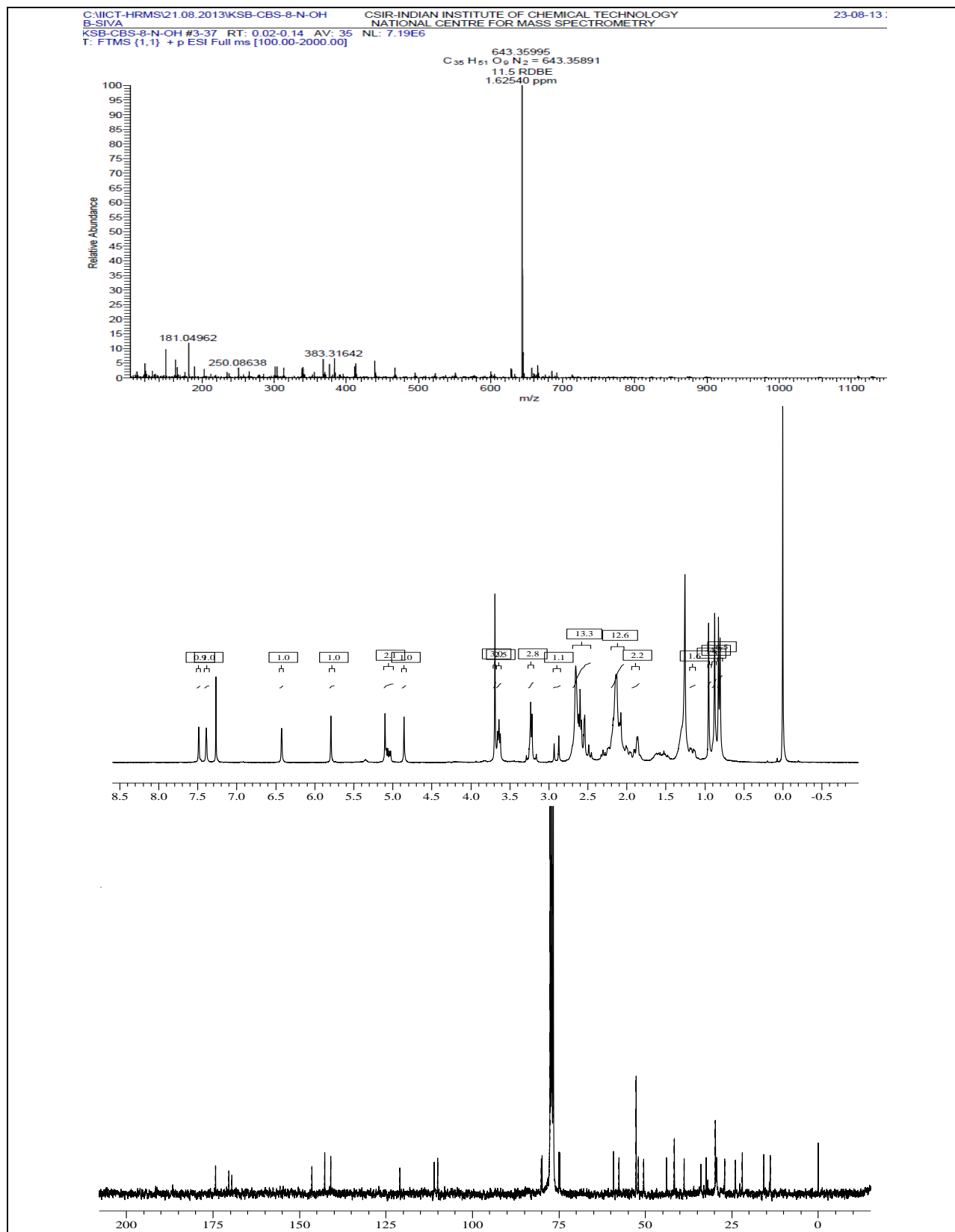


Figure 28: HRESIMS,  $^1H$  &  $^{13}C$  NMR of Compound **13f**

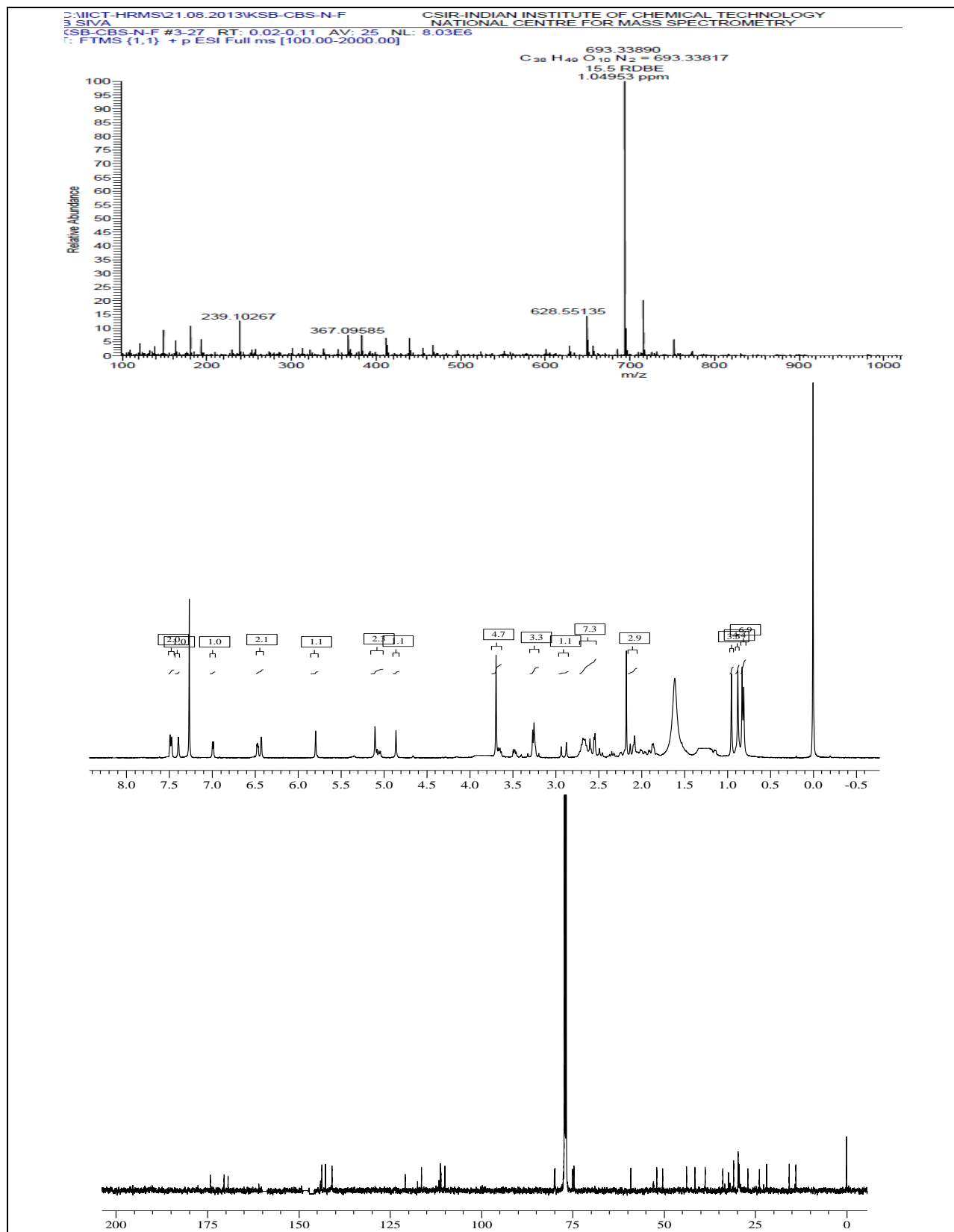


Figure 29: HRESIMS, <sup>1</sup>H & <sup>13</sup>C NMR of Compound 13g

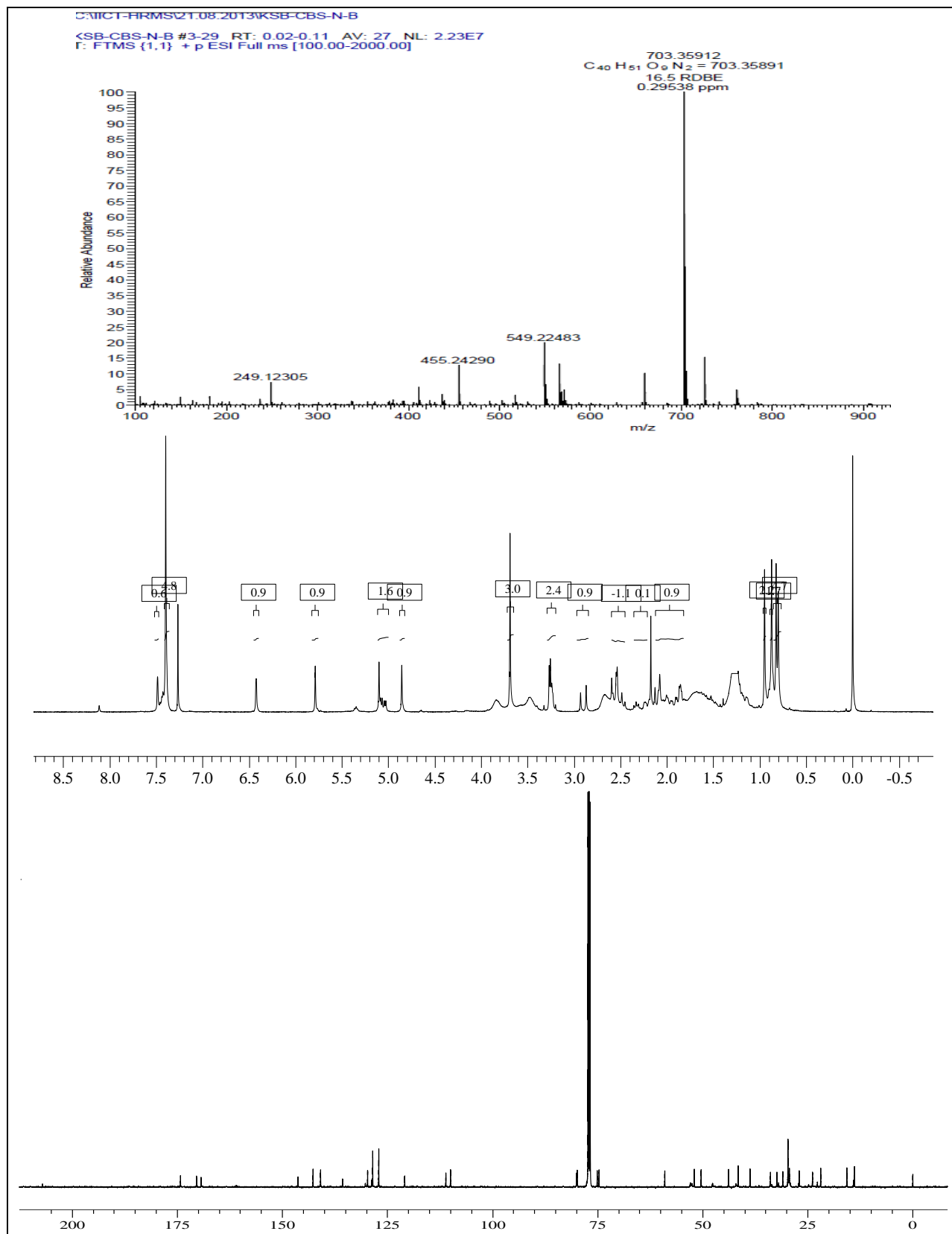


Figure 30: HRESIMS, <sup>1</sup>H & <sup>13</sup>C NMR of Compound 13h

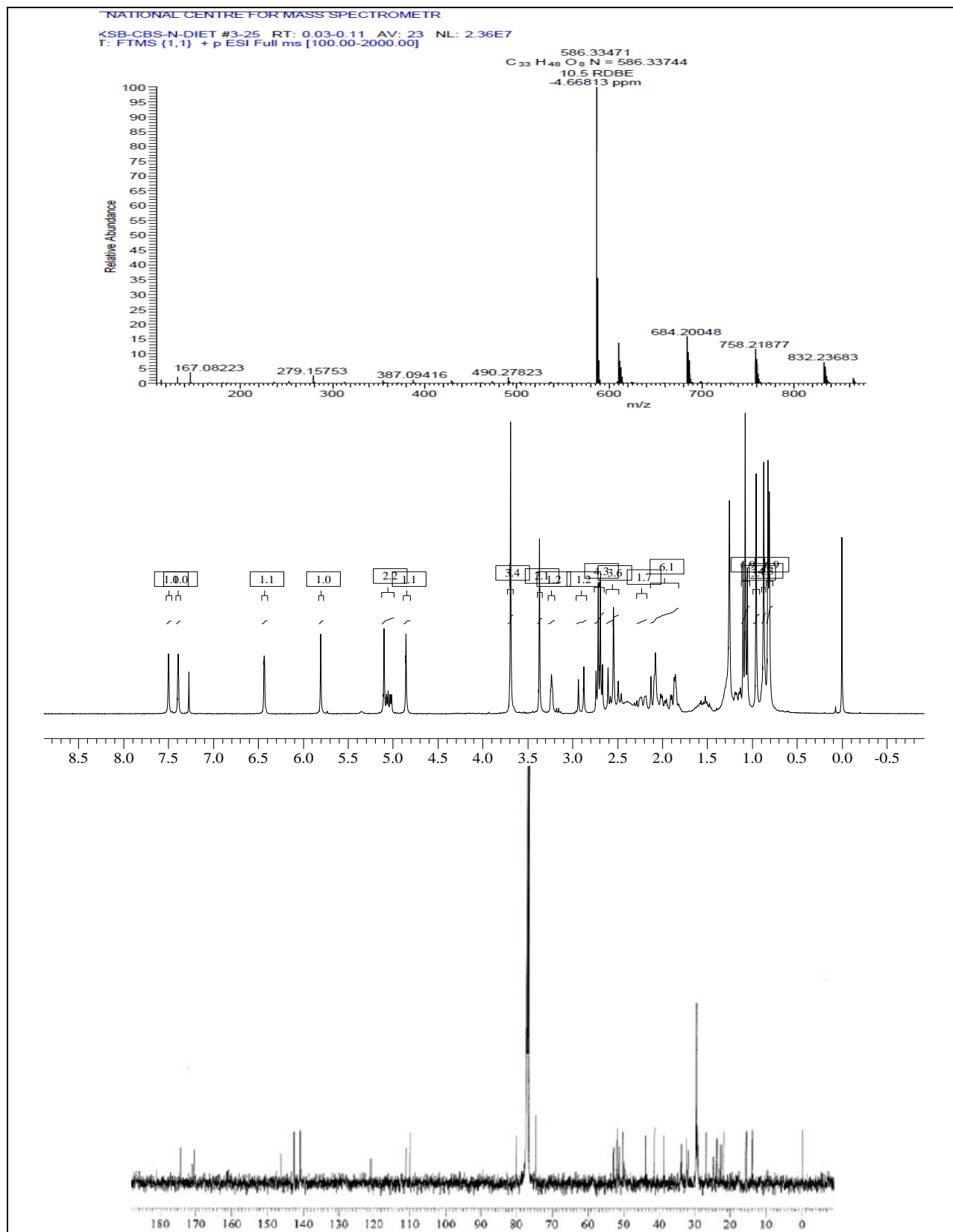


Figure 31: HRESIMS, <sup>1</sup>H & <sup>13</sup>C NMR of Compound **13i**