

**Convenient construction of tetrahydrochromeno[4',3':2,3]indolizino[8,7-*b*]indoles and
tetrahydroindolizino[8,7-*b*]indoles via one-pot domino reaction**

Jing Sun, Wang Jiang, Chao-Guo Yan*

Supporting Information

Figures of single crystal structures s1-s3	2-3
¹H NMR, ¹³C NMR and HRMS spectra of the compounds	4-49

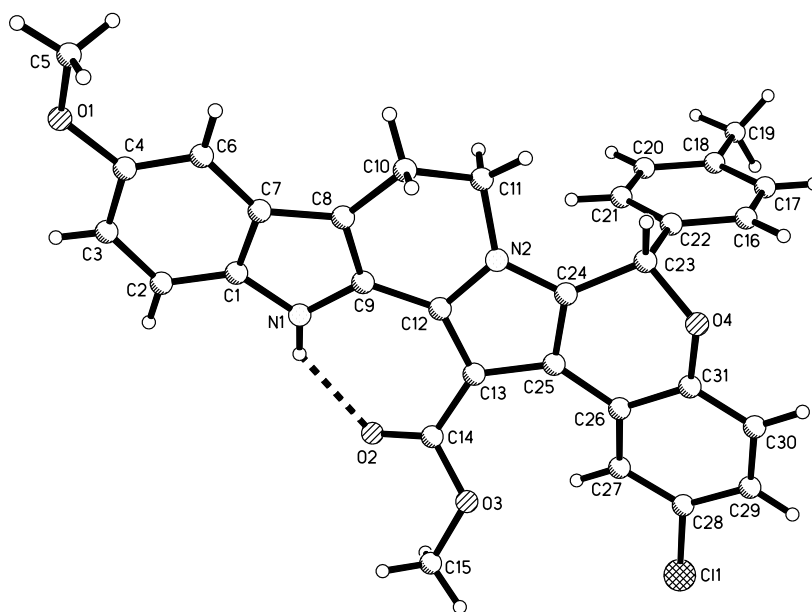


Fig. s1 Single crystal structure of compound **1h**

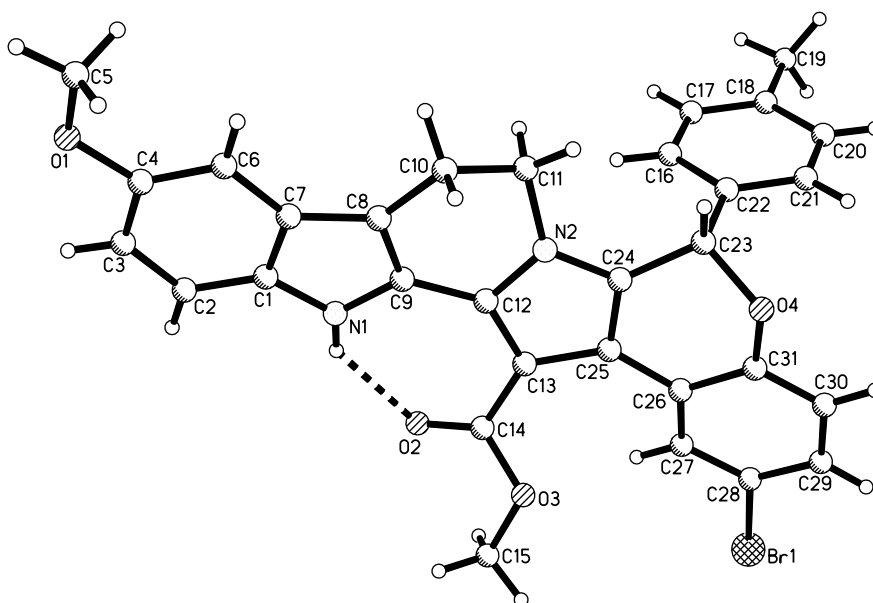


Fig. s2 Single crystal structure of compound **1i**

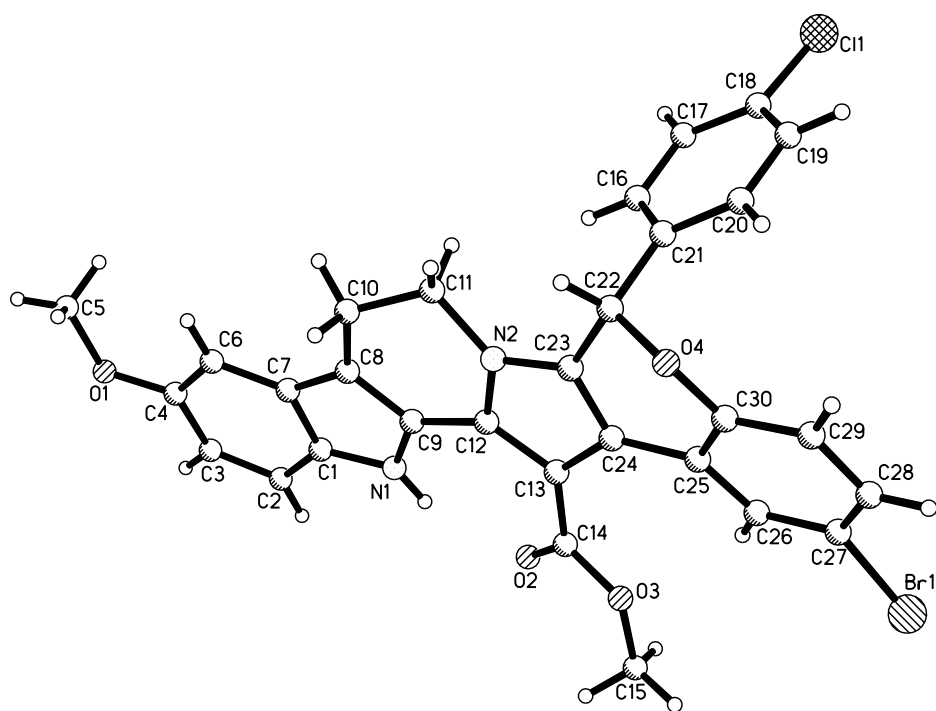


Fig. s3 Single crystal structure of compound **1i**

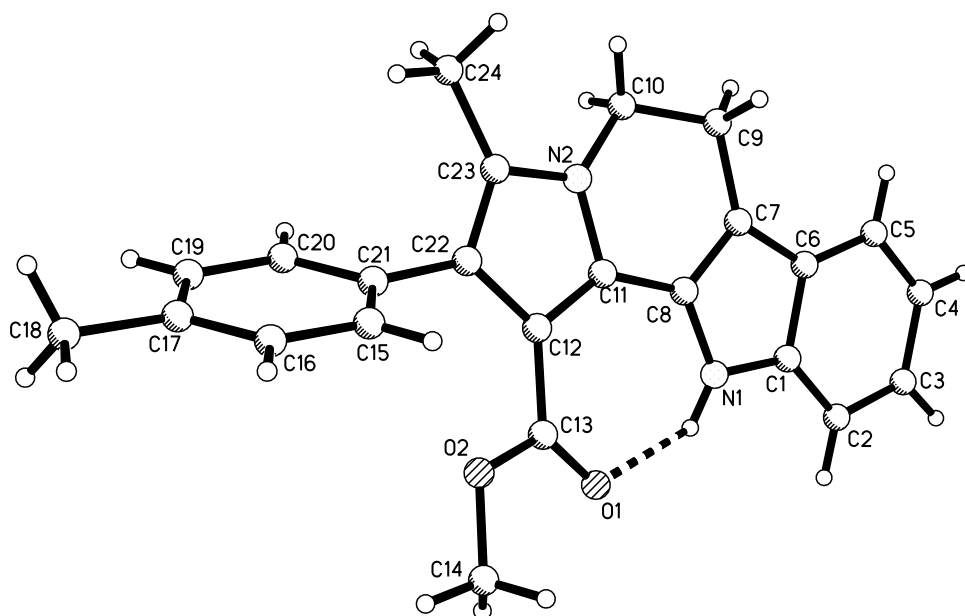
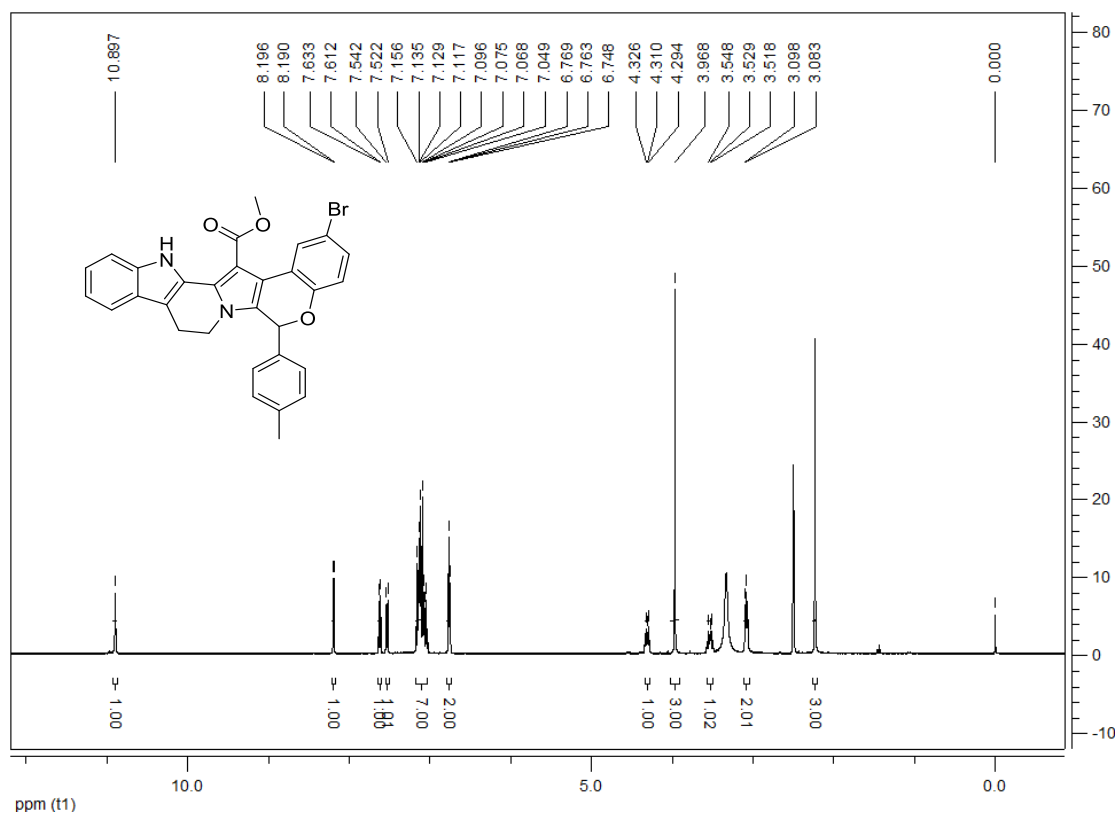
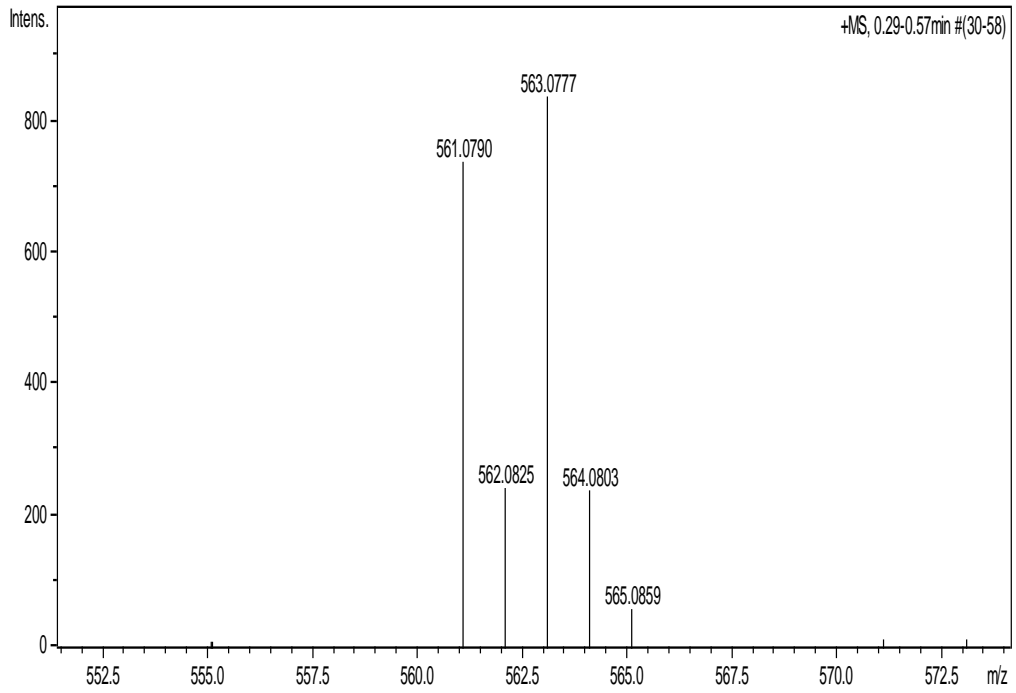
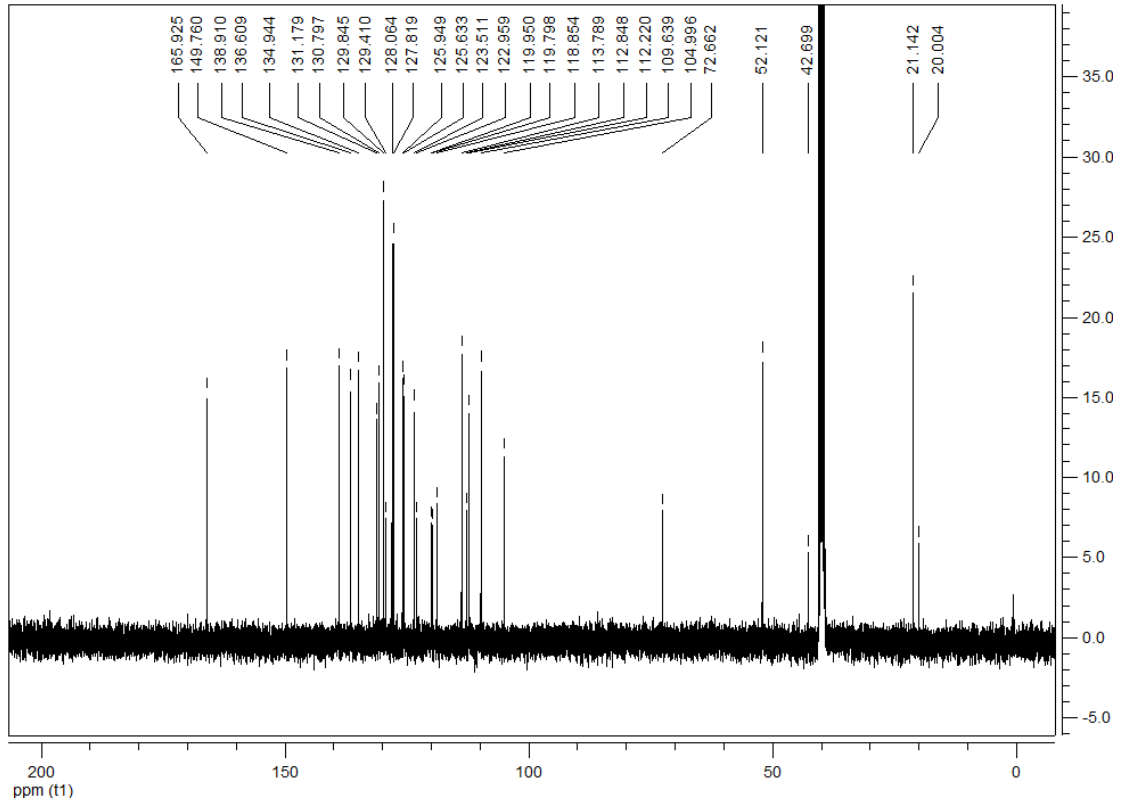
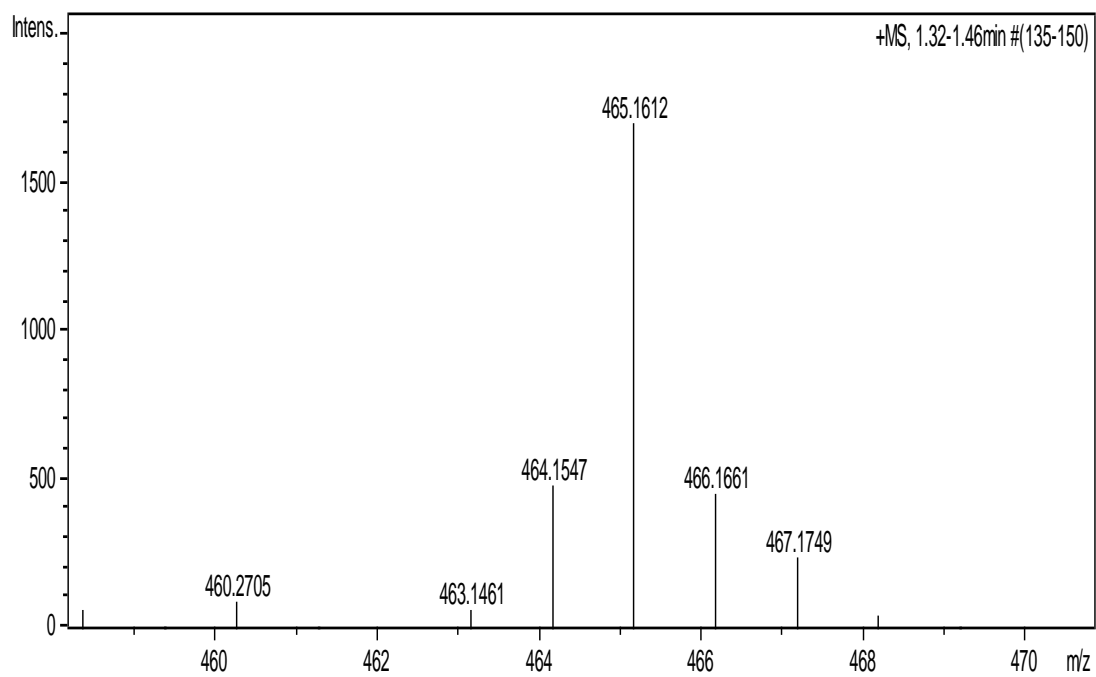
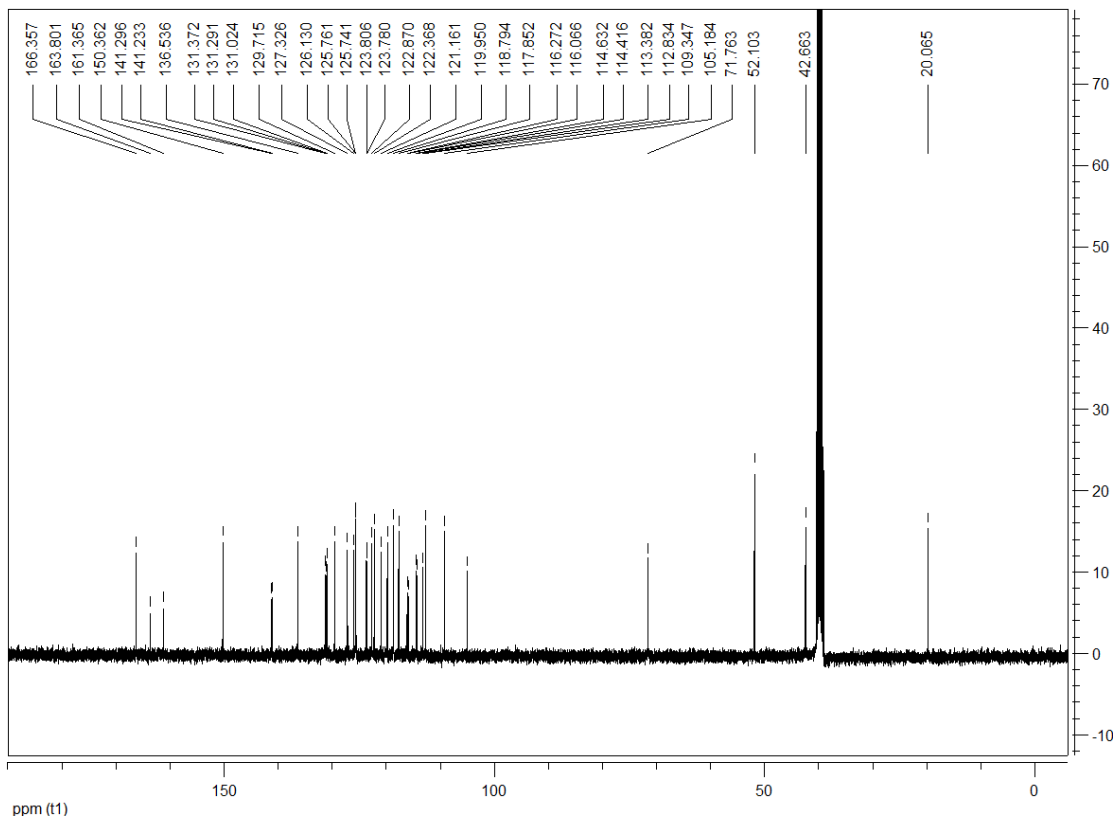


Fig. s4 Single crystal structure of compound **2e**

Methyl 2-bromo-6-(p-tolyl)-6,8,9,14-tetrahydrochromeno[4',3':2,3]indolizino[8,7-b]indole-15-carboxylate (1a) : yellow solid, 81%, m.p. 235-237°C; ¹H NMR (400 MHz, DMSO-*d*₆) δ: 10.90 (s, 1H, NH), 8.19 (d, *J* = 2.4 Hz, 1H, CH), 7.62 (d, *J* = 8.4 Hz, 1H, ArH), 7.53 (d, *J* = 8.0 Hz, 1H, ArH), 7.17-7.03 (m, 7H, ArH), 6.77-6.75 (m, 2H, ArH), 4.33-4.29 (m, 1H, CH), 3.97 (s, 3H, OCH₃), 3.55-3.52 (m, 1H, CH), 3.10-3.06 (m, 2H, CH), 2.23 (s, 3H, CH₃); ¹³C NMR (100 MHz, DMSO-*d*₆) δ: 165.9, 149.7, 138.9, 136.6, 134.9, 131.1, 130.7, 129.8, 129.4, 128.0, 127.8, 125.9, 125.6, 123.5, 122.9, 119.9, 119.7, 118.8, 113.7, 112.8, 112.2, 109.6, 104.9, 72.6, 52.1, 42.6, 21.1, 20.0; MS (*m/z*): HRMS (ESI) Calcd. for C₃₀H₂₃BrN₂O₃Na ([M+Na]⁺): 561.0784. Found: 561.0790; IR (KBr) ν: 3366, 3019, 2939, 1686, 1583, 1494, 1447, 1326, 1206, 968, 849, 784 cm⁻¹.



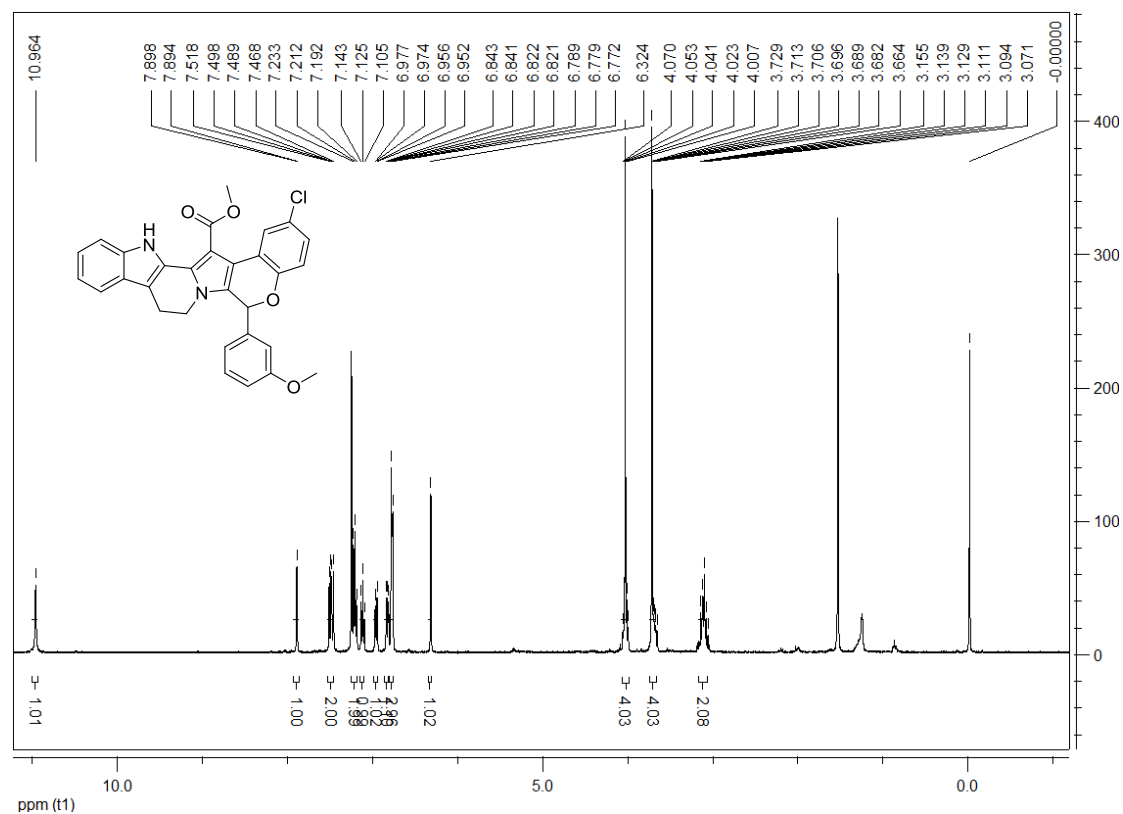


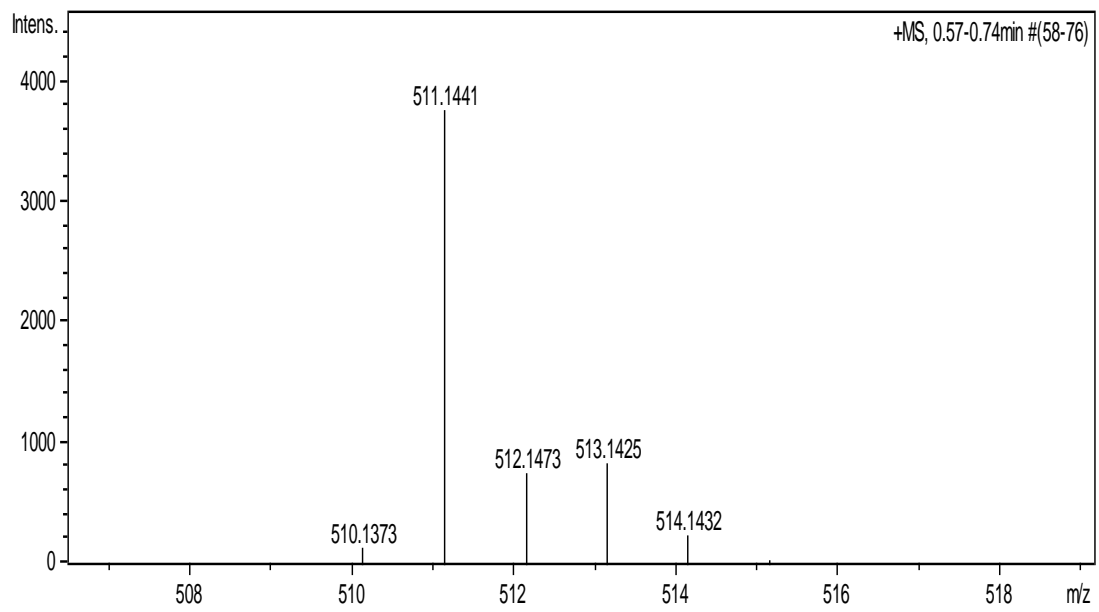
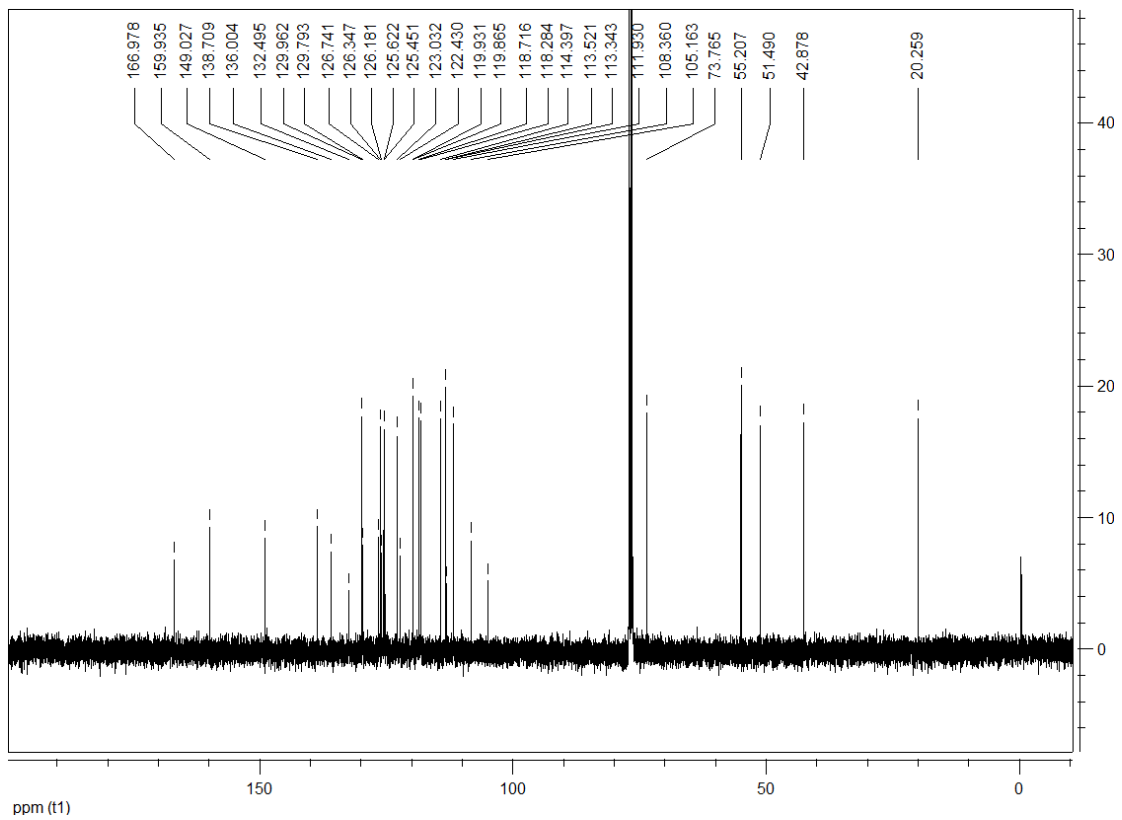


Methyl

2-chloro-6-(3-methoxyphenyl)-6,8,9,14-tetrahydrochromeno[4',3':2,3]indolizino[8,7-b]indole -15-carboxylate (1c):

yellow solid, 62%, m.p. 227-228°C; ^1H NMR (400 MHz, CDCl_3) δ : 10.96 (s, 1H, NH), 7.90-7.89 (m, 1H, ArH), 7.52-7.47 (m, 2H, ArH), 7.23-7.19 (m, 2H, ArH), 7.14-7.10 (m, 1H, ArH), 6.98-6.95 (m, 1H, ArH), 6.84-6.82 (m, 1H, ArH), 6.79-6.77 (m, 3H, ArH), 6.32 (s, 1H, CH), 4.07-4.00 (m, 1H, CH), 3.73-3.67 (m, 4H, OCH_3 , CH), 3.19-3.07 (m, 2H, CH); ^{13}C NMR (100 MHz, CDCl_3) δ : 166.9, 159.9, 149.0, 138.7, 136.0, 132.4, 129.9, 129.7, 126.7, 126.3, 126.1, 125.6, 125.4, 123.0, 122.4, 119.9, 119.8, 118.7, 118.2, 114.3, 113.5, 113.3, 111.9, 108.3, 105.1, 73.7, 55.2, 51.4, 42.8, 20.2; MS (m/z): HRMS (ESI) Calcd. for $\text{C}_{30}\text{H}_{24}\text{ClN}_2\text{O}_4$ ($[\text{M}+\text{H}]^+$): 511.1419. Found: 511.1441; IR (KBr) ν : 3395, 2988, 2894, 1698, 1625, 1578, 1527, 1280, 825, 867, 725 cm^{-1} .

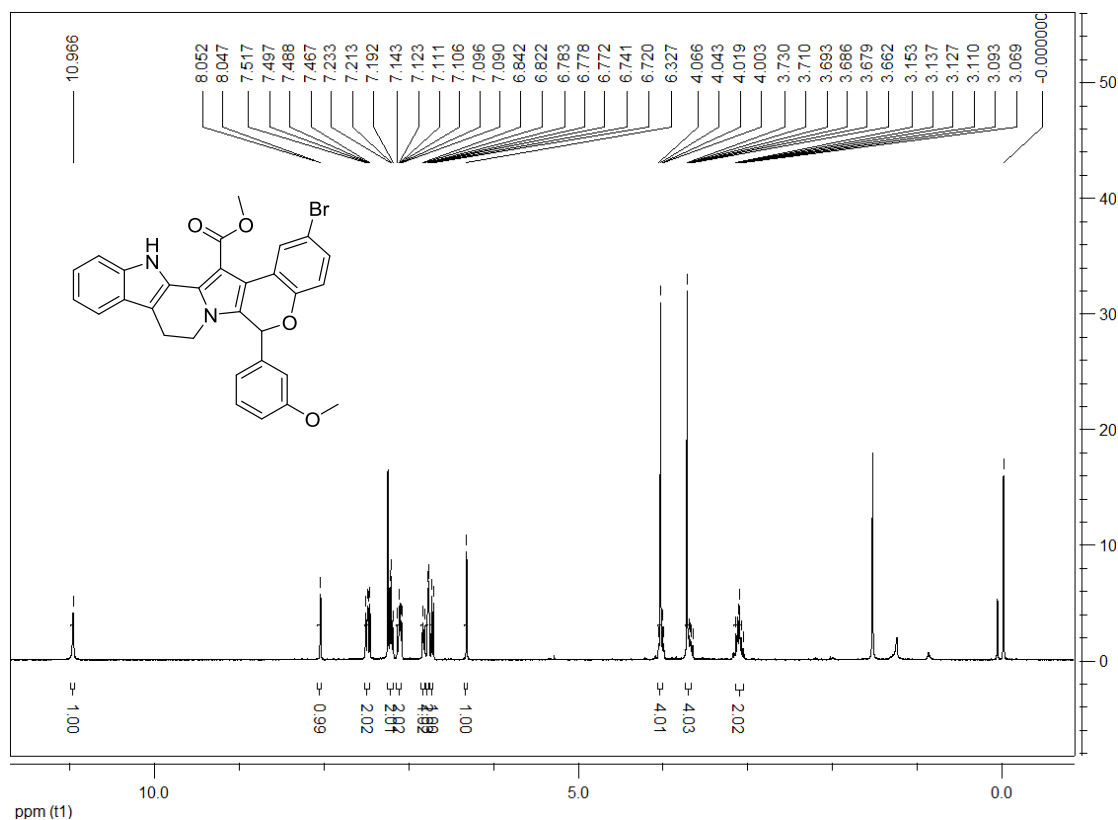


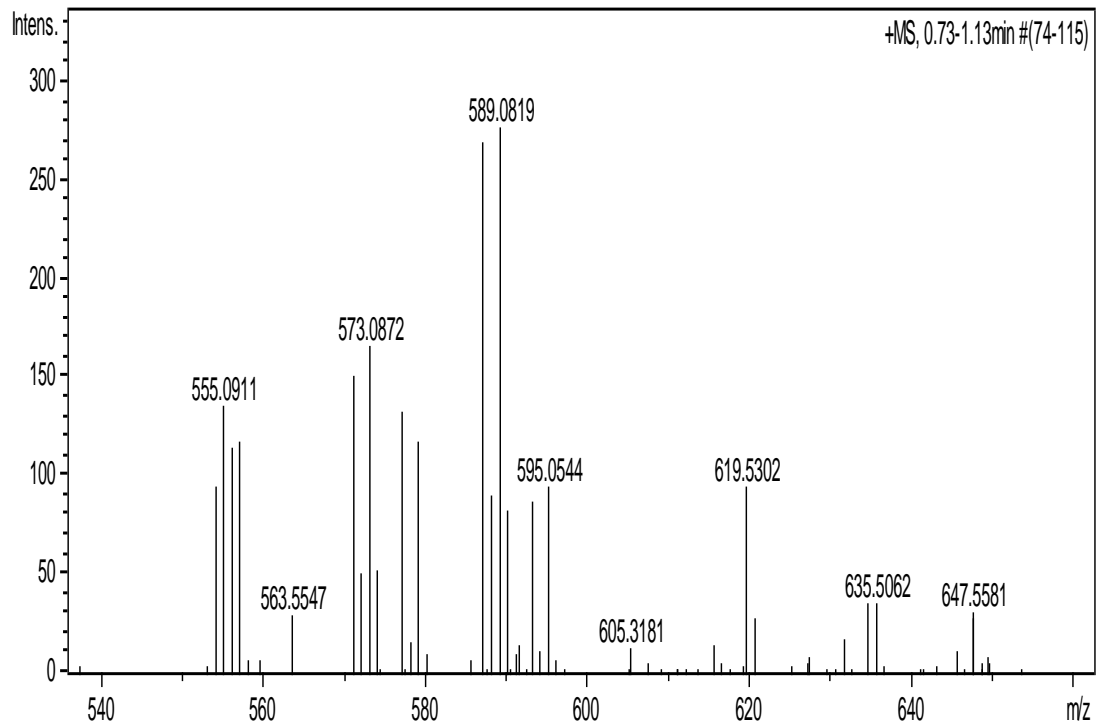
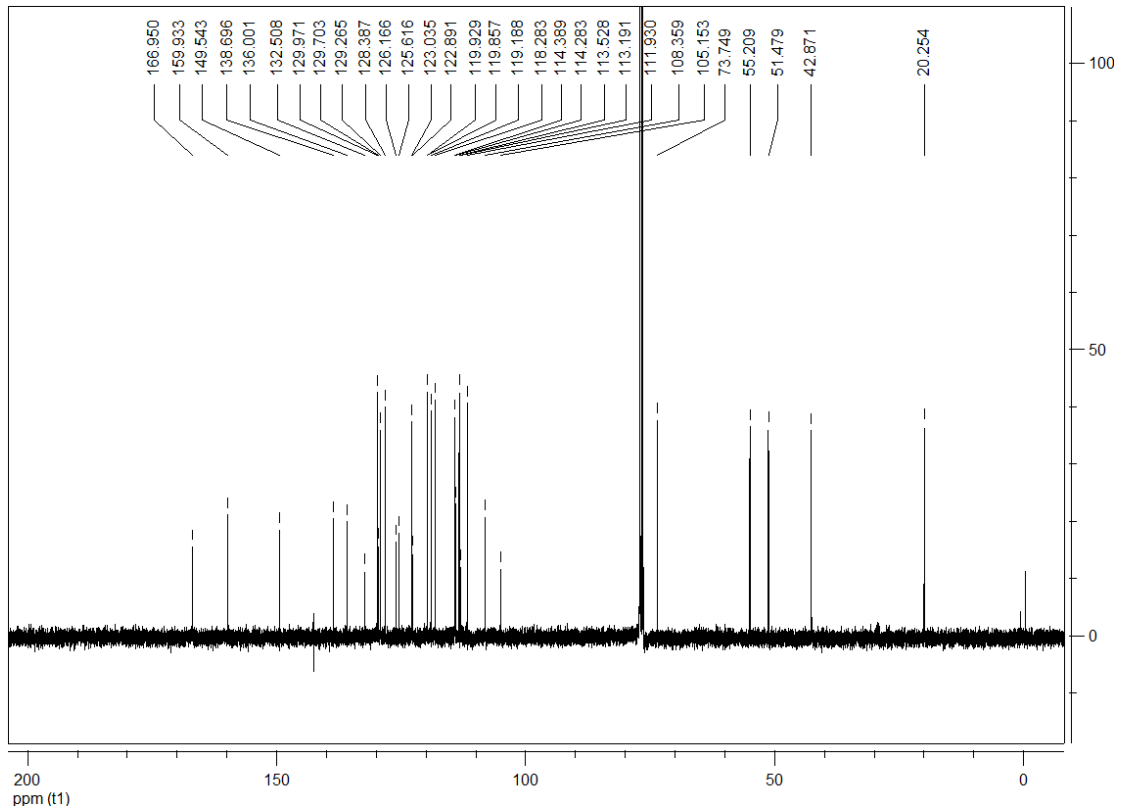


Methyl

2-bromo-6-(3-methoxyphenyl)-6,8,9,14-tetrahydrochromeno[4',3':2,3]indolizino[8,7-b]indole -15-carboxylate (1d):

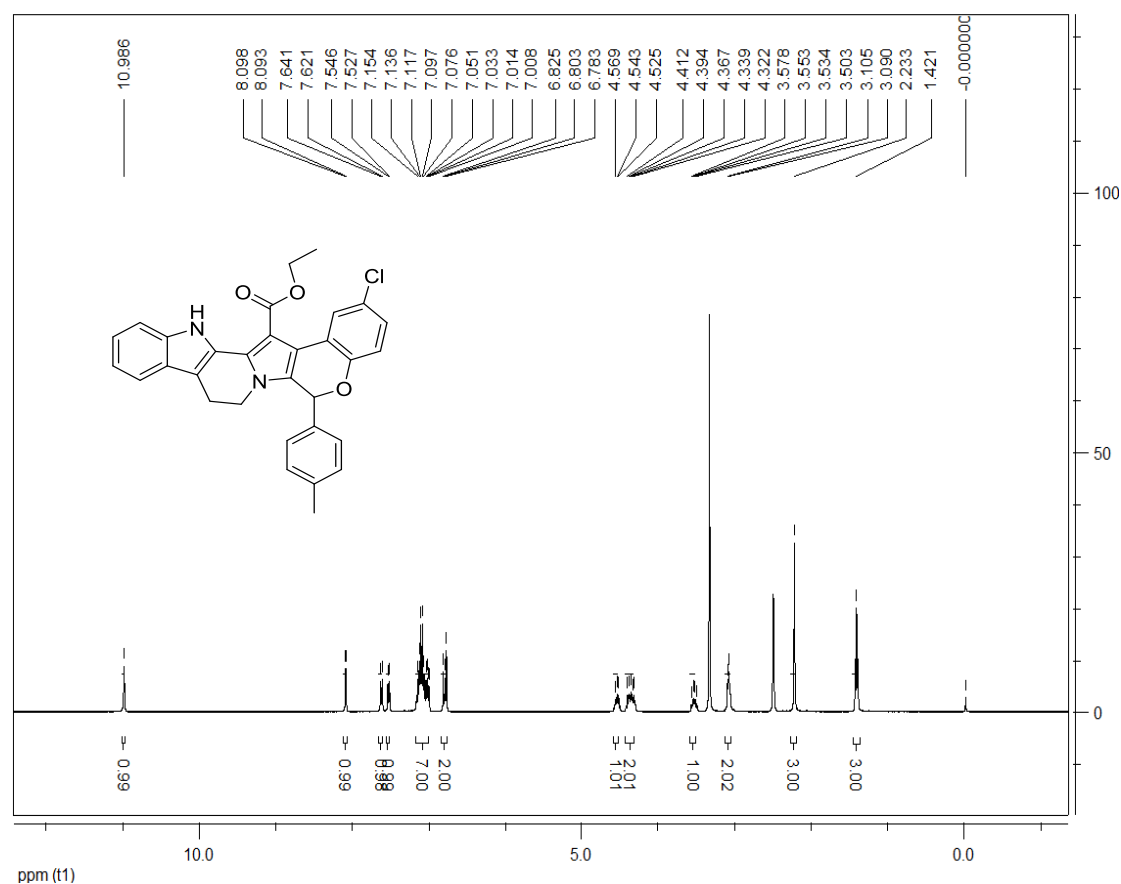
yellow solid, 65%, m.p. 229-230°C; ¹H NMR (400 MHz, CDCl₃) δ: 10.97 (s, 1H, NH), 8.05-8.05 (m, 1H, ArH), 7.52-7.47 (m, 2H, ArH), 7.23-7.19 (m, 2H, ArH), 7.14-7.09 (m, 2H, ArH), 6.84-6.82 (m, 1H, ArH), 6.78-6.77 (m, 2H, ArH), 6.74-6.72 (m, 1H, ArH), 6.33 (s, 1H, CH), 4.07-4.00 (m, 1H, CH), 3.73-3.66 (m, 4H, OCH₃, CH), 3.15-3.07 (m, 2H, CH); ¹³C NMR (100 MHz, CDCl₃) δ: 166.9, 159.9, 149.5, 138.6, 136.0, 132.5, 129.9, 129.7, 129.2, 128.3, 126.1, 125.6, 123.0, 122.8, 119.9, 119.8, 119.1, 118.2, 114.3, 114.2, 113.5, 113.1, 111.9, 108.3, 105.1, 73.7, 55.2, 51.4, 42.8, 20.2; MS (*m/z*): HRMS (ESI) Calcd. for C₃₀H₂₄BrN₂O₄ ([M+H]⁺): 555.0914. Found: 555.0911; IR (KBr) ν: 3385, 2972, 2954, 1690, 1680, 1547, 1437, 1290, 1025, 921, 831 cm⁻¹.

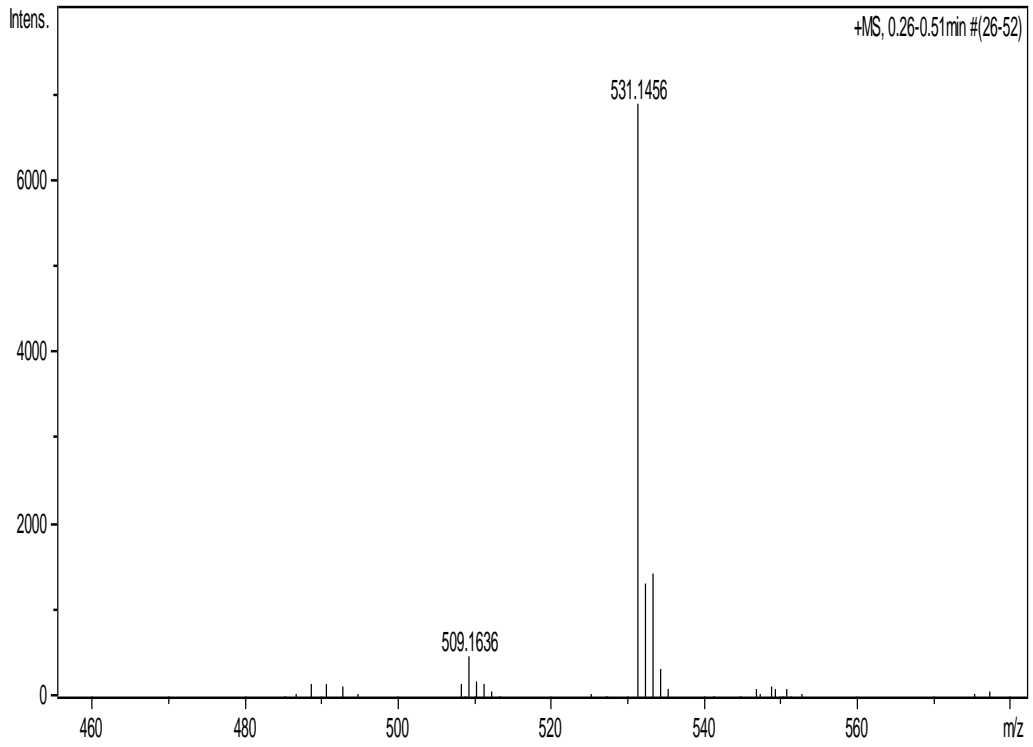
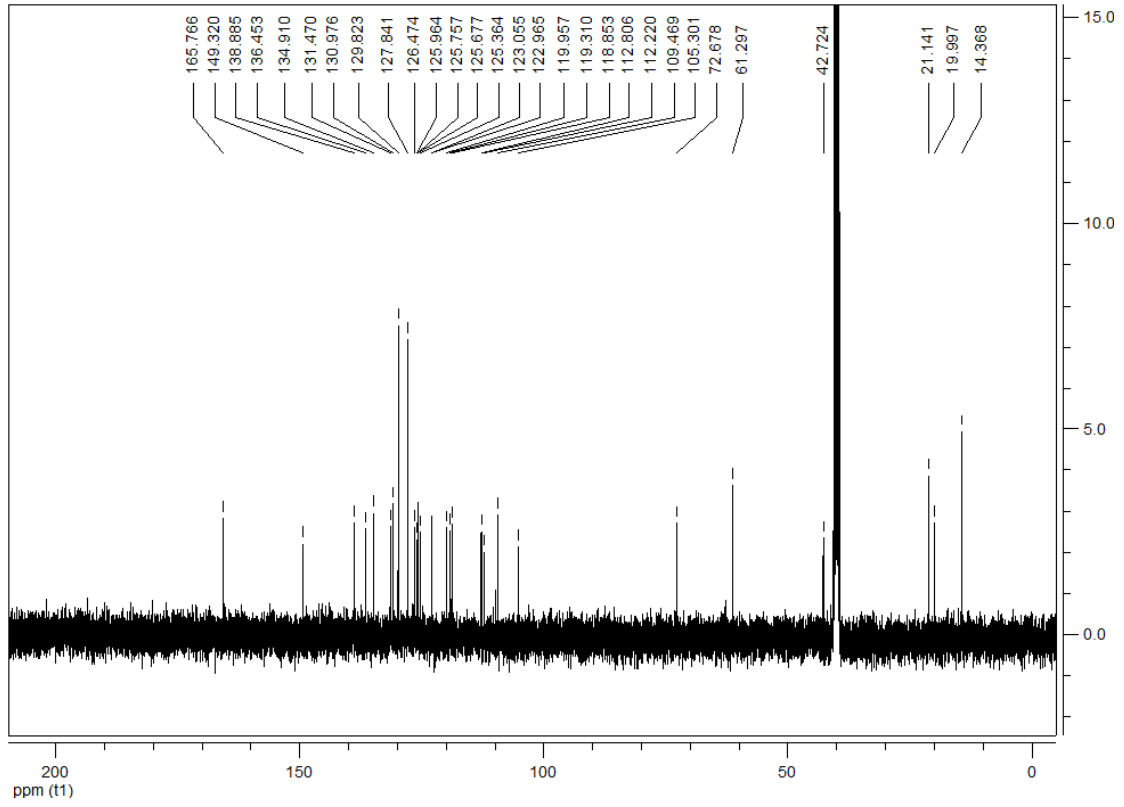




Ethyl 2-chloro-6-(p-tolyl)-6,8,9,14-tetrahydrochromeno[4',3':2,3]indolizino[8,7-b]indole-15-carboxylate (1e):

yellow solid, 79%, m.p. 232-233 °C; ¹H NMR (400 MHz, DMSO-*d*₆) δ: 10.99 (s, 1H, NH), 8.09 (d, *J* = 2.0 Hz, 1H, CH), 7.63 (d, *J* = 8.0 Hz, 1H, ArH), 7.54 (d, *J* = 7.6 Hz, 1H, ArH), 7.17-7.01 (m, 7H, ArH), 6.82-6.78 (m, 2H, ArH), 4.57-4.52 (m, 1H, CH), 4.41-4.31 (m, 2H, OCH₂), 3.58-3.50 (m, 1H, CH), 3.10-3.09 (m, 2H, CH), 2.23 (s, 3H, CH₃), 1.42 (t, *J* = 7.2 Hz, 3H, CH₃); ¹³C NMR (100 MHz, DMSO-*d*₆) δ: 165.7, 149.3, 138.8, 136.4, 134.9, 131.4, 130.9, 129.8, 127.8, 126.4, 125.9, 125.7, 125.6, 125.3, 123.0, 122.9, 119.9, 119.3, 118.8, 112.8, 112.2, 109.4, 105.3, 72.6, 61.2, 42.7, 21.1, 19.9, 14.3; MS (*m/z*): HRMS (ESI) Calcd. for C₃₁H₂₅ClN₂O₃Na ([M+Na]⁺): 531.1446. Found: 531.1456; IR (KBr) ν: 3453, 3362, 1679, 1639, 1567, 1387, 1156, 1093, 978, 853, 818, 740 cm⁻¹.

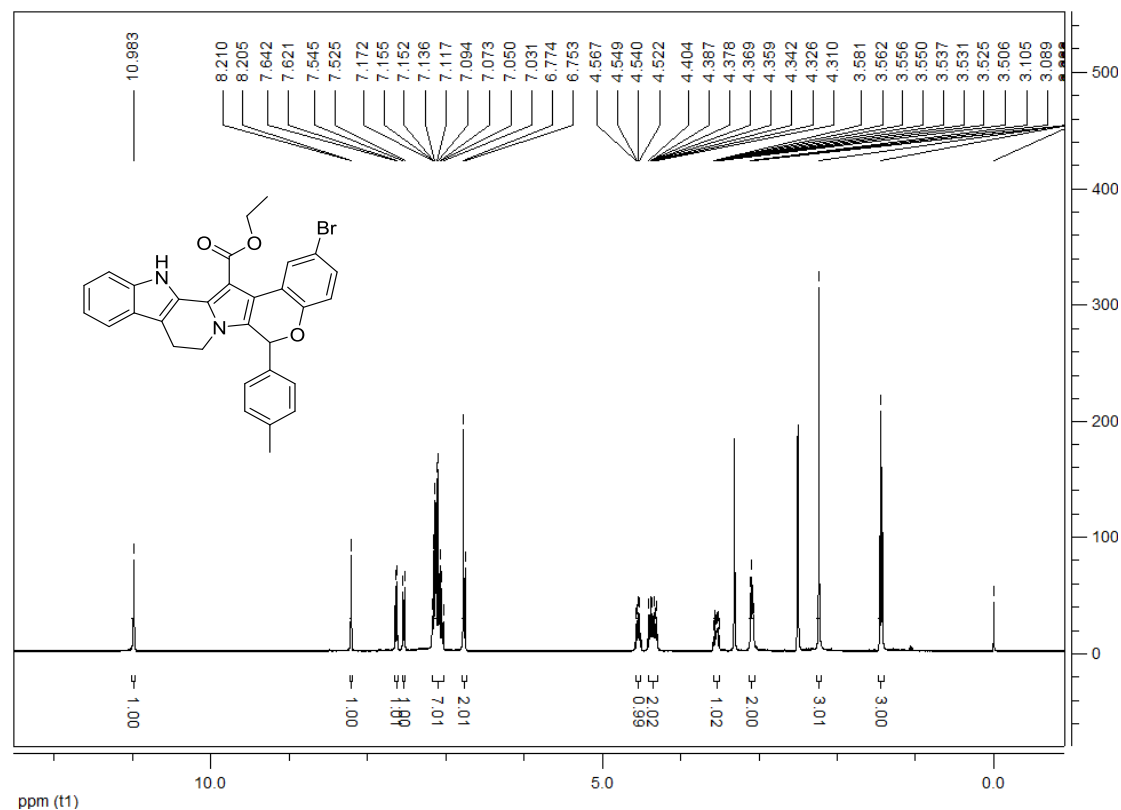


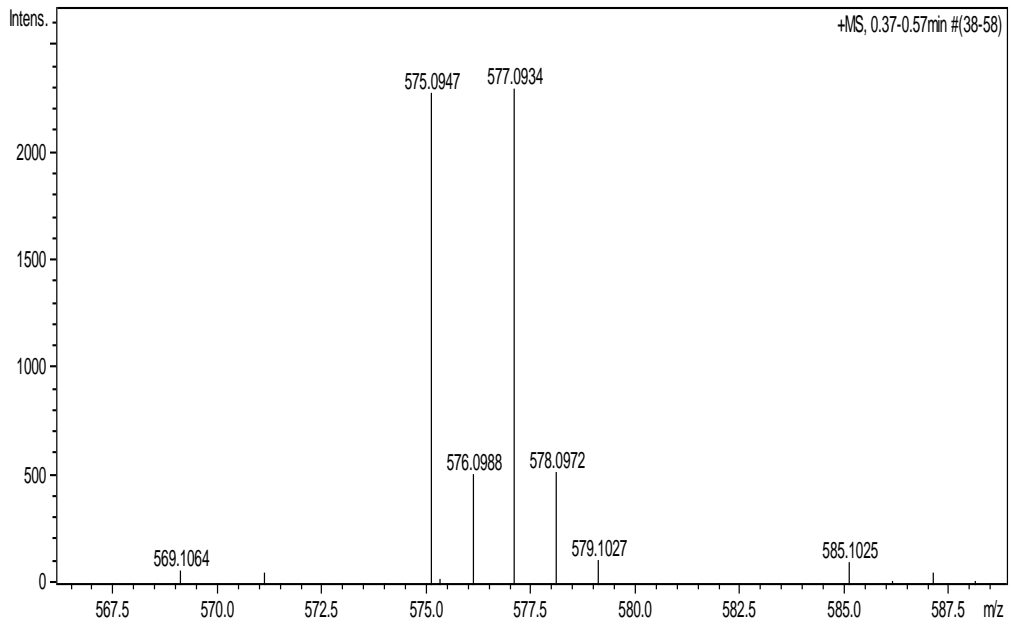
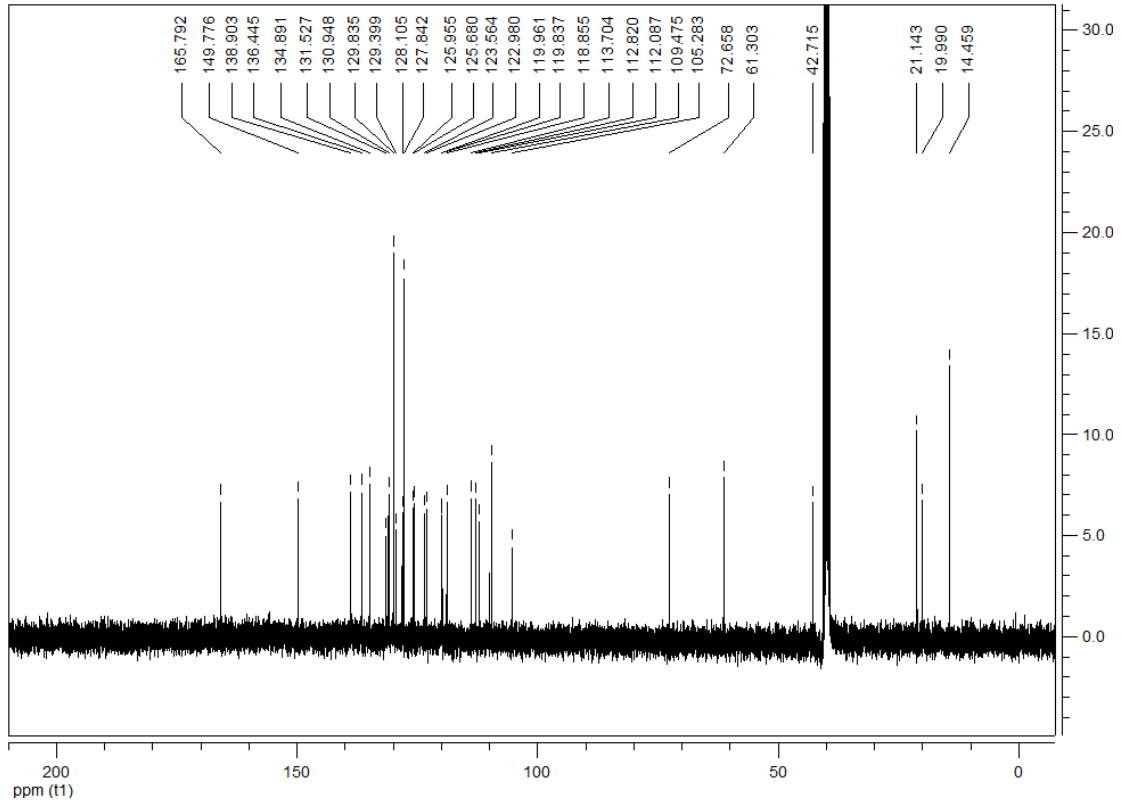


Ethyl

2-bromo-11-methoxy-6-(p-tolyl)-6,8,9,14-tetrahydrochromeno[4',3':2,3]indolizino[8,7-b]indole-15-carboxylate (1f):

yellow solid, 84%, m.p. 204-206 °C; $^1\text{H NMR}$ (400 MHz, $\text{DMSO-}d_6$) δ : 10.98 (s, 1H, NH), 8.21 (d, $J = 2.0$ Hz, 1H, CH), 7.63 (d, $J = 8.4$ Hz, 1H, ArH), 7.54 (d, $J = 8.0$ Hz, 1H, ArH), 7.17-7.03 (m, 7H, ArH), 6.77-6.75 (m, 2H, ArH), 4.57-4.50 (m, 1H, CH), 4.40-4.30 (m, 2H, OCH_2), 3.58-3.51 (m, 1H, CH), 3.10-3.06 (m, 2H, CH), 2.23 (s, 3H, CH_3), 1.44 (t, $J = 7.2$ Hz, 3H, CH_3); $^{13}\text{C NMR}$ (100 MHz, $\text{DMSO-}d_6$) δ : 165.7, 149.7, 138.9, 136.4, 134.8, 131.5, 130.9, 129.8, 129.3, 128.1, 127.8, 125.9, 125.6, 123.5, 122.9, 119.9, 119.8, 118.8, 113.7, 112.8, 112.0, 109.4, 105.2, 72.6, 61.3, 42.7, 21.1, 19.9, 14.4; MS (m/z): HRMS (ESI) Calcd. for $\text{C}_{31}\text{H}_{25}\text{BrN}_2\text{O}_3\text{Na}$ ($[\text{M}+\text{Na}]^+$): 575.0941. Found: 575.0947; IR (KBr) ν : 3453, 3355, 2980, 2929, 1679, 1564, 1492, 978, 850, 816, 785 cm^{-1} .

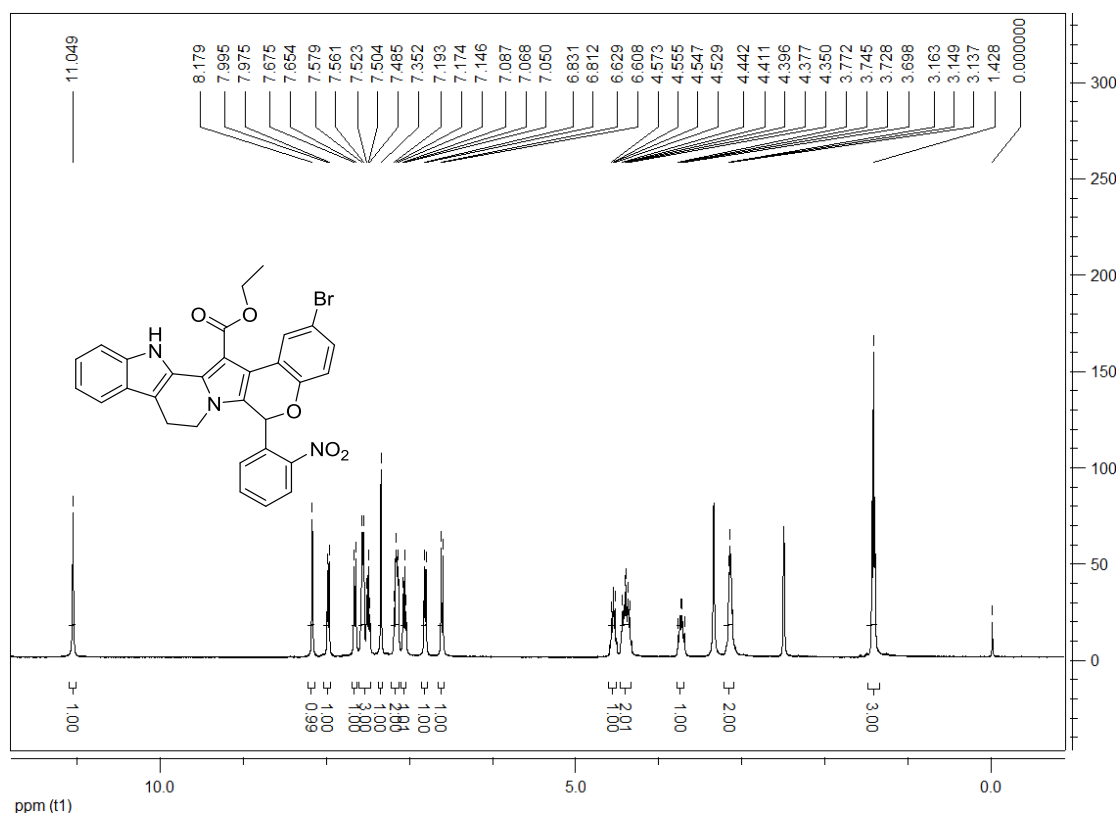


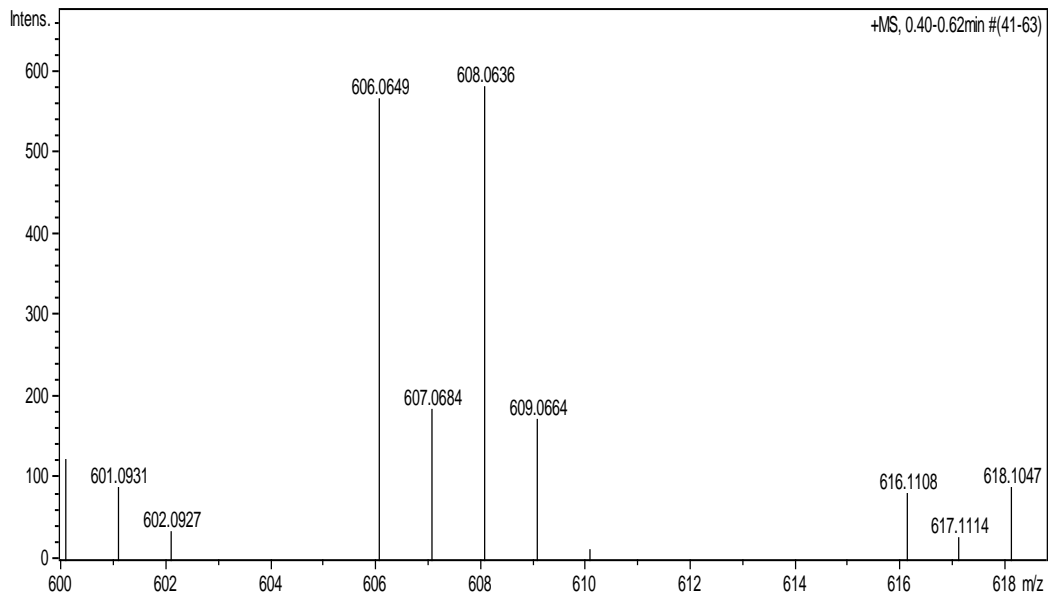
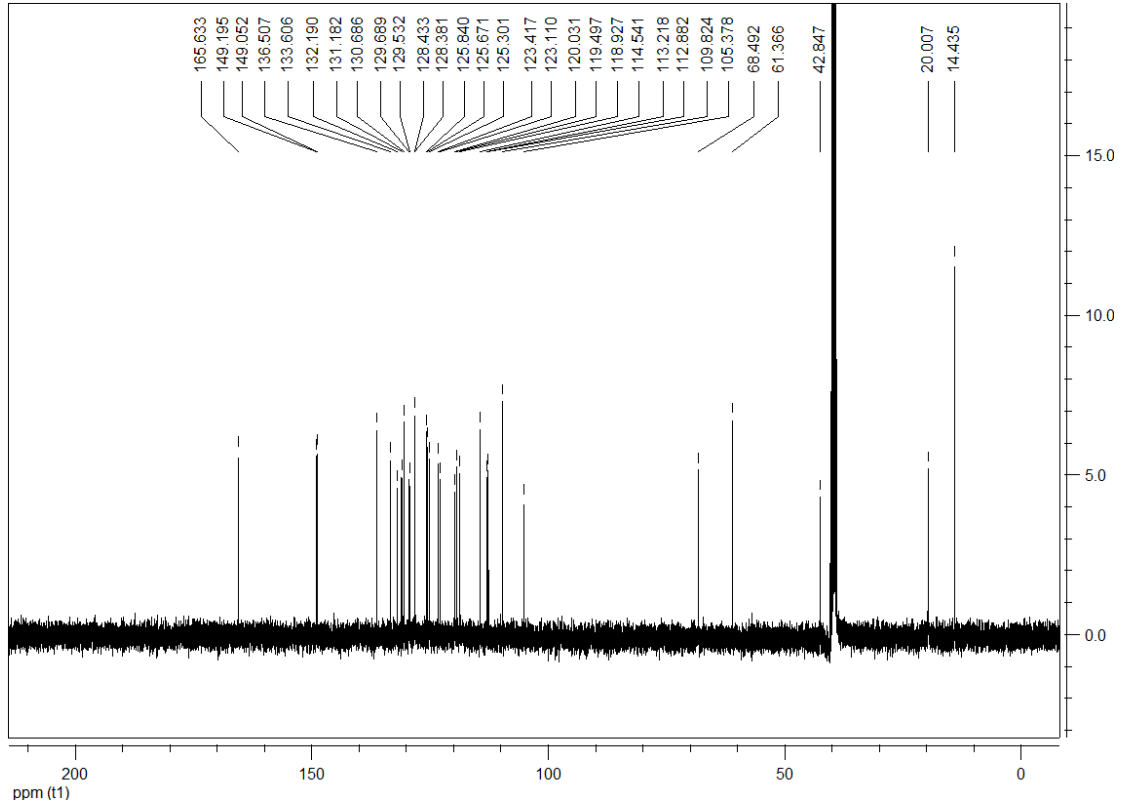


Ethyl

2-bromo-6-(2-nitrophenyl)-6,8,9,14-tetrahydrochromeno[4',3':2,3]indolizino[8,7-b]indole-15-carboxylate (1g):

yellow solid, 81%, m.p. 239-240 °C; ^1H NMR (400 MHz, $\text{DMSO-}d_6$) δ : 11.05 (s, 1H, NH), 8.18 (s, 1H, CH), 7.99 (d, $J = 8.0$ Hz, 1H, ArH), 7.66 (d, $J = 8.4$ Hz, 1H, ArH), 7.58-7.50 (m, 3H, ArH), 7.35 (s, 1H, ArH), 7.19-7.15 (m, 2H, ArH), 7.09-7.07 (m, 1H, ArH), 6.82 (d, $J = 7.6$ Hz, 1H, ArH), 6.62 (d, $J = 8.4$ Hz, 1H, ArH), 4.56-4.53 (m, 1H, CH), 4.44-4.37 (m, 2H, OCH_2), 3.77-3.70 (m, 1H, CH), 3.16-3.12 (m, 2H, CH), 1.43 (t, $J = 7.2$ Hz, 3H, CH_3); ^{13}C NMR (100 MHz, $\text{DMSO-}d_6$) δ : 165.6, 149.1, 149.0, 136.5, 133.6, 132.1, 131.1, 130.6, 129.6, 129.5, 128.4, 128.3, 125.8, 125.6, 125.3, 123.4, 123.1, 120.0, 119.4, 118.9, 114.5, 113.2, 112.8, 109.8, 105.3, 68.4, 61.3, 42.8, 20.0, 14.4; MS (m/z): HRMS (ESI) Calcd. for $\text{C}_{30}\text{H}_{22}\text{BrN}_3\text{O}_5\text{Na}$ ($[\text{M}+\text{Na}]^+$): 606.0635. Found: 606.0649; IR (KBr) ν : 3458, 3299, 2977, 1674, 1574, 1491, 1364, 1081, 885, 787, 735 cm^{-1} .

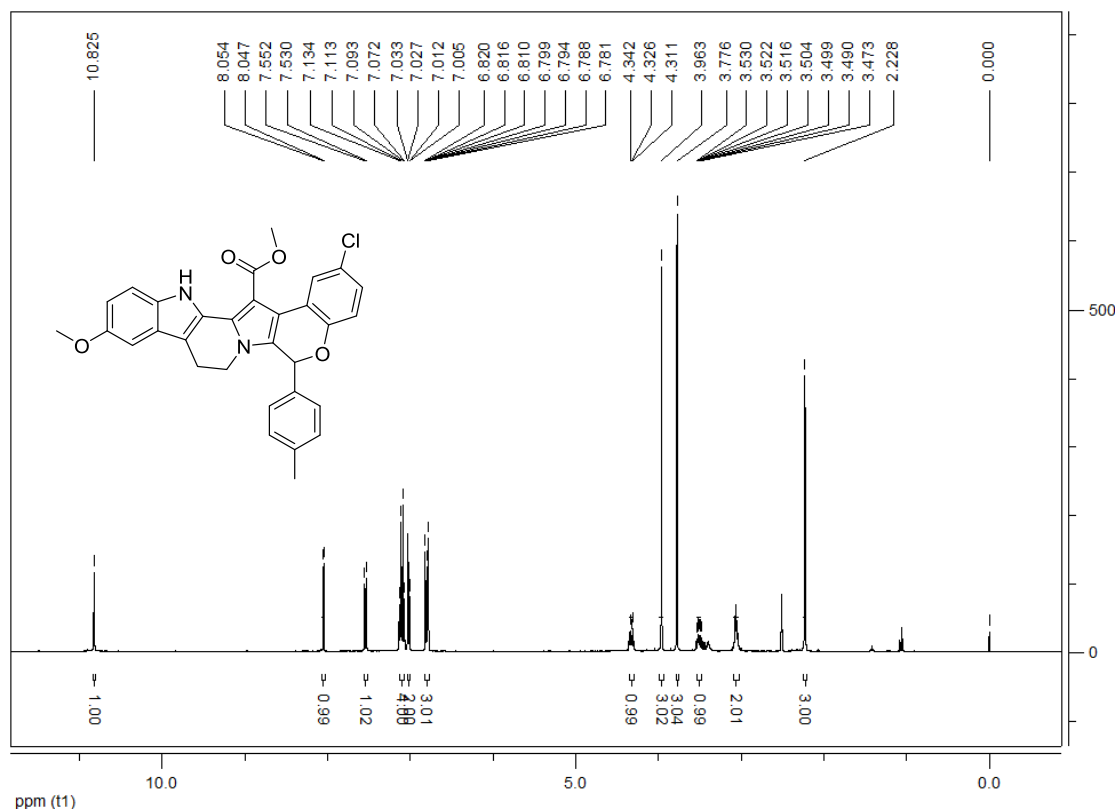


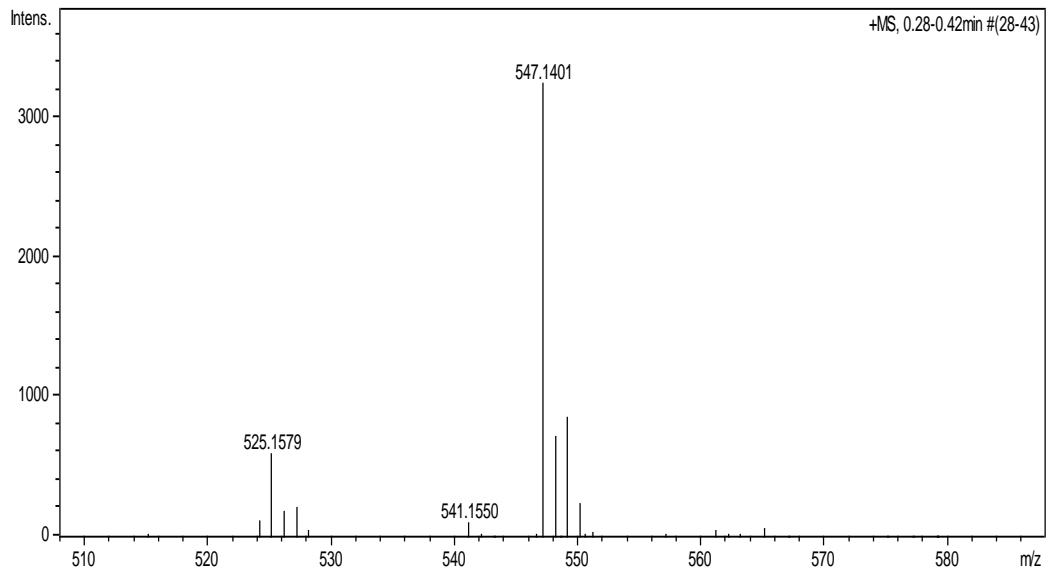
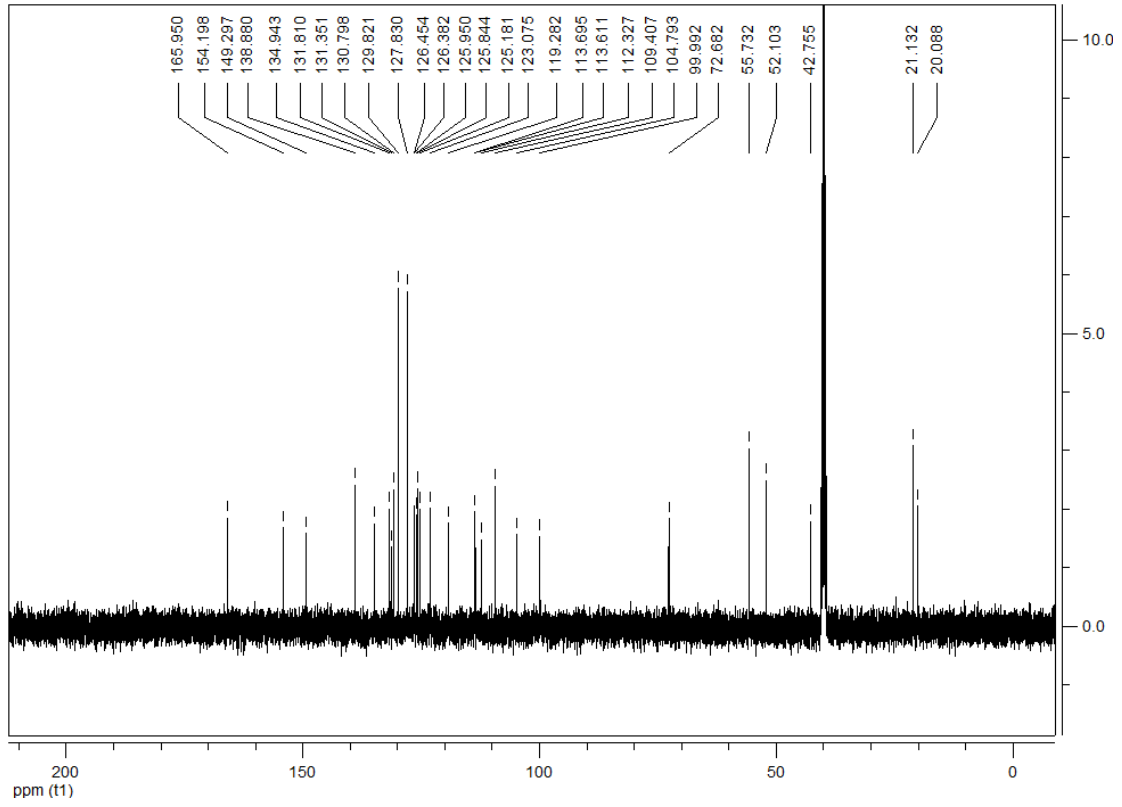


Methyl

2-chloro-11-methoxy-6-(p-tolyl)-6,8,9,14-tetrahydrochromeno[4',3':2,3]indolizino[8,7-b]indole-15-carboxylate (1h):

yellow solid, 83%, m.p. 208-210 °C; ¹H NMR (400 MHz, DMSO-*d*₆) δ: 10.82 (s, 1H, NH), 8.05 (d, *J* = 2.8 Hz, 1H, ArH), 7.55 (d, *J* = 8.8 Hz, 1H, ArH), 7.13-7.07 (m, 4H, ArH), 7.03-7.00 (m, 2H, ArH), 6.82-6.78 (m, 3H, ArH), 4.34-4.31 (m, 1H, CH), 3.96 (s, 3H, OCH₃), 3.78 (s, 3H, OCH₃), 3.52-3.48 (m, 1H, CH), 3.08-3.04 (m, 2H, CH), 2.23 (s, 3H, CH₃); ¹³C NMR (100 MHz, DMSO-*d*₆) δ: 165.9, 154.1, 149.2, 138.8, 134.9, 131.8, 131.3, 130.7, 129.8, 127.8, 126.4, 126.3, 125.9, 125.8, 125.1, 123.0, 119.2, 113.6, 113.6, 112.3, 109.4, 104.7, 99.9, 72.6, 55.7, 52.1, 42.7, 21.1, 20.0; MS (*m/z*): HRMS (ESI) Calcd. for C₃₁H₂₅ClN₂O₄Na ([M+Na]⁺): 547.1395. Found: 547.1401; IR (KBr) ν: 3387, 2944, 1679, 1623, 1567, 1488, 1452, 1367, 1325, 1283, 1082, 871, 81, 839, 623 cm⁻¹.

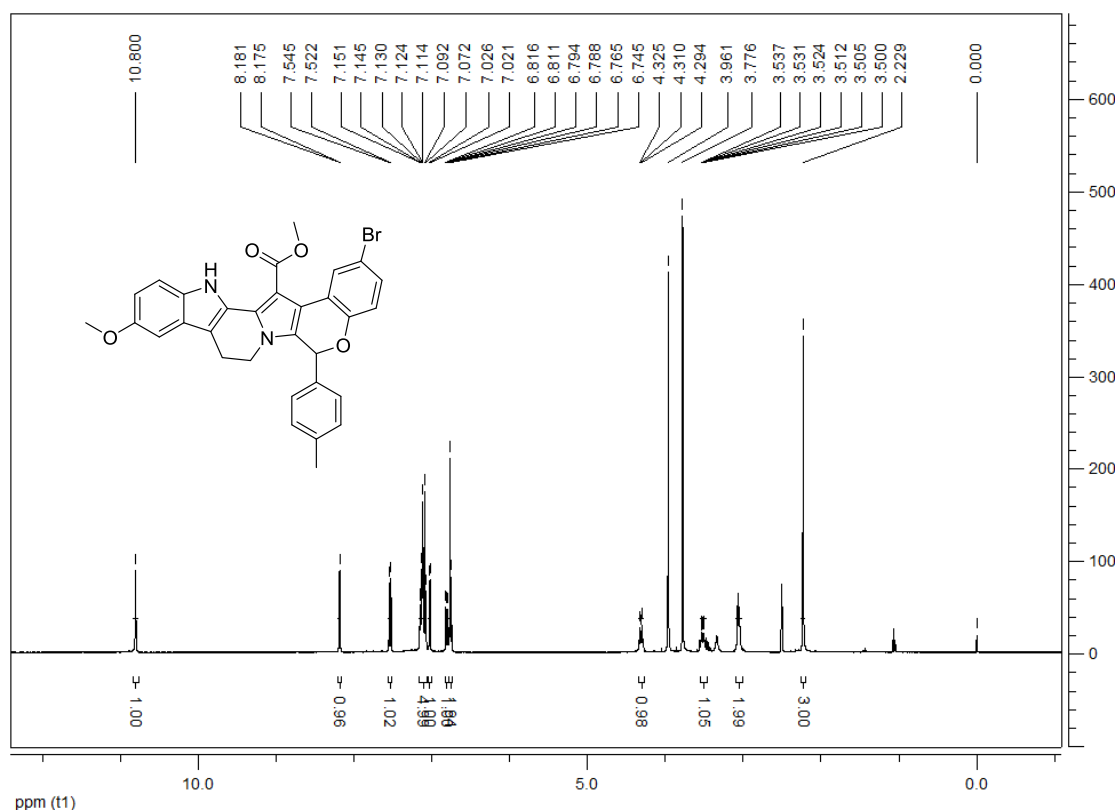


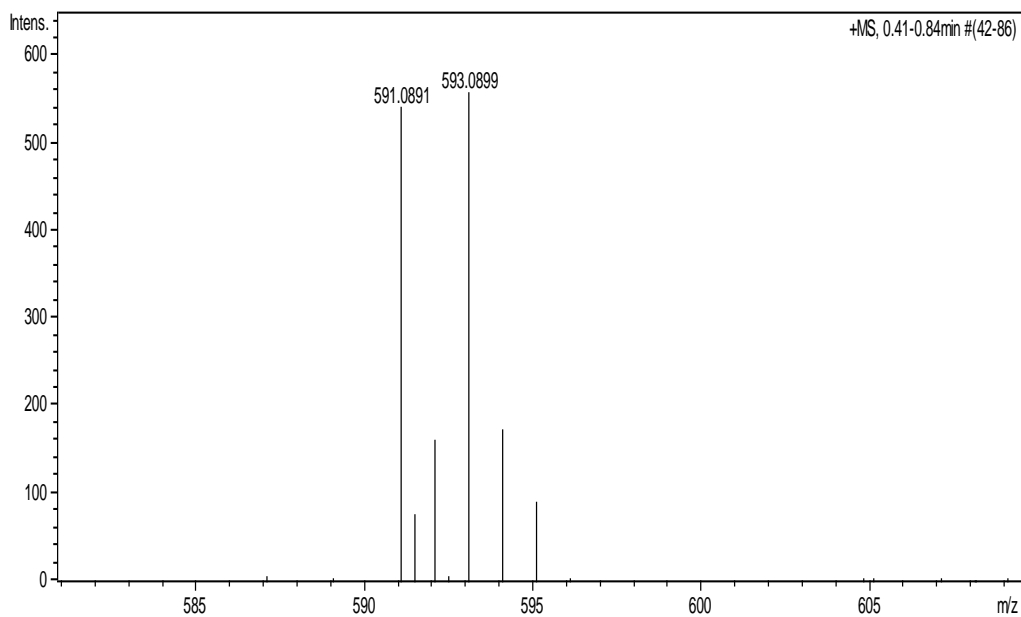
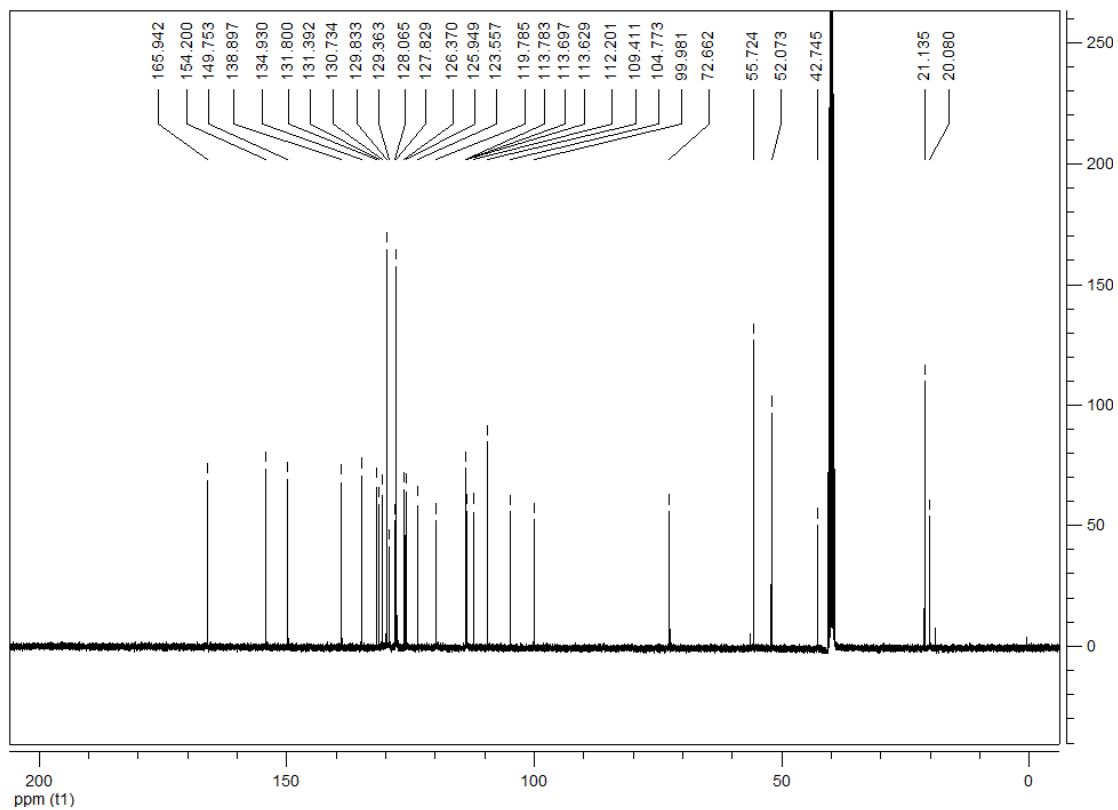


Methyl

2-bromo-11-methoxy-6-(p-tolyl)-6,8,9,14-tetrahydrochromeno[4',3':2,3]indolizino[8,7-b]indole-15-carboxylate (1i):

yellow solid, 87%, m.p. 213-215 °C; ^1H NMR (400 MHz, $\text{DMSO-}d_6$) δ : 10.80 (s, 1H, NH), 8.18 (d, $J = 2.4$ Hz, 1H, CH), 7.53 (d, $J = 9.2$ Hz, 1H, ArH), 7.15-7.07 (m, 5H, ArH), 7.02 (d, $J = 2.0$ Hz, 1H, ArH), 6.82-6.79 (m, 1H, ArH), 6.76-6.74 (m, 2H, ArH), 4.32-4.29 (m, 1H, CH), 3.96 (s, 3H, OCH_3), 3.78 (s, 3H, OCH_3), 3.53-3.50 (m, 1H, CH), 3.08-3.04 (m, 2H, CH), 2.23 (s, 3H, CH_3); ^{13}C NMR (100 MHz, $\text{DMSO-}d_6$) δ : 165.9, 154.2, 149.7, 138.8, 134.9, 131.7, 131.3, 130.7, 129.8, 129.3, 128.0, 127.8, 126.3, 125.9, 123.5, 119.7, 113.7, 113.6, 113.6, 112.2, 109.4, 104.7, 99.9, 72.6, 55.7, 52.0, 42.7, 21.1, 20.0; MS (m/z): HRMS (ESI) Calcd. for $\text{C}_{31}\text{H}_{25}\text{BrN}_2\text{O}_4\text{Na}$ ($[\text{M}+\text{Na}]^+$): 591.0890. Found: 591.0891; IR (KBr) ν : 3381, 2943, 1679, 1621, 1566, 1450, 1283, 1075, 870, 810, 622 cm^{-1} .

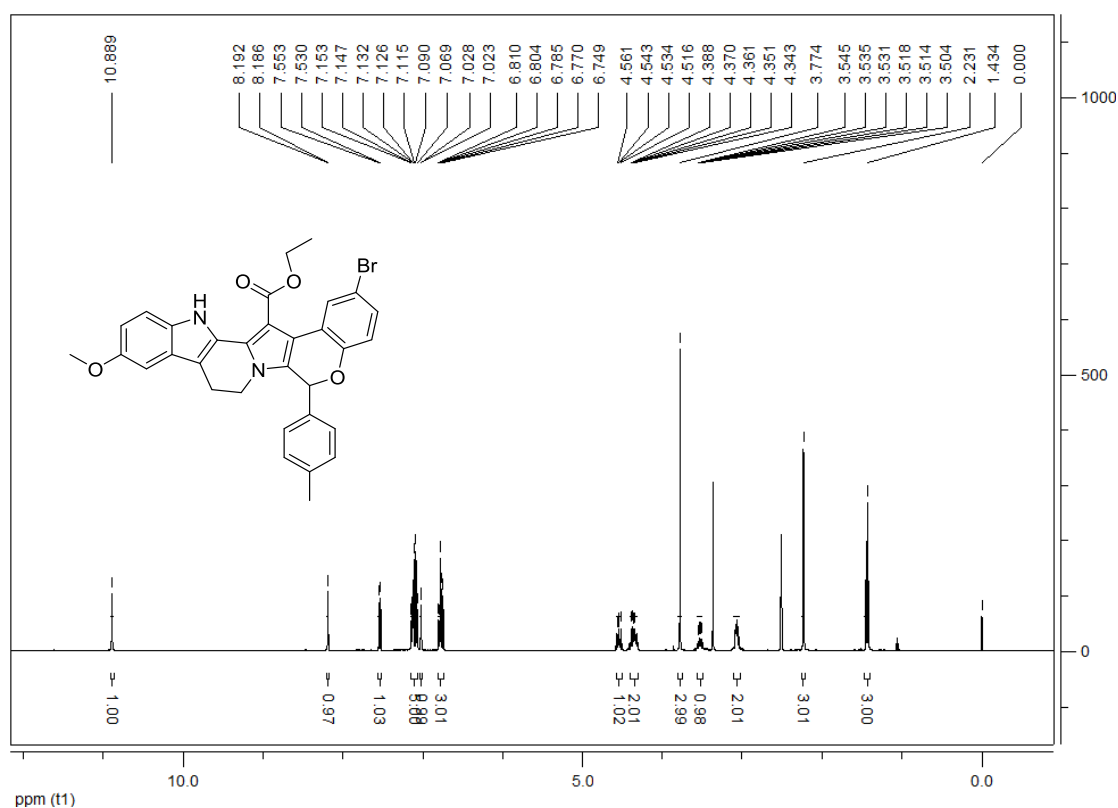


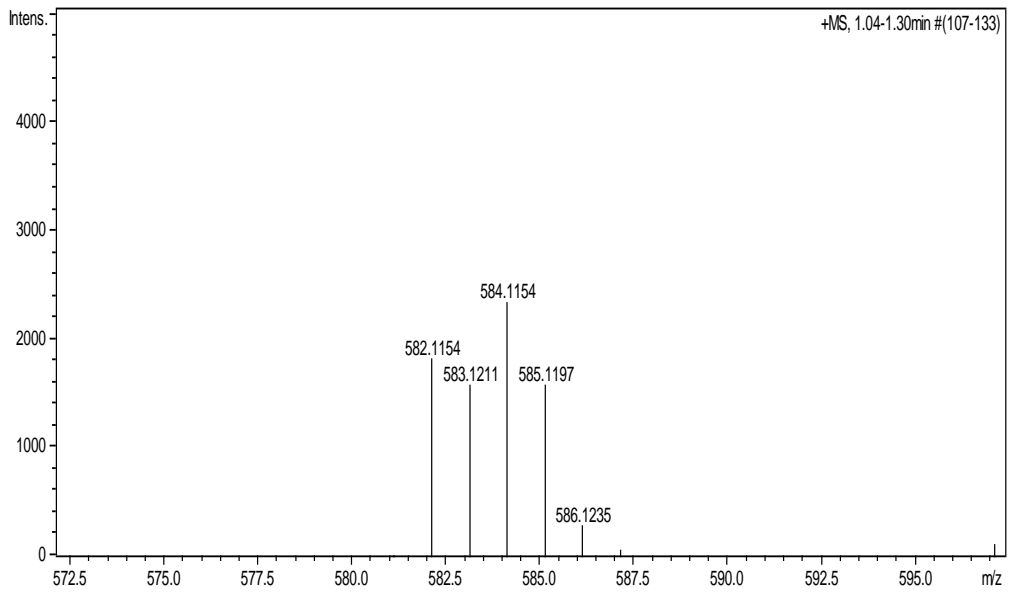
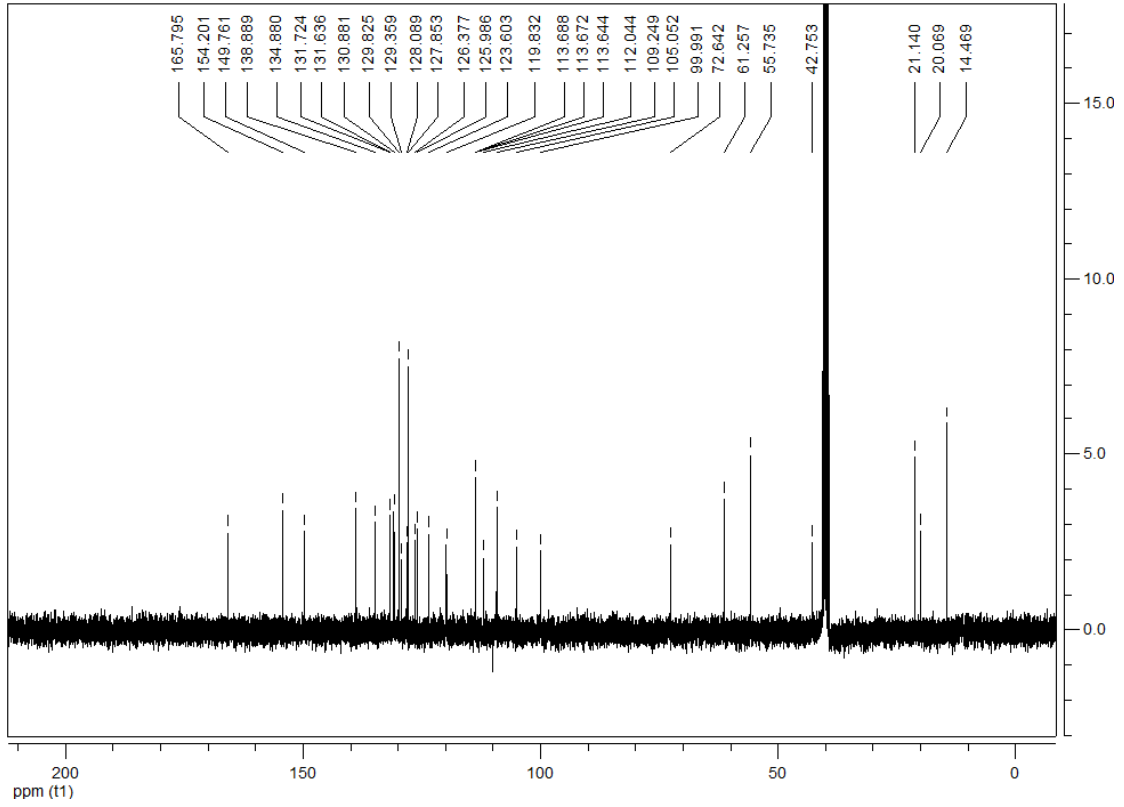


Ethyl

2-bromo-11-methoxy-6-(p-tolyl)-6,8,9,14-tetrahydrochromeno[4',3':2,3]indolizino[8,7-b]indole-15-carboxylate (1j):

yellow solid, 82%, m.p. 217-218 °C; $^1\text{H NMR}$ (400 MHz, $\text{DMSO-}d_6$) δ : 10.89 (s, 1H, NH), 8.19 (d, $J = 2.4$ Hz, 1H, CH), 7.54 (d, $J = 9.2$ Hz, 1H, ArH), 7.15-7.07 (m, 5H, ArH), 7.03-7.02 (m, 1H, ArH), 6.81-6.75 (m, 3H, ArH), 4.56-4.52 (m, 1H, CH), 4.39-4.30 (m, 2H, OCH_2), 3.77 (s, 3H, OCH_3), 3.54-3.49 (m, 1H, CH), 3.08-3.04 (m, 2H, CH), 2.23 (s, 3H, CH_3), 1.43 (t, $J = 7.2$ Hz, 3H, CH_3); $^{13}\text{C NMR}$ (100 MHz, $\text{DMSO-}d_6$) δ : 165.7, 154.2, 149.7, 138.8, 134.8, 131.7, 131.6, 130.8, 129.8, 129.3, 128.0, 127.8, 126.3, 125.9, 123.6, 119.8, 113.6, 113.6, 113.6, 112.0, 109.2, 105.0, 99.9, 72.6, 61.2, 55.7, 42.7, 21.1, 20.0, 14.4; MS (m/z): HRMS (ESI) Calcd. for $\text{C}_{32}\text{H}_{28}\text{BrN}_2\text{O}_4$ ($[\text{M}+\text{H}]^+$): 583.1227. Found: 583.1211; IR (KBr) ν : 3327, 2944, 1682, 1529, 1487, 1286, 1078, 790, 739, 624 cm^{-1} .

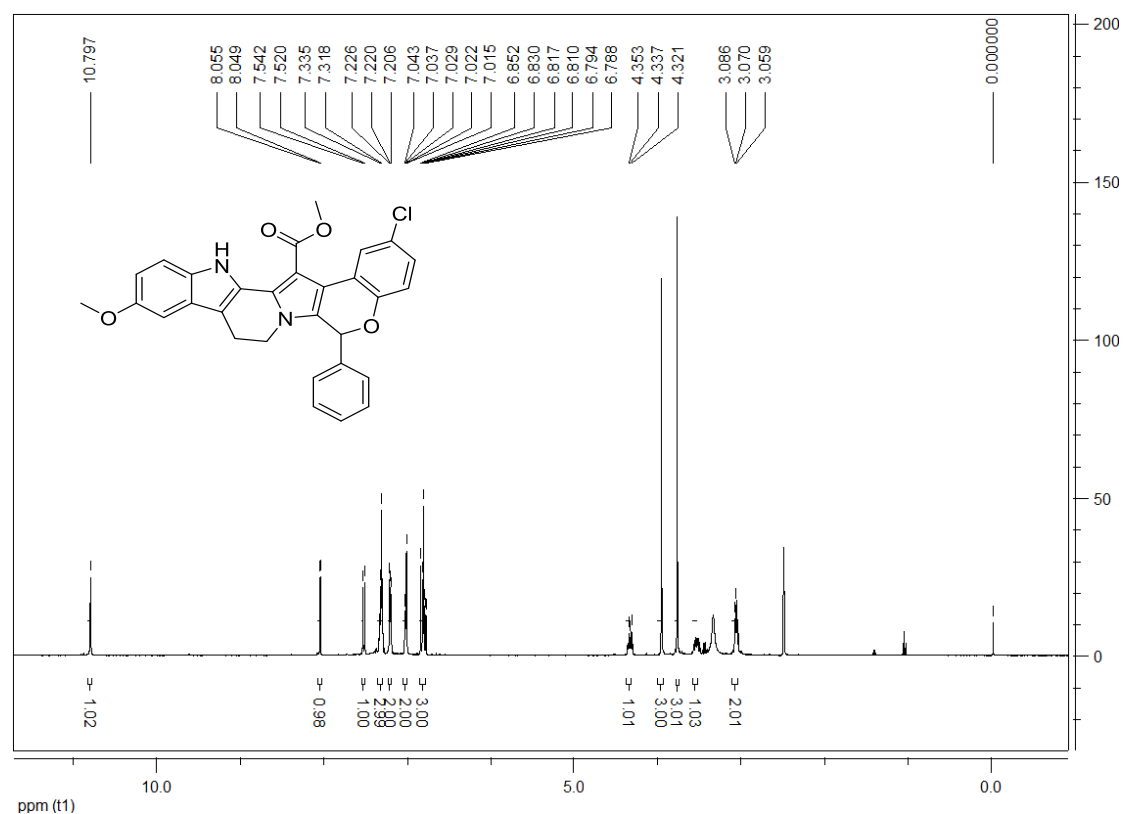


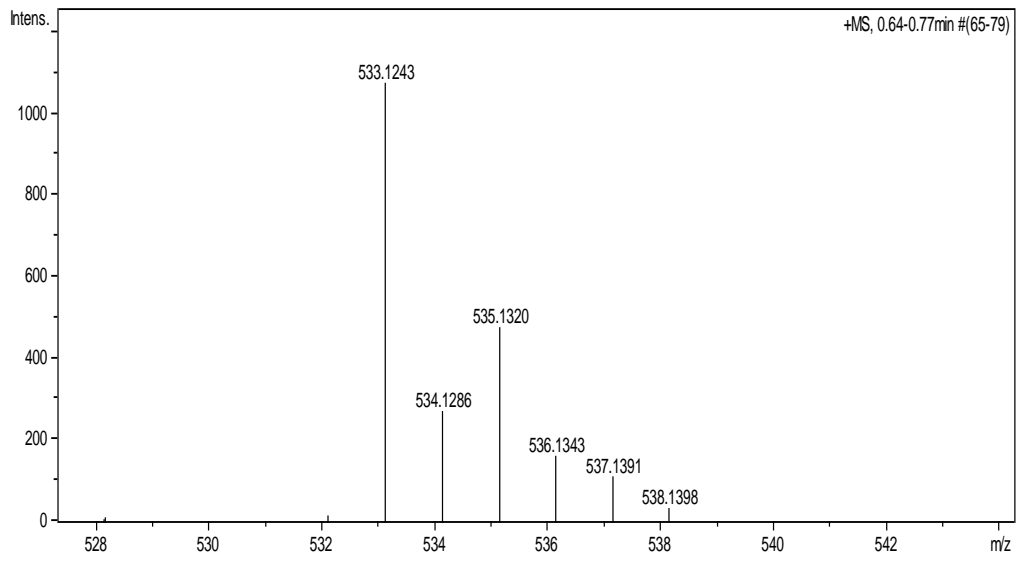
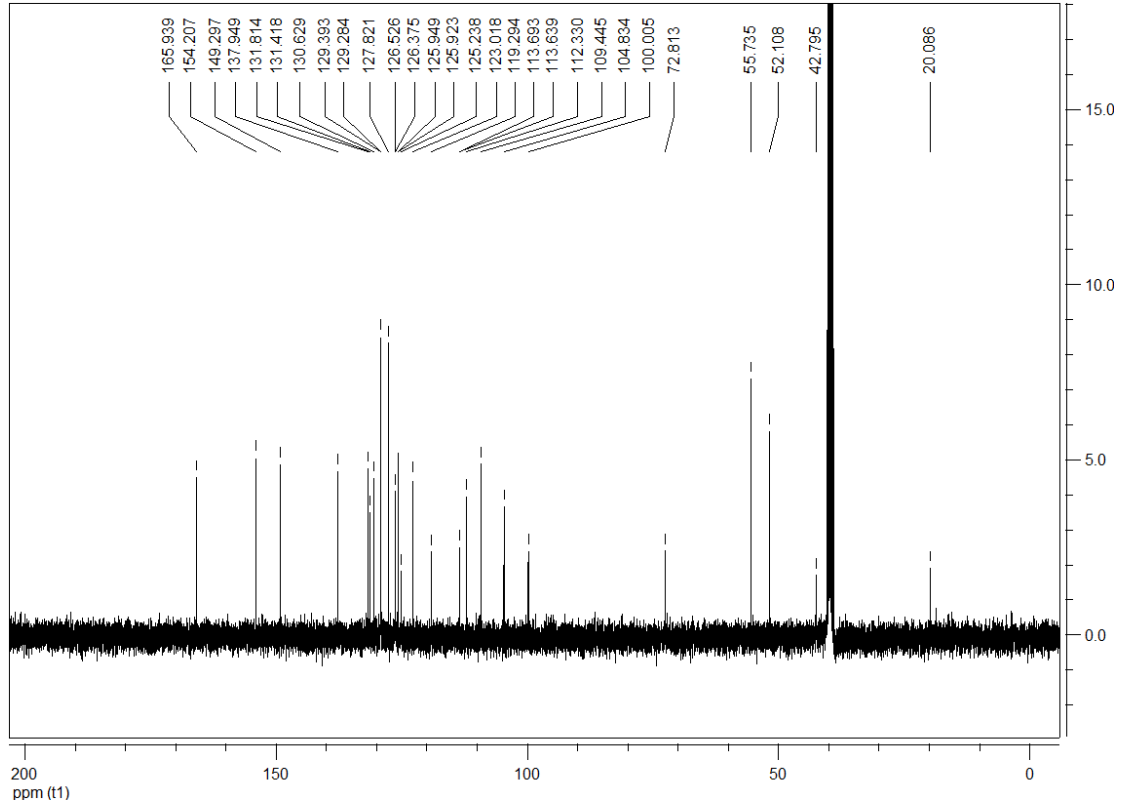


Methyl

2-chloro-11-methoxy-6-phenyl-6,8,9,14-tetrahydrochromeno[4',3':2,3]indolizino[8,7-b]indole-15-carboxylate (1k):

yellow solid, 75%, m.p. 218-220°C; $^1\text{H NMR}$ (400 MHz, $\text{DMSO-}d_6$) δ : 10.80 (s, 1H, NH), 8.05 (d, $J = 2.4$ Hz, 1H, CH), 7.53 (d, $J = 8.8$ Hz, 1H, ArH), 7.36-7.31 (m, 3H, ArH), 7.23-7.21 (m, 2H, ArH), 7.04-7.02 (m, 2H, ArH), 6.85-6.79 (m, 3H, ArH), 4.37-4.31 (m, 1H, CH), 3.96 (s, 3H, OCH_3), 3.78 (s, 3H, OCH_3), 3.58-3.52 (m, 1H, CH), 3.09-3.04 (m, 2H, CH); $^{13}\text{C NMR}$ (100 MHz, $\text{DMSO-}d_6$) δ : 165.9, 154.2, 149.2, 137.9, 131.8, 131.4, 130.6, 129.3, 129.2, 127.8, 126.5, 126.3, 125.9, 125.9, 125.2, 123.0, 119.2, 113.6, 113.6, 112.3, 109.4, 104.8, 100.0, 72.8, 55.7, 52.1, 42.7, 20.0; MS (m/z): HRMS (ESI) Calcd. for $\text{C}_{30}\text{H}_{23}\text{ClN}_2\text{O}_4\text{Na}$ ($[\text{M}+\text{Na}]^+$): 533.1239. Found: 533.1243; IR (KBr) ν : 3448, 3352, 2944, 1678, 1623, 1564, 1490, 1368, 1083, 806, 743 cm^{-1} .

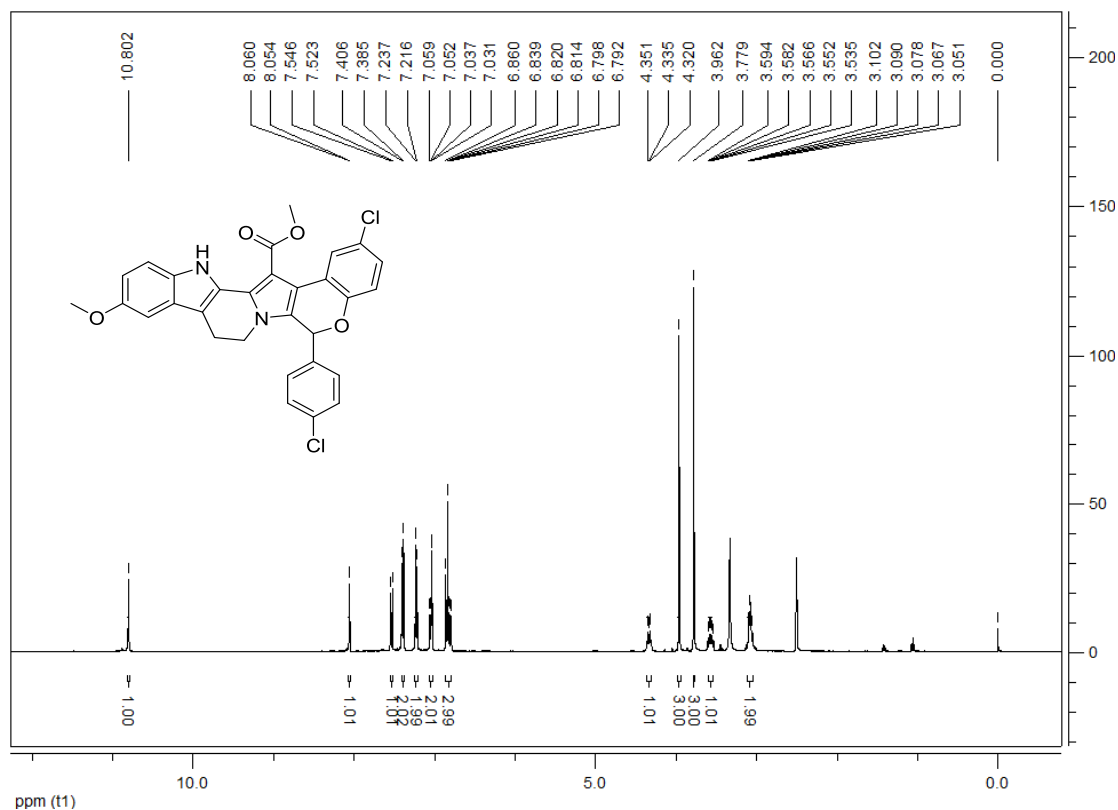


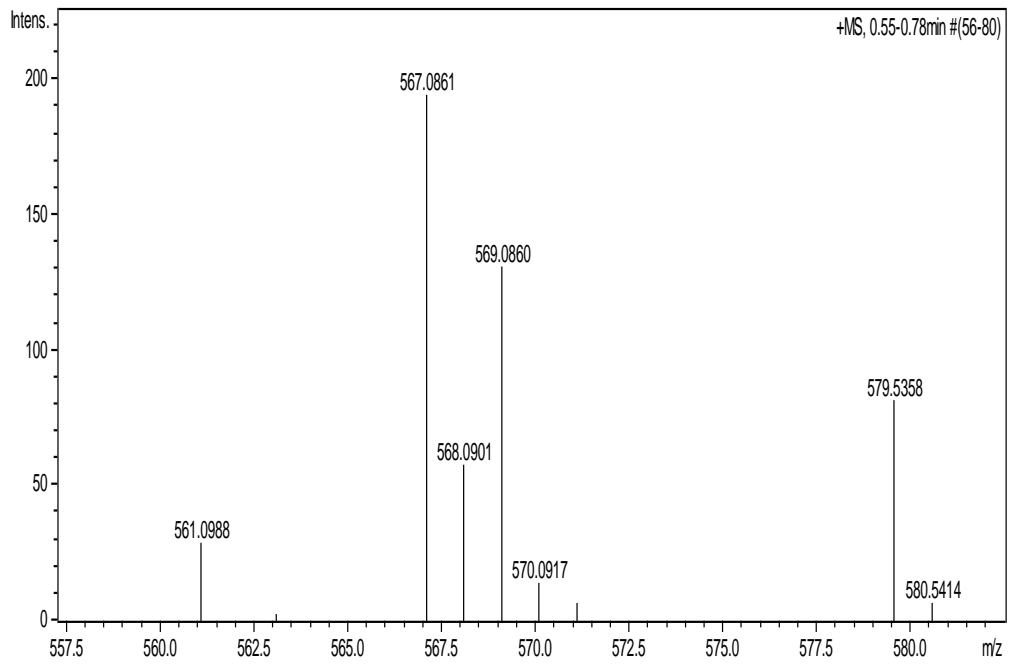
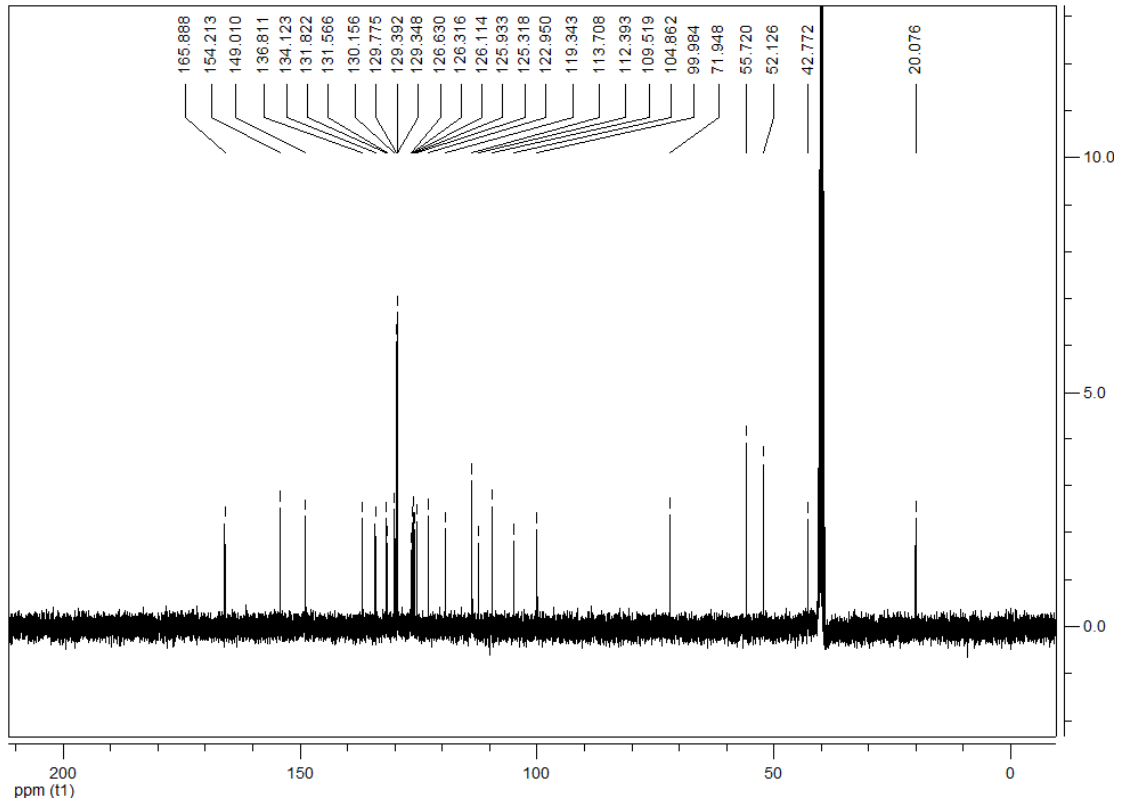


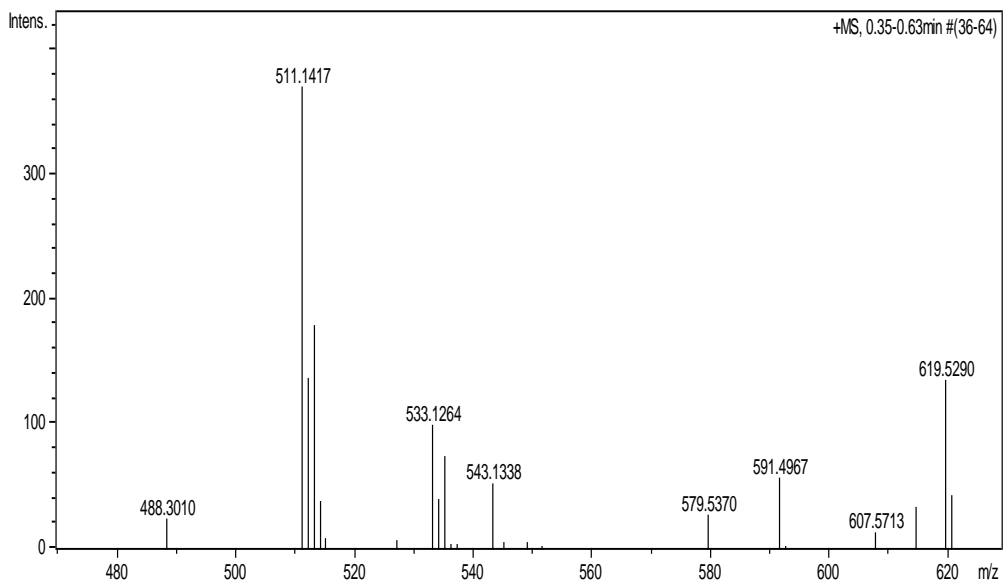
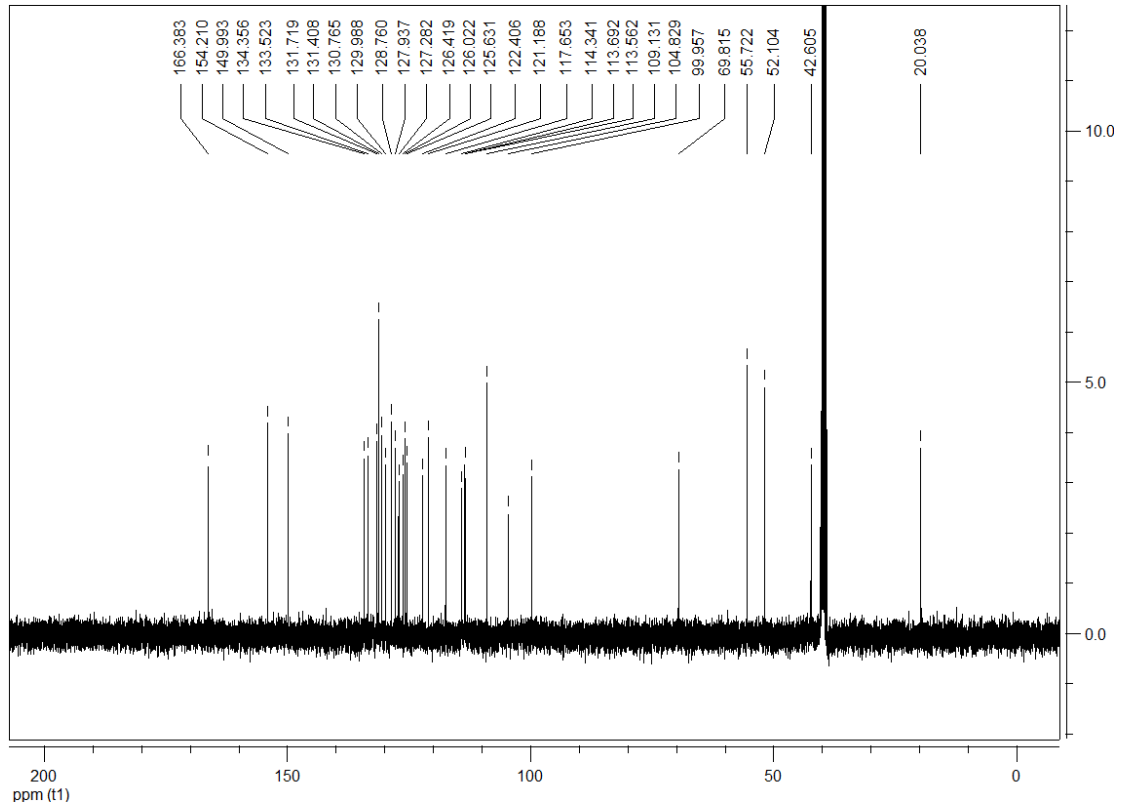
Methyl

2-chloro-6-(4-chlorophenyl)-11-methoxy-6,8,9,14-tetrahydrochromeno[4',3':2,3]indolizino[8,7-b]indole-15-carboxylate (II):

yellow solid, 76%, m.p. 231-232 °C; ^1H NMR (400 MHz, $\text{DMSO-}d_6$) δ : 10.80 (s, 1H, NH), 8.06 (d, $J = 2.4$ Hz, 1H, CH), 7.53 (d, $J = 9.2$ Hz, 1H, ArH), 7.40 (d, $J = 8.4$ Hz, 2H, ArH), 7.22 (d, $J = 8.4$ Hz, 2H, ArH), 6.86-6.79 (m, 3H, ArH), 4.35-4.32 (m, 1H, CH), 3.96 (s, 3H, OCH_3), 3.78 (s, 3H, OCH_3), 3.59-3.55 (m, 1H, CH), 3.10-3.05 (m, 2H, CH); ^{13}C NMR (100 MHz, $\text{DMSO-}d_6$) δ : 165.8, 154.2, 149.0, 136.8, 134.1, 131.8, 131.5, 130.1, 129.7, 129.3, 129.3, 126.6, 126.3, 126.1, 125.9, 125.3, 122.9, 119.3, 113.7, 112.3, 109.5, 104.8, 99.9, 71.9, 55.7, 52.1, 42.7, 20.0; MS (m/z): HRMS (ESI) Calcd. for $\text{C}_{30}\text{H}_{22}\text{Cl}_2\text{N}_2\text{O}_4\text{Na}$ ($[\text{M}+\text{Na}]^+$): 567.0849. Found: 567.0861; IR (KBr) ν : 3385, 2897, 1678, 1621, 1568, 1489, 1325, 871, 813, 733 cm^{-1} .



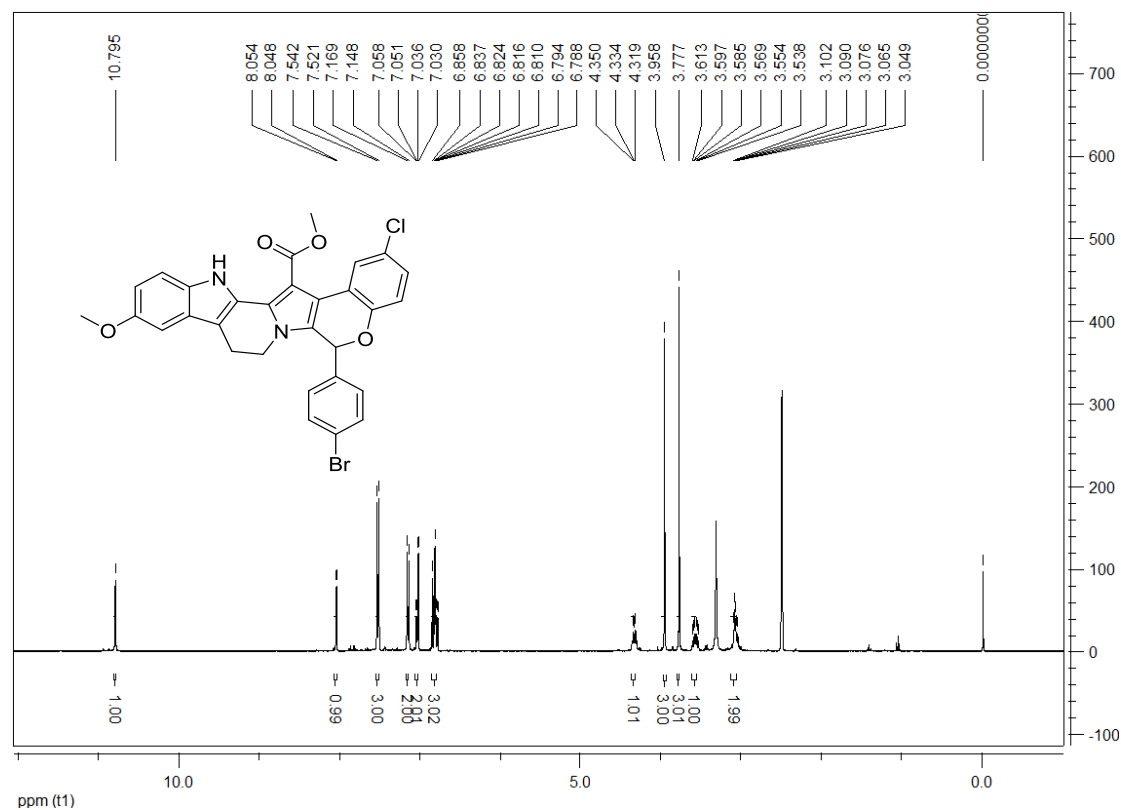


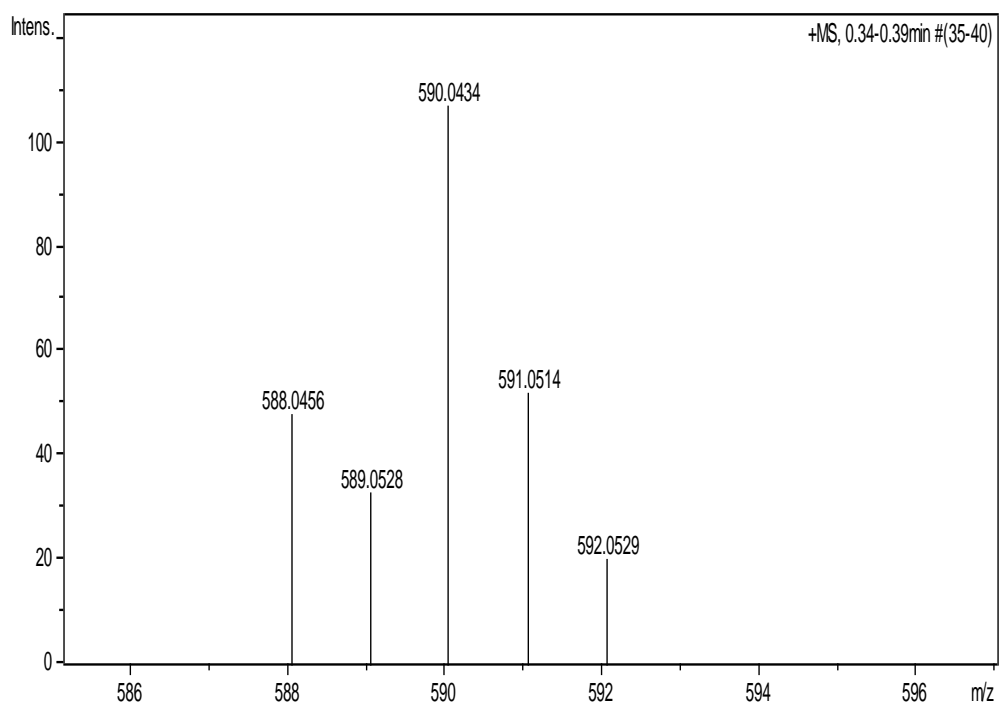
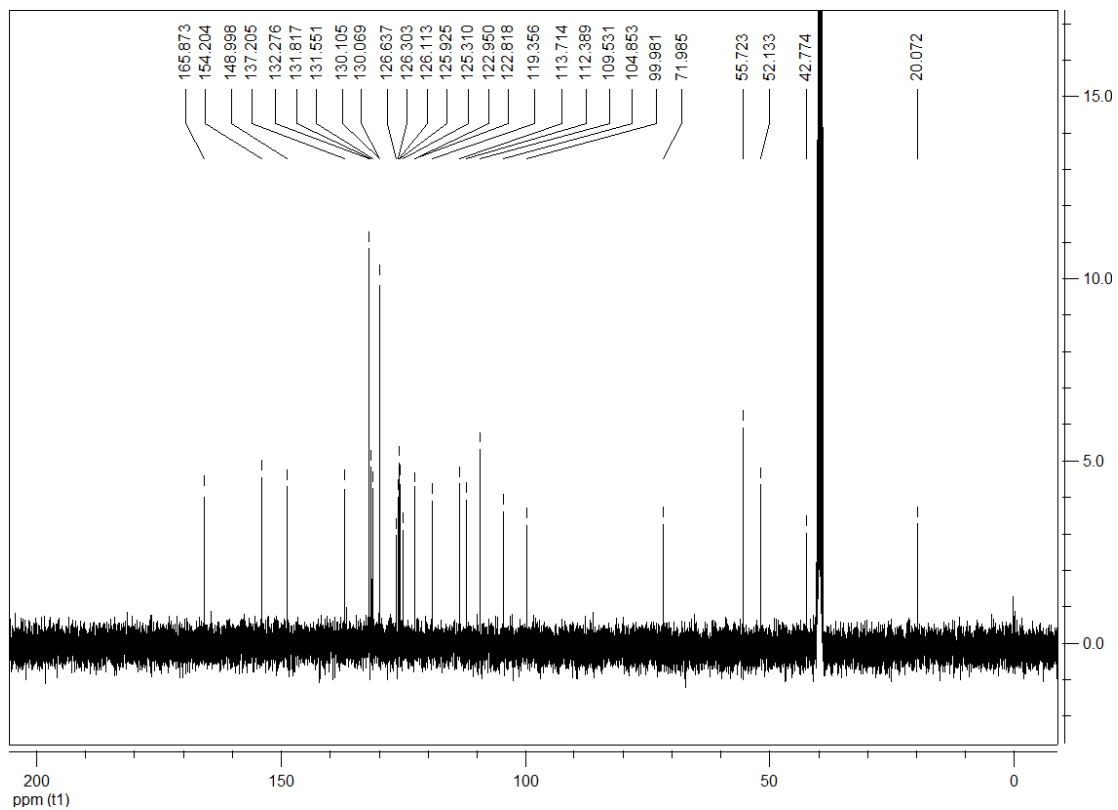


Methyl

6-(4-bromophenyl)-2-chloro-11-methoxy-6,8,9,14-tetrahydrochromeno[4',3':2,3]indolizino[8,7-b]indole-15-carboxylate (1n):

yellow solid, 89%, m.p. 237-239°C; $^1\text{H NMR}$ (400 MHz, $\text{DMSO-}d_6$) δ : 10.80 (s, 1H, NH), 8.05 (d, $J = 2.4$ Hz, 1H, CH), 7.53 (d, $J = 9.2$ Hz, 1H, ArH), 7.17-7.15 (m, 2H, ArH), 7.06-7.03 (m, 2H, ArH), 6.86-6.79 (m, 3H, ArH), 4.36-4.30 (m, 1H, CH), 3.96 (s, 3H, OCH_3), 3.78 (s, 3H, OCH_3), 3.61-3.53 (m, 1H, CH), 3.10-3.05 (m, 2H, CH); $^{13}\text{C NMR}$ (100 MHz, $\text{DMSO-}d_6$) δ : 165.7, 154.2, 149.7, 138.8, 134.8, 131.7, 131.6, 130.8, 129.8, 129.3, 128.0, 127.8, 126.3, 125.9, 123.6, 119.8, 113.6, 113.6, 113.6, 112.0, 109.2, 105.0, 99.9, 72.6, 61.2, 55.7, 42.7, 21.1, 20.0, 14.4; MS (m/z): HRMS (ESI) Calcd. for $\text{C}_{30}\text{H}_{23}\text{BrClN}_2\text{O}_4$ ($[\text{M}+\text{H}]^+$): 589.0524. Found: 589.0528; Found: 605.0717; IR (KBr) ν : 3385, 2939, 1678, 1623, 1568, 1488, 1325, 1284, 870, 810, 619 cm^{-1} .

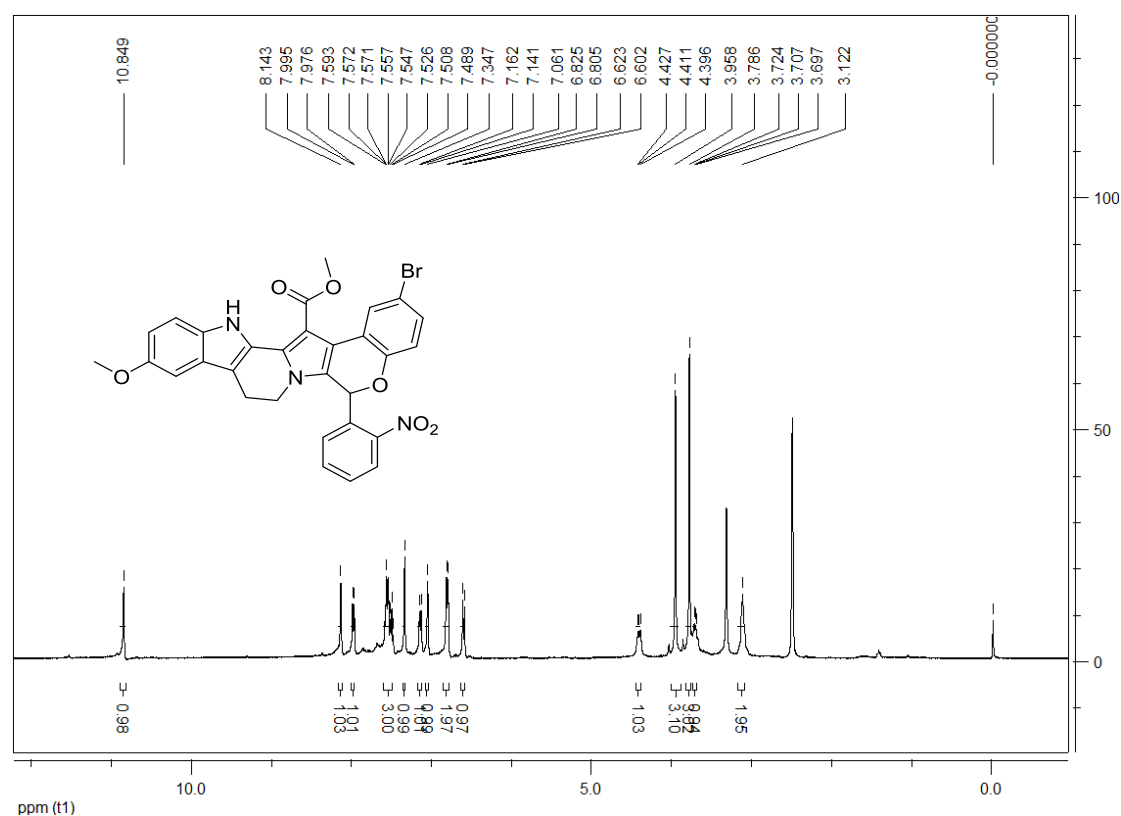


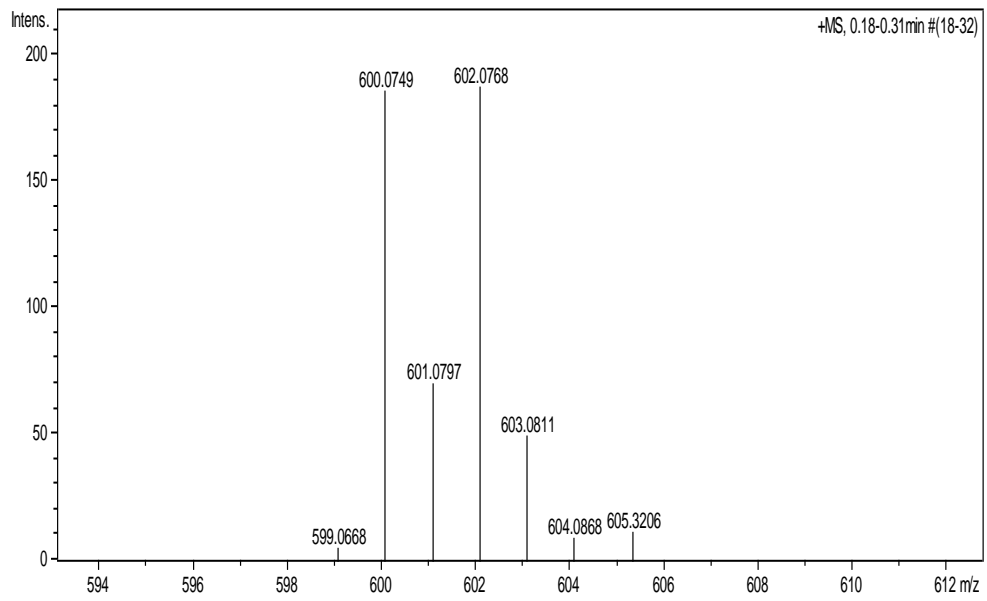
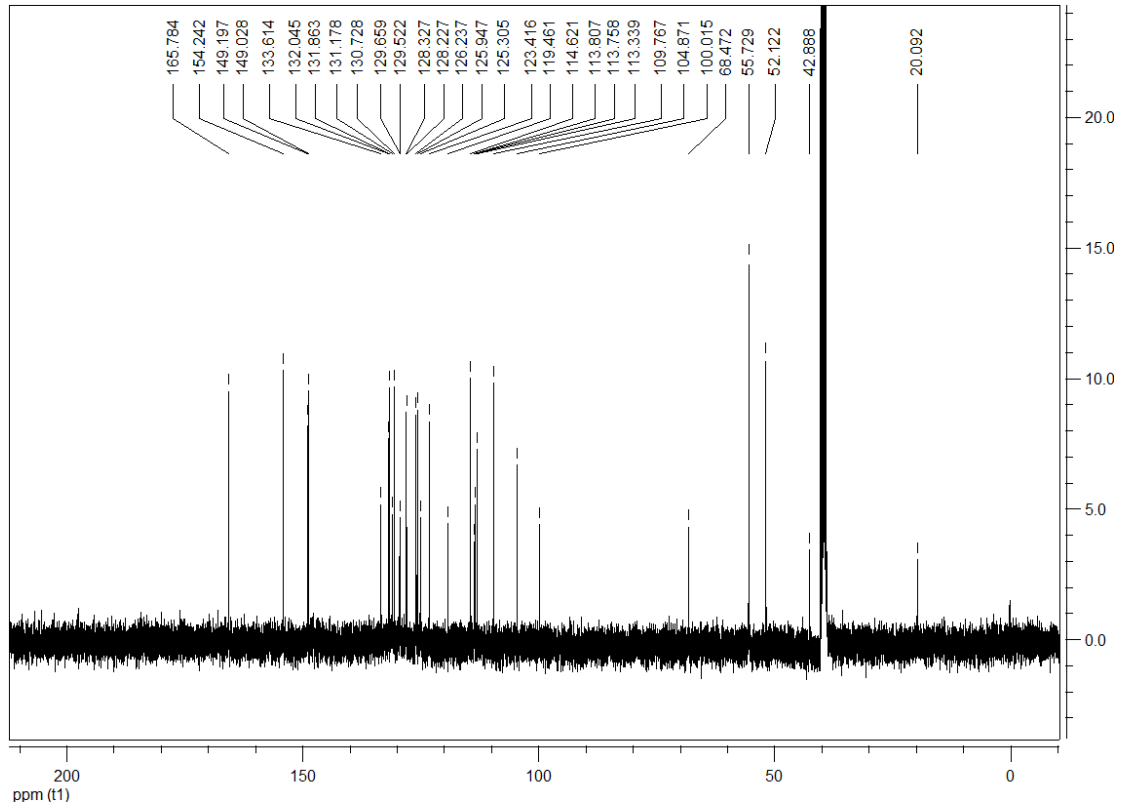


Methyl

2-bromo-11-methoxy-6-(2-nitrophenyl)-6,8,9,14-tetrahydrochromeno[4',3':2,3]indolizino[8,7-b]indole-15-carboxylate (1o):

yellow solid, 82%, m.p. 231-233 °C; $^1\text{H NMR}$ (400 MHz, $\text{DMSO-}d_6$) δ : 10.85 (s, 1H, NH), 8.14 (d, $J = 2.8$ Hz, 1H, CH), 7.99 (d, $J = 7.6$ Hz, 1H, ArH), 7.59-7.49 (m, 3H, ArH), 7.35 (s, 1H, ArH), 7.15 (d, $J = 8.4$ Hz, 1H, ArH), 7.06 (s, 1H, ArH), 6.82 (d, $J = 7.6$ Hz, 2H, ArH), 6.61 (d, $J = 8.4$ Hz, 1H, ArH), 4.44-4.40 (m, 1H, CH), 3.96 (s, 3H, OCH_3), 3.79 (s, 3H, OCH_3), 3.72-3.68 (m, 1H, CH), 3.12-3.09 (m, 2H, CH); $^{13}\text{C NMR}$ (100 MHz, $\text{DMSO-}d_6$) δ : 165.7, 154.2, 149.1, 149.0, 133.6, 132.0, 131.8, 131.1, 130.7, 129.6, 129.5, 128.3, 128.2, 126.2, 125.9, 125.3, 123.4, 119.4, 114.6, 113.8, 113.7, 113.3, 109.7, 104.8, 100.0, 68.4, 55.7, 52.1, 42.8, 20.0; MS (m/z): HRMS (ESI) Calcd. for $\text{C}_{30}\text{H}_{23}\text{BrN}_3\text{O}_6$ ($[\text{M}+\text{H}]^+$): 600.0765. Found: 600.0749; IR (KBr) ν : 3327, 2944, 1682, 1619, 1529, 1487, 1356, 1078, 790, 739, 624 cm^{-1} .

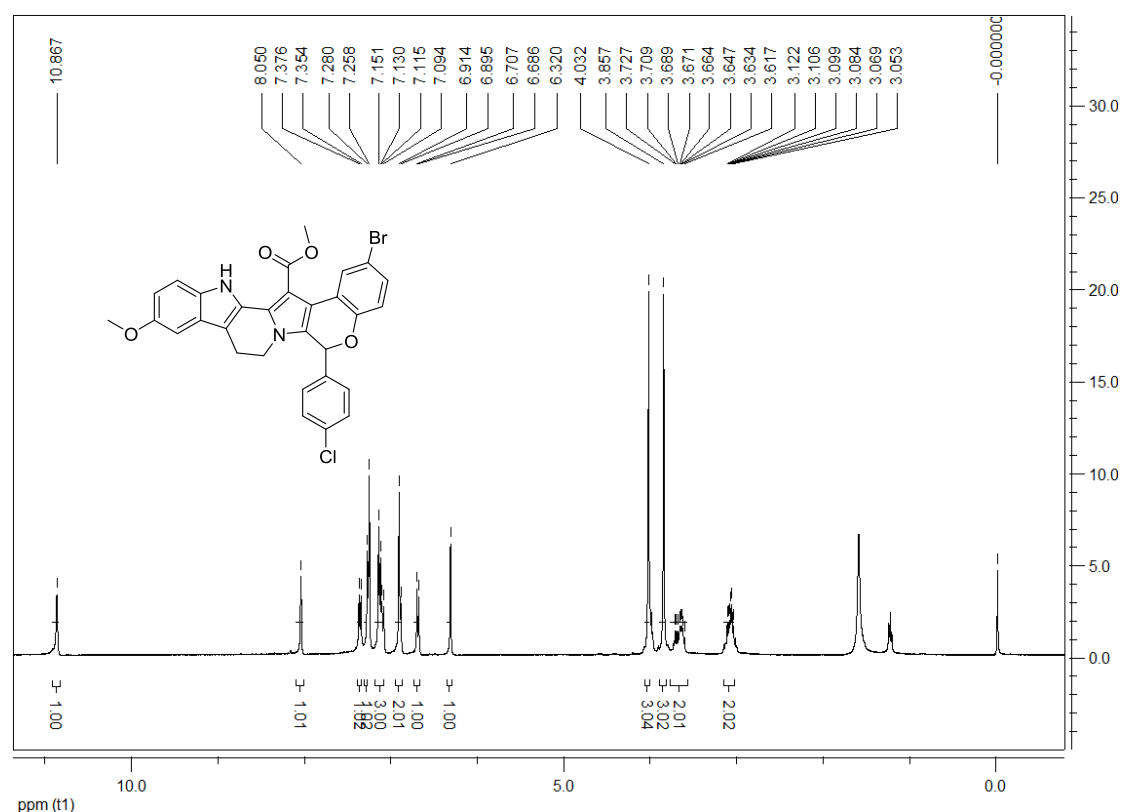


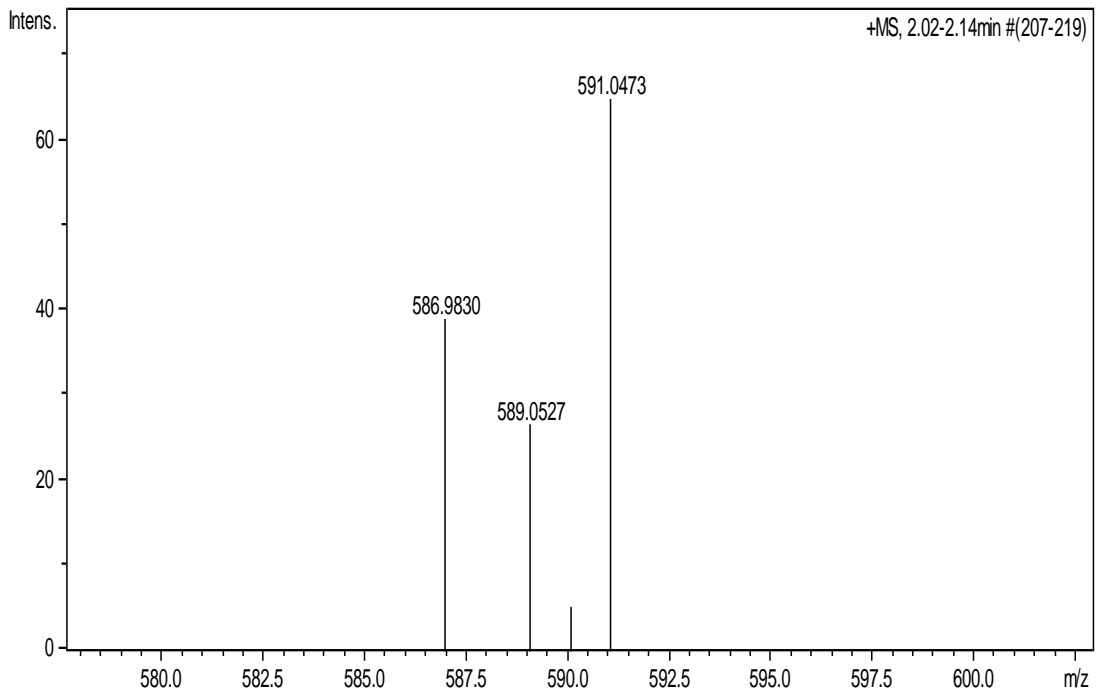
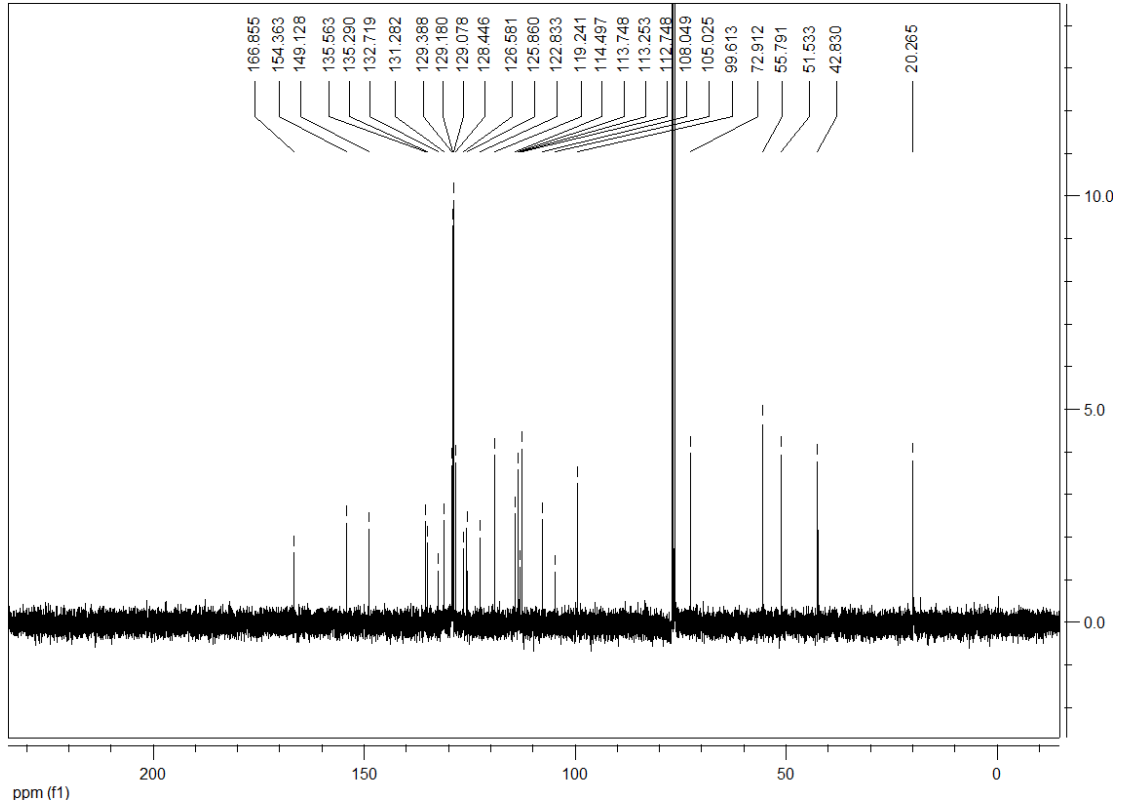


Methyl

2-bromo-6-(4-chlorophenyl)-11-methoxy-6,8,9,14-tetrahydrochromeno[4',3':2,3]indolizino[8,7-b]indole-15-carboxylate (1p):

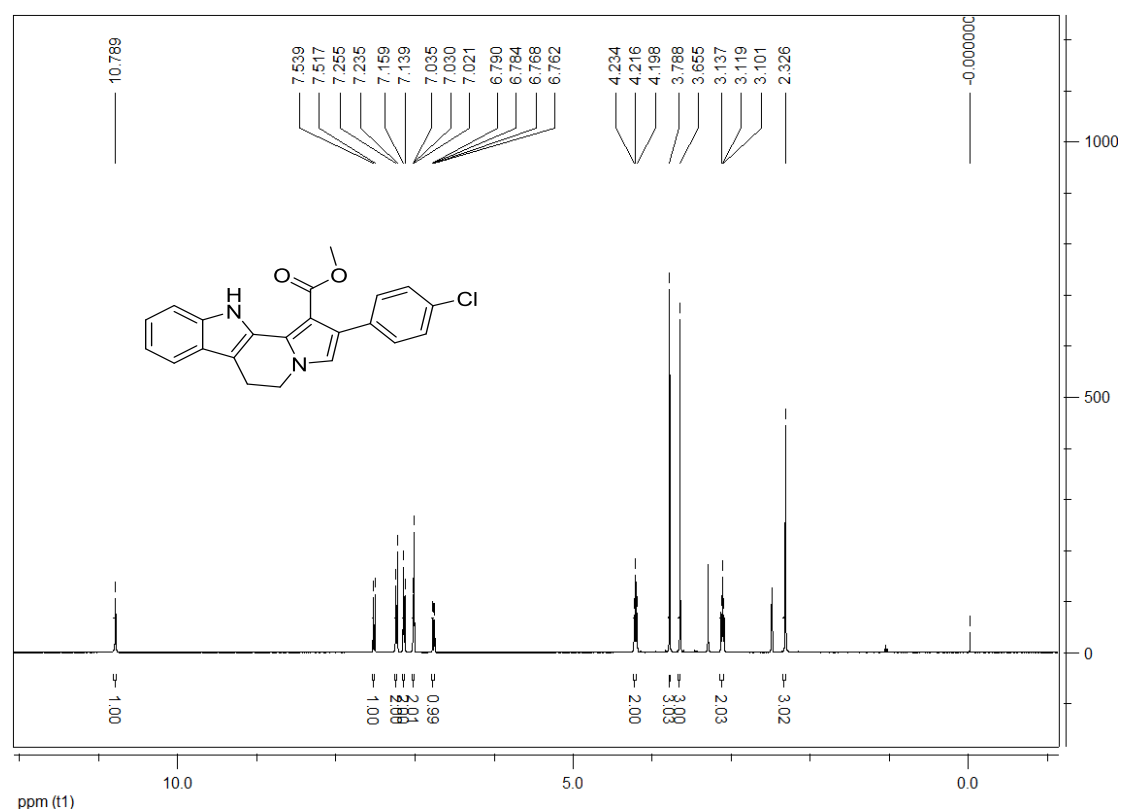
yellow solid, 87%, m.p. 227-228 °C; ^1H NMR (400 MHz, CDCl_3) δ : 10.87 (s, 1H, NH), 8.05 (s, 1H, ArH), 7.37-7.35 (m, 1H, ArH), 7.28-7.26 (m, 2H, ArH), 7.15-7.09 (m, 3H, ArH), 6.91-6.90 (m, 2H, ArH), 6.71-6.69 (m, 1H, ArH), 6.32 (s, 1H, CH), 4.03 (s, 3H, OCH_3), 3.86 (s, 3H, OCH_3), 3.73-3.63 (m, 2H, CH_2), 3.12-3.05 (m, 2H, CH_2); ^{13}C NMR (100 MHz, CDCl_3) δ : 166.8, 154.3, 149.1, 135.5, 135.2, 132.7, 131.2, 129.3, 129.1, 129.0, 128.4, 126.5, 125.8, 122.8, 119.2, 114.4, 113.7, 113.2, 112.7, 108.0, 105.0, 99.6, 72.9, 55.7, 51.5, 42.8, 20.2; MS (m/z): HRMS (ESI) Calcd. for $\text{C}_{30}\text{H}_{23}\text{BrClN}_2\text{O}_4$ ($[\text{M}+\text{H}]^+$): 589.0524. Found: 589.0527; IR (KBr) ν : 3321, 2939, 1682, 1619, 1487, 1346, 1077, 739 cm^{-1} .

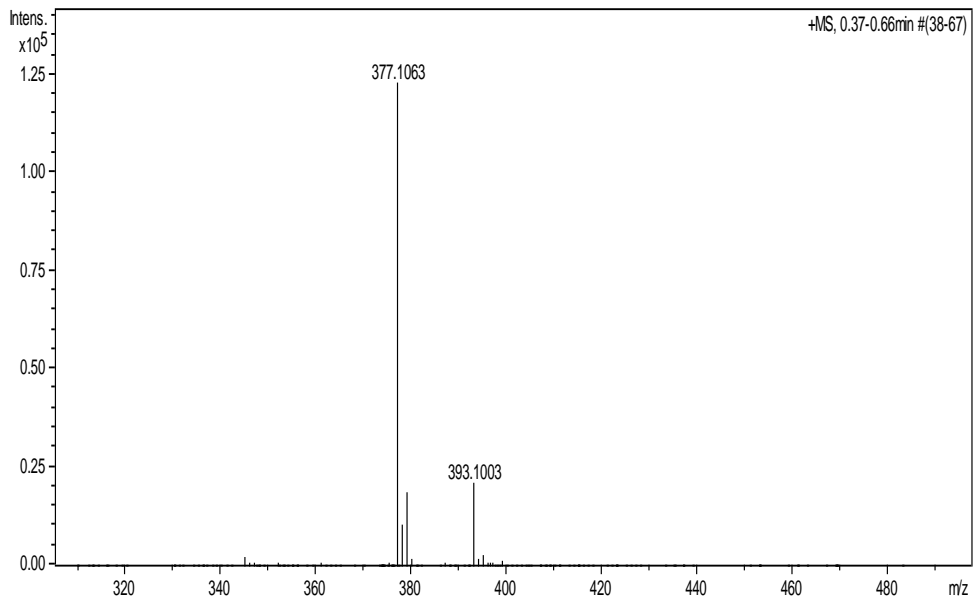
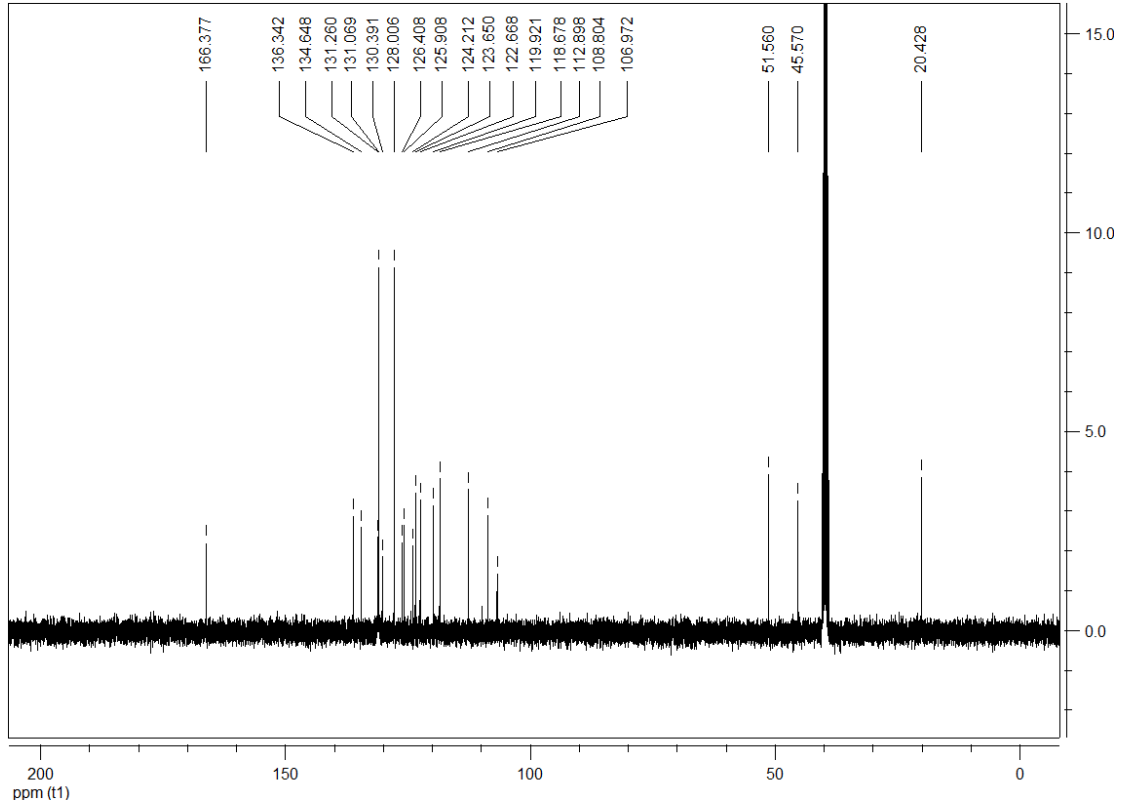




Methyl 2-(4-chlorophenyl)-6,11-dihydro-5H-indolizino[8,7-b]indole-1-carboxylate (2a):

Light yellow solid, 79%, m.p. 176-178°C; ¹H NMR (400 MHz, DMSO-*d*₆) δ: 10.93 (s, 1H, NH), 7.64 (d, *J* = 8.0 Hz, 1H, ArH), 7.55 (d, *J* = 7.6 Hz, 1H, ArH), 7.42-7.37 (m, 4H, ArH), 7.16-7.12 (m, 2H, ArH), 7.08-7.04 (m, 1H, ArH), 4.24 (t, *J* = 7.2 Hz, 2H, CH), 3.68 (s, 3H, OCH₃), 3.12 (t, *J* = 7.2 Hz, 2H, CH); ¹³C NMR (100 MHz, DMSO-*d*₆) δ: 166.3, 136.3, 134.6, 131.2, 131.0, 130.3, 128.0, 126.4, 125.9, 124.2, 123.6, 122.6, 119.9, 118.6, 112.8, 108.8, 106.9, 51.5, 45.5, 20.4; MS (*m/z*): HRMS (ESI) Calcd. for C₂₂H₁₈ClN₂O₂ ([M+H]⁺): 377.1051. Found: 377.1063; IR (KBr) ν: 3374, 2932, 2839, 1688, 1611, 1529, 1456, 1364, 1127, 1033, 927, 822, 747 cm⁻¹.



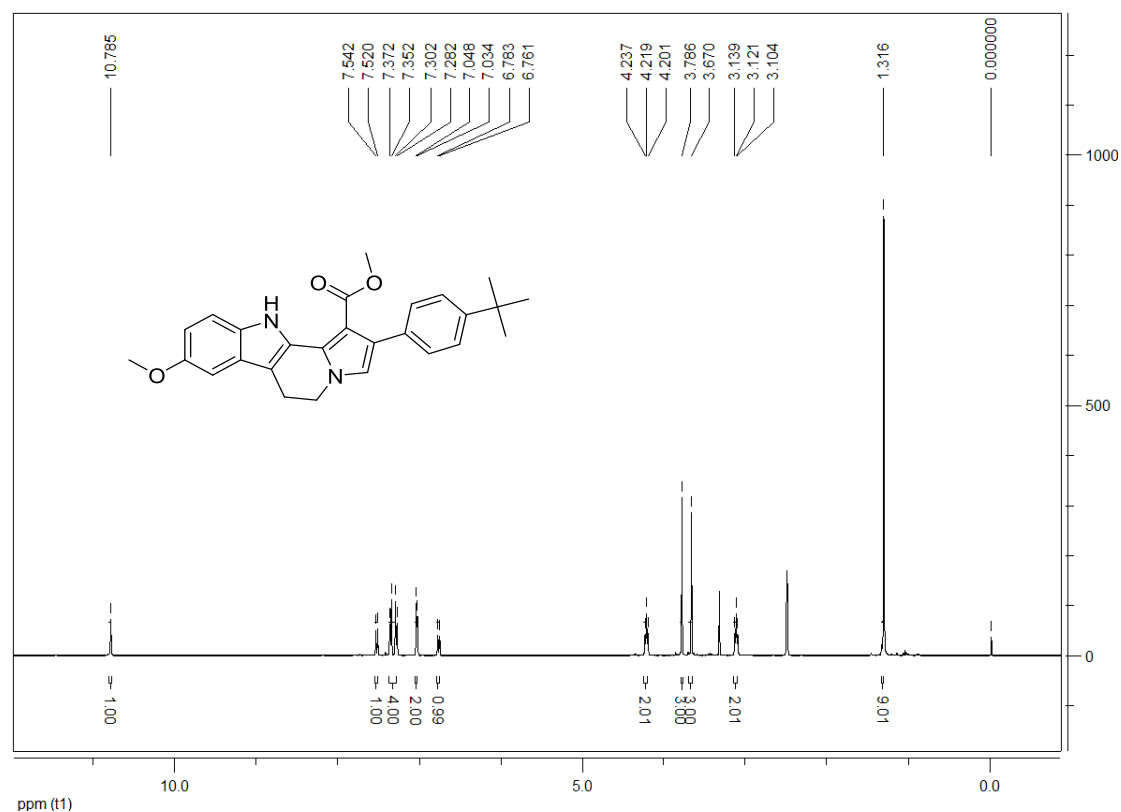


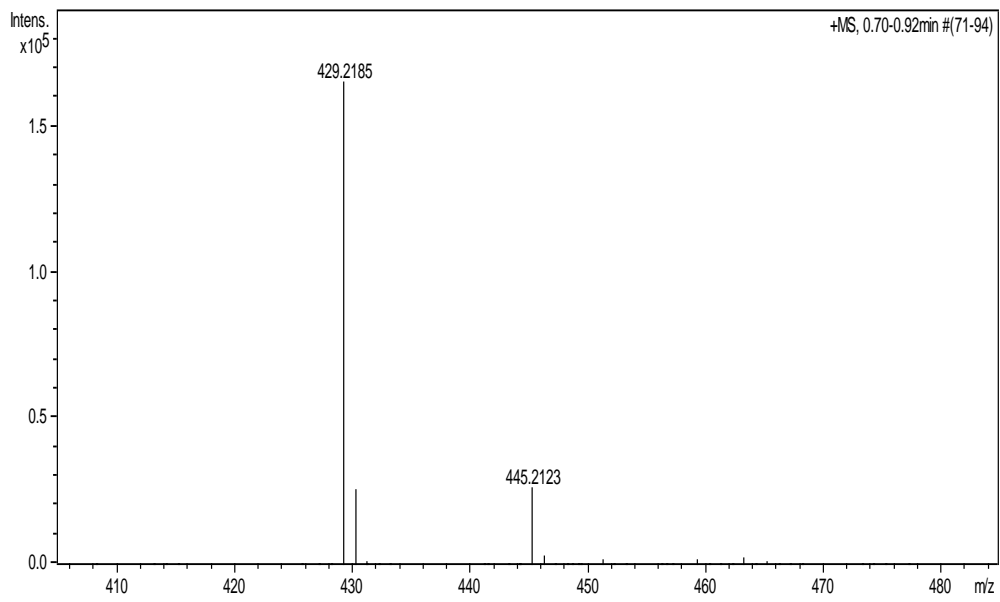
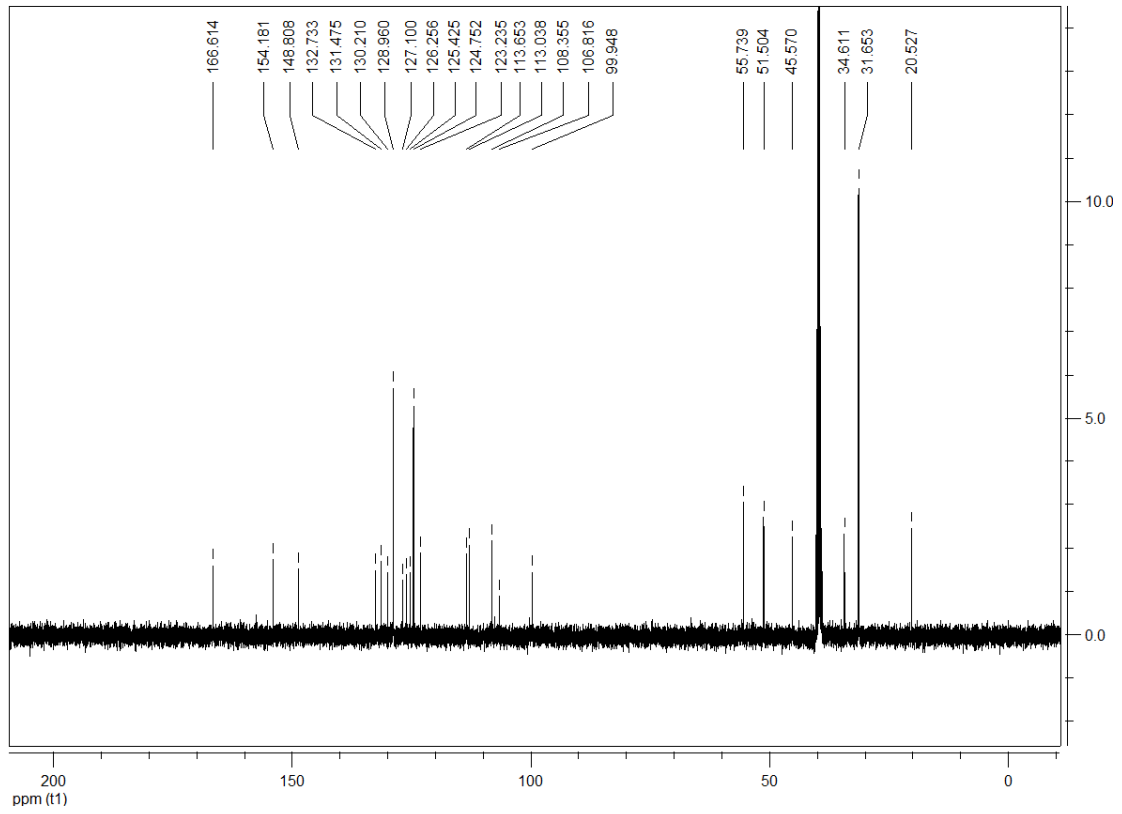
Methyl

2-(4-(tert-butyl)phenyl)-8-methoxy-6,11-dihydro-5H-indolizino[8,7-b]indole-1-carboxylate

(2b):

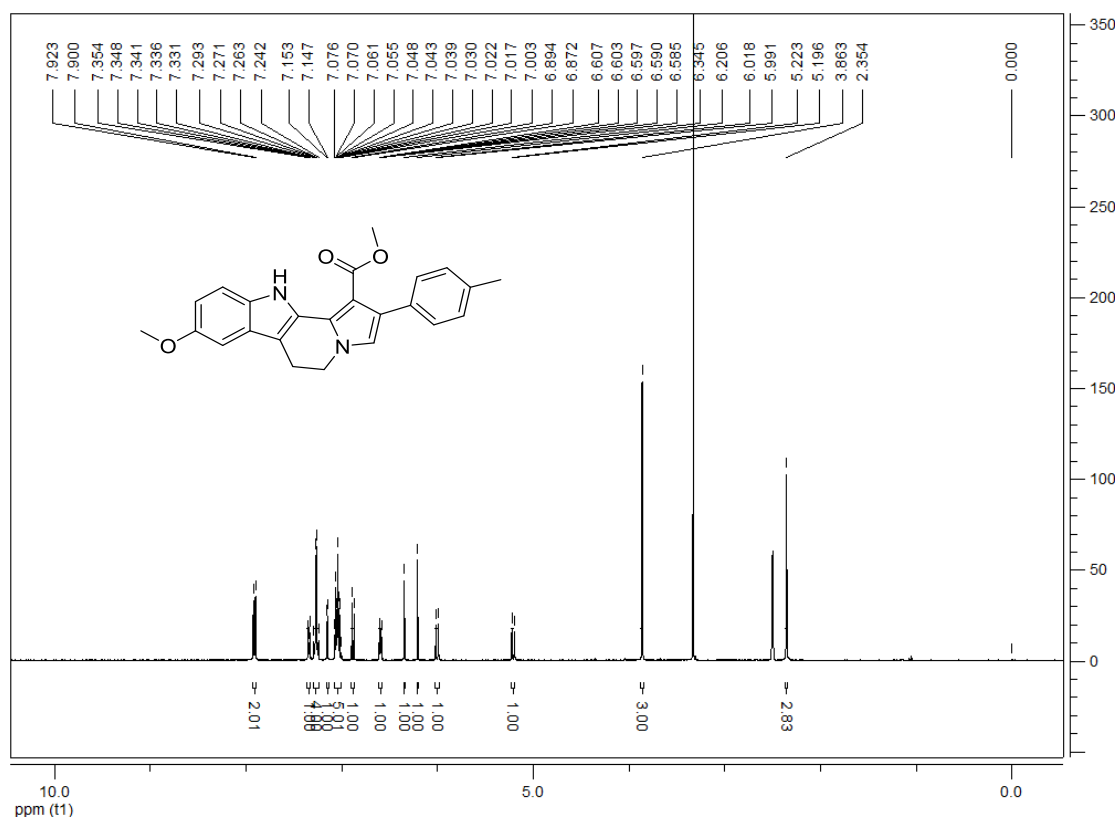
Light yellow solid, 91%, m.p. 183-185°C; ¹H NMR (400 MHz, DMSO-*d*₆) δ: 10.79 (s, 1H, NH), 7.53 (d, *J* = 8.8 Hz, 1H, ArH), 7.36 (d, *J* = 8.0 Hz, 2H, ArH), 7.29 (d, *J* = 8.0 Hz, 2H, ArH), 7.05-7.03 (m, 2H, ArH), 6.77 (d, *J* = 8.8 Hz, 1H, ArH), 4.22 (t, *J* = 7.2 Hz, 2H, CH), 3.79 (s, 3H, OCH₃), 3.67 (s, 3H, OCH₃), 3.12 (t, *J* = 7.2 Hz, 2H, CH), 1.32 (s, 9H, C(CH₃)₃); ¹³C NMR (100 MHz, DMSO-*d*₆) δ: 166.6, 154.1, 148.8, 132.7, 131.4, 130.2, 128.9, 127.1, 126.2, 125.4, 124.7, 123.2, 113.6, 113.0, 108.3, 106.8, 99.9, 55.7, 51.5, 45.5, 34.6, 31.6, 20.5; MS (*m/z*): HRMS (ESI) Calcd. for C₂₇H₂₉N₂O₃ ([M+H]⁺): 429.2173. Found: 429.2185; IR (KBr) ν: 3390, 3013, 2968, 1685, 1529, 1456, 1364, 1306, 1250, 1033, 927, 822, 747 cm⁻¹.

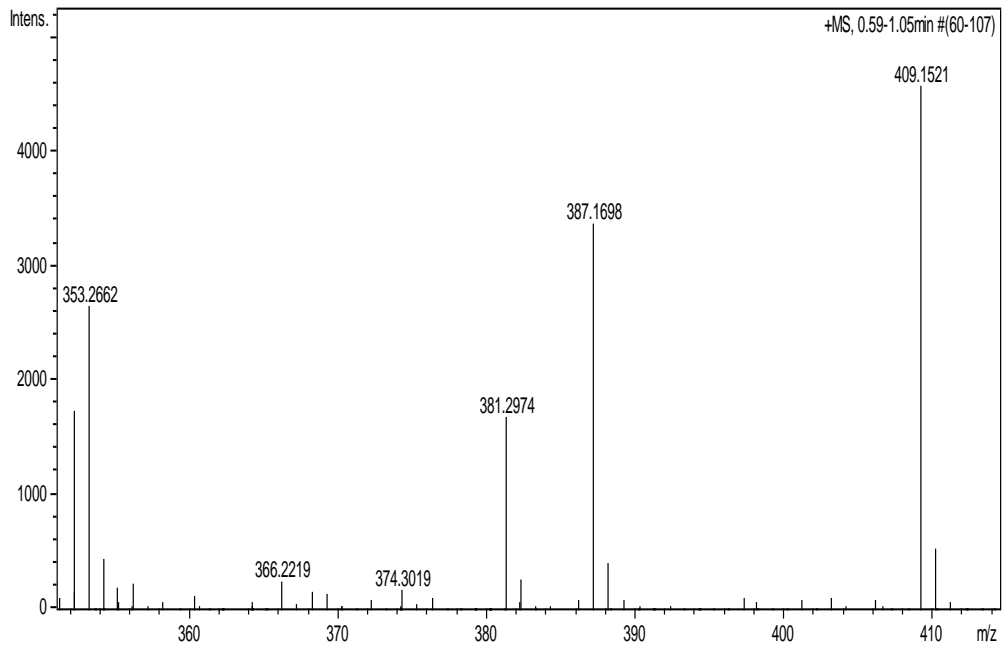
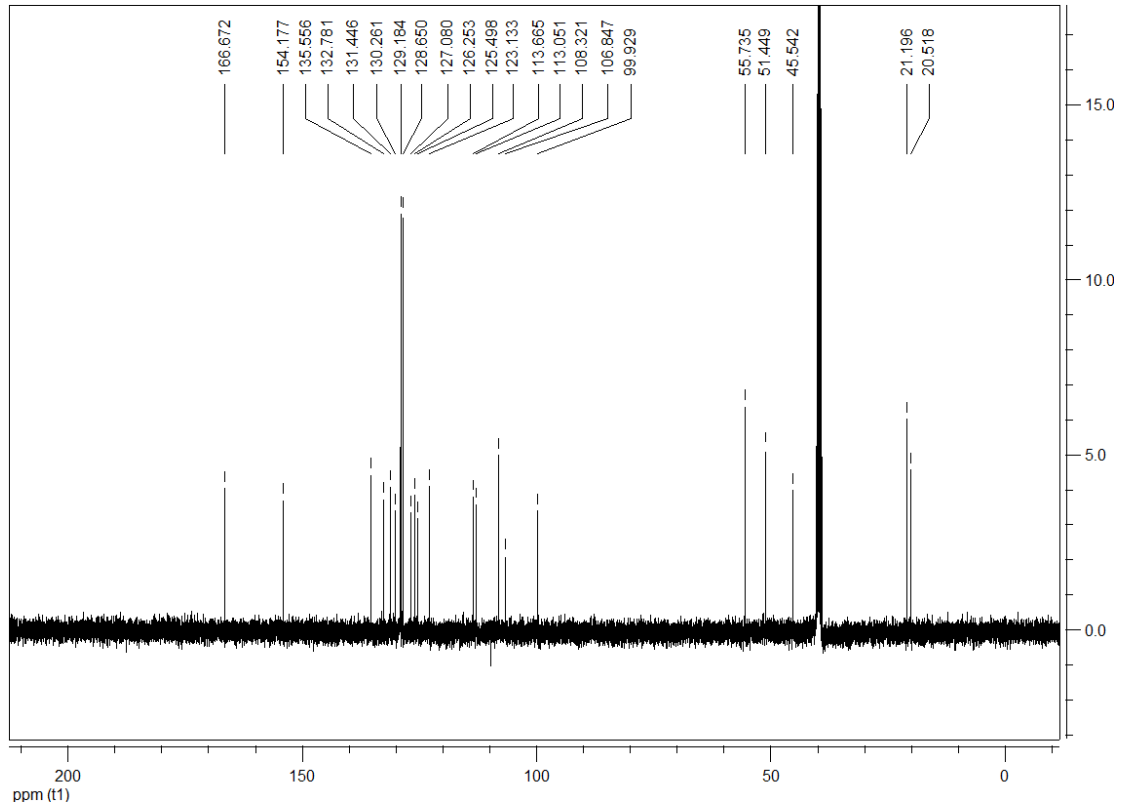




Methyl 8-methoxy-2-(p-tolyl)-6,11-dihydro-5H-indolizino[8,7-b]indole-1-carboxylate (2c):

grew solid, 85%, m.p. 196-198°C; ¹H NMR (400 MHz, DMSO-*d*₆) δ: 10.79 (s, 1H, NH), 7.53 (d, *J* = 8.8 Hz, 1H, ArH), 7.24 (d, *J* = 8.0 Hz, 2H, ArH), 7.15 (d, *J* = 8.0 Hz, 2H, ArH), 7.04-7.02 (m, 2H, ArH), 6.79-6.76 (m, 1H, ArH), 4.22 (t, *J* = 7.2 Hz, 2H, CH), 3.79 (s, 3H, OCH₃), 3.66 (s, 3H, OCH₃), 3.12 (t, *J* = 7.2 Hz, 2H, CH), 2.33 (s, 3H, CH₃); ¹³C NMR (100 MHz, DMSO-*d*₆) δ: 166.6, 154.1, 135.5, 132.7, 131.4, 130.2, 129.1, 128.6, 127.0, 126.2, 125.4, 123.1, 113.6, 113.0, 108.3, 106.8, 99.9, 55.7, 51.4, 45.5, 21.1, 20.5; MS (*m/z*): HRMS (ESI) Calcd. for C₂₄H₂₃N₂O₃ ([M+H]⁺): 387.1703. Found: 387.1698; IR (KBr) ν: 3386, 2932, 2839, 1688, 1611, 1529, 1456, 1364, 1306, 1250, 1176, 1033, 927, 822, 747 cm⁻¹.



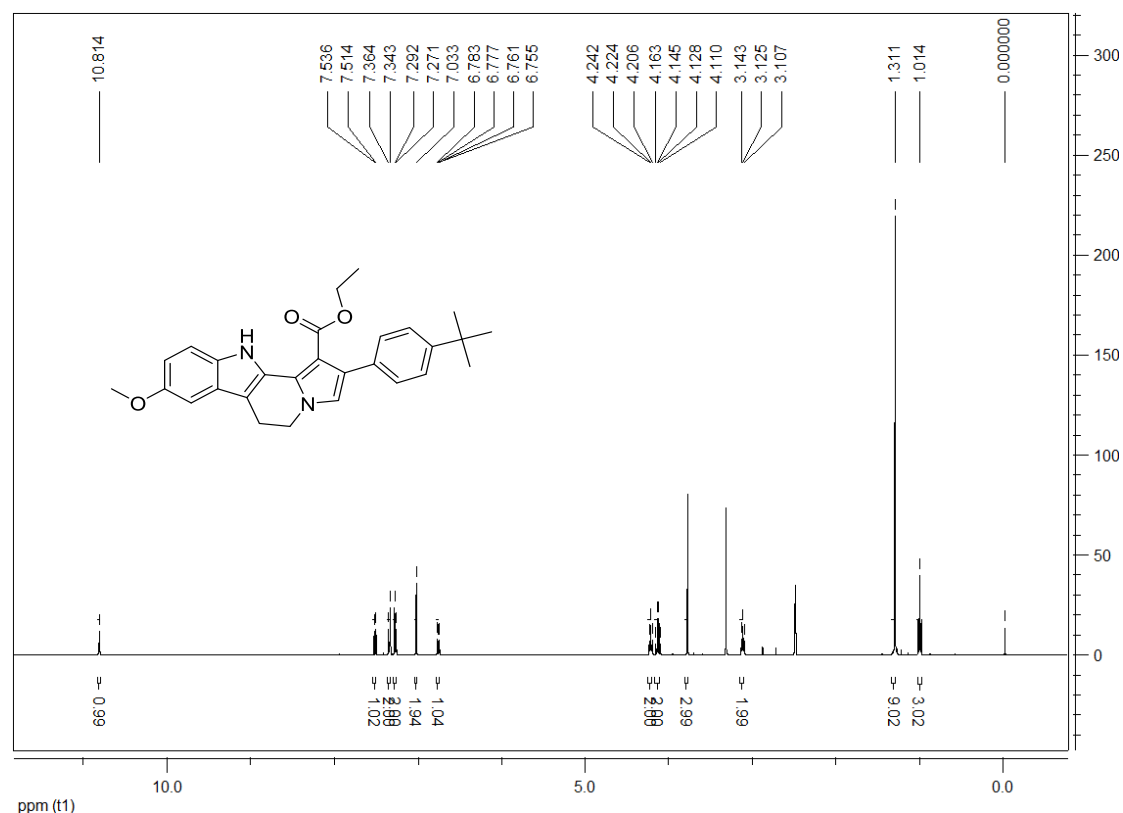


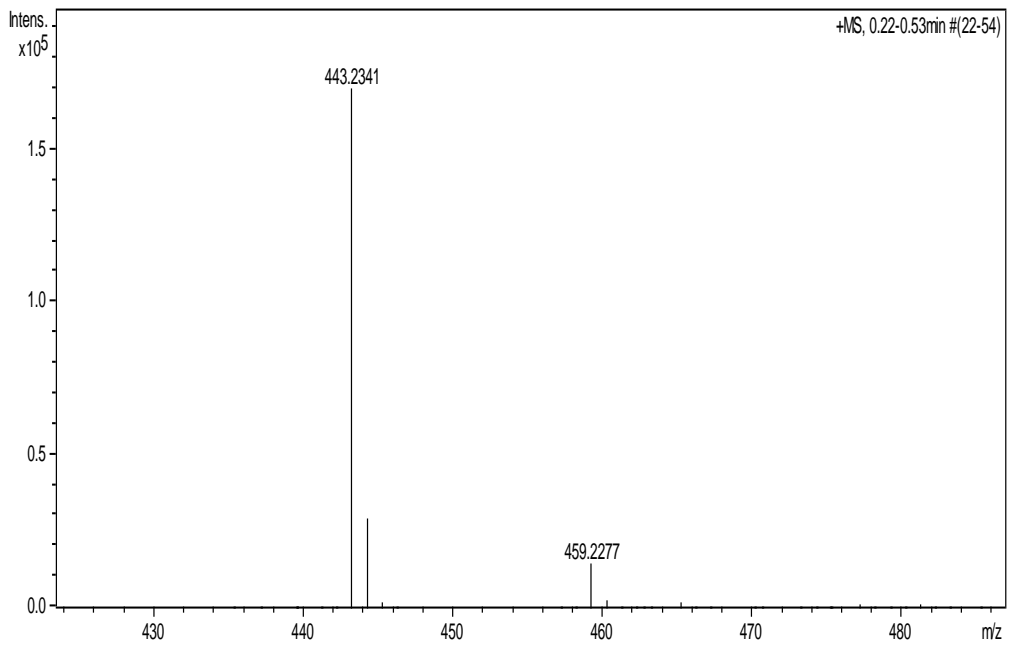
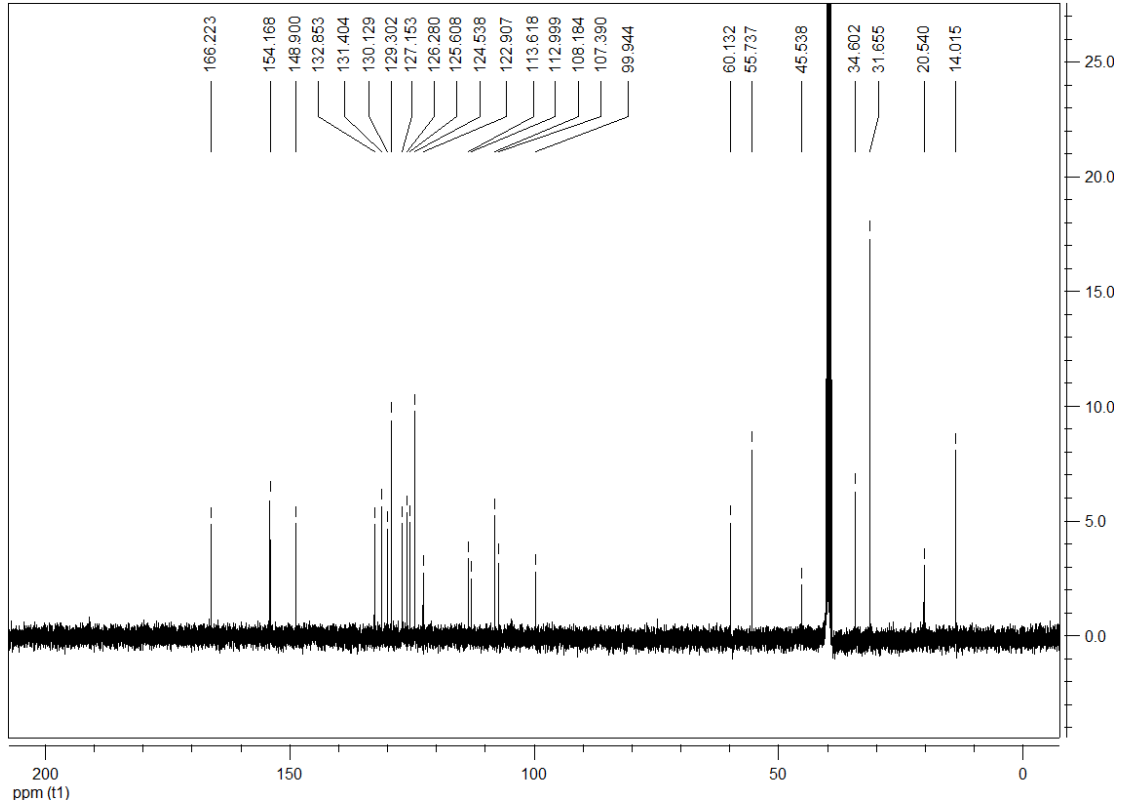
Ethyl

2-(4-(tert-butyl)phenyl)-8-methoxy-6,11-dihydro-5H-indolizino[8,7-b]indole-1-carboxylate

(2d):

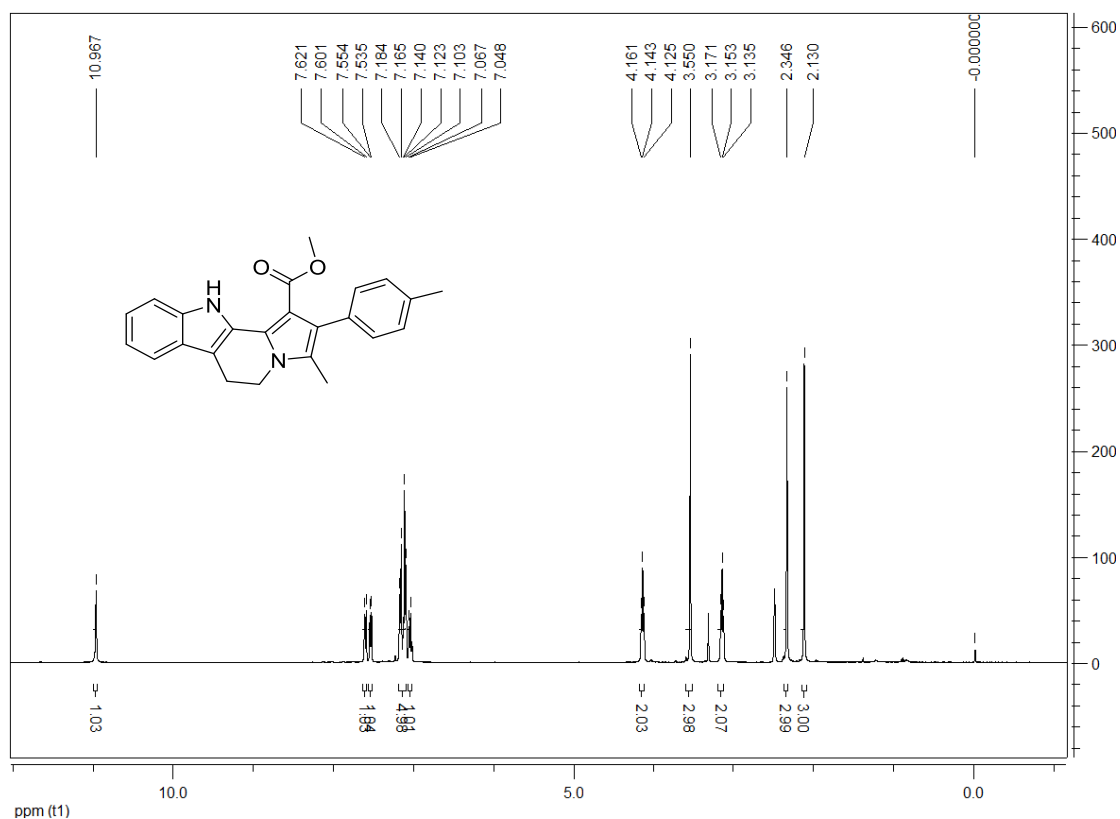
yellow solid, 83%, m.p. 182-184 °C; $^1\text{H NMR}$ (400 MHz, $\text{DMSO-}d_6$) δ : 10.81 (s, 1H, NH), 7.52 (d, $J = 8.8$ Hz, 1H, ArH), 7.35 (d, $J = 8.0$ Hz, 2H, ArH), 7.28 (d, $J = 8.0$ Hz, 2H, ArH), 7.03 (s, 2H, ArH), 6.77 (dd, $J_1 = 8.8$ Hz, $J_2 = 2.4$ Hz, 1H, ArH), 4.22 (t, $J = 7.2$ Hz, 2H, CH), 4.14 (dd, $J_1 = 14$ Hz, $J_2 = 7.6$ Hz, 2H, OCH_2), 3.79 (s, 3H, OCH_3), 3.12 (t, $J = 7.2$ Hz, 2H, CH), 1.31 (s, 9H, $\text{C}(\text{CH}_3)_3$), 1.01 (t, $J = 7.2$ Hz, 3H, CH_3); $^{13}\text{C NMR}$ (100 MHz, $\text{DMSO-}d_6$) δ : 166.2, 154.1, 148.8, 132.8, 131.4, 130.1, 129.3, 127.1, 126.2, 125.6, 124.5, 122.9, 113.6, 112.9, 108.1, 107.3, 99.9, 60.1, 55.7, 45.5, 34.6, 31.6, 20.5, 14.0; MS (m/z): HRMS (ESI) Calcd. for $\text{C}_{28}\text{H}_{31}\text{N}_2\text{O}_3$ ($[\text{M}+\text{H}]^+$): 443.2329. Found: 443.2431; IR (KBr) ν : 3452, 3027, 2987, 2968, 1679, 1580, 1364, 1306, 1250, 1176, 1127, 1033, 927, 822, 747 cm^{-1} .

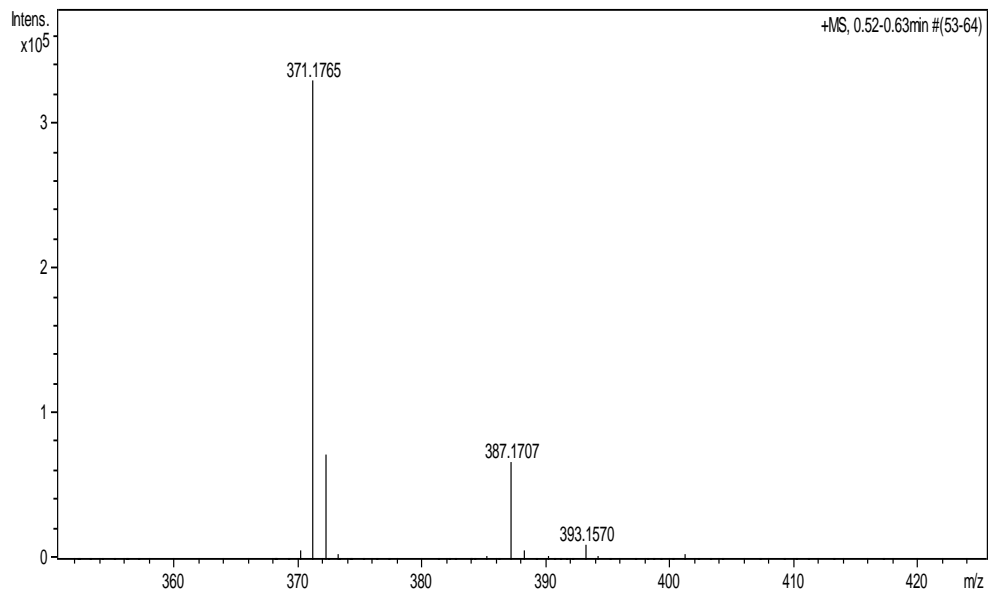
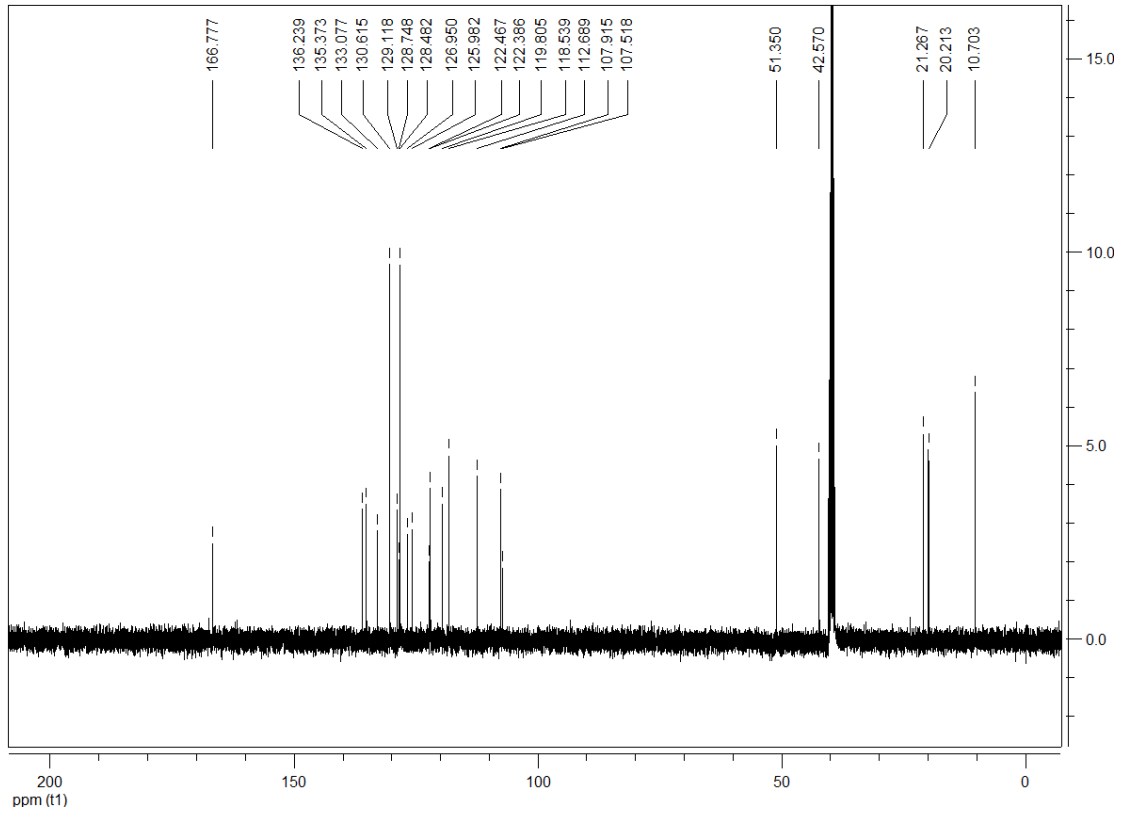




Methyl 3-methyl-2-(p-tolyl)-6,11-dihydro-5H-indolizino[8,7-b]indole-1-carboxylate (2e):

yellow solid, 69%, m.p. 193-195 °C; ¹H NMR (400 MHz, DMSO-*d*₆) δ: 10.97 (s, 1H, NH), 7.61 (d, *J* = 8.0 Hz, 1H, ArH), 7.54 (d, *J* = 7.6 Hz, 1H, ArH), 7.18-7.10 (m, 5H, ArH), 7.07-7.03 (m, 2H, ArH), 4.14 (t, *J* = 7.2 Hz, 2H, CH), 3.55 (s, 3H, OCH₃), 3.15 (t, *J* = 7.2 Hz, 2H, CH), 2.35 (s, 1H, CH₃), 2.13 (s, 3H, CH₃); ¹³C NMR (100 MHz, CDCl₃) δ: 166.7, 136.2, 135.3, 133.0, 130.6, 129.1, 128.7, 128.4, 126.9, 125.9, 122.4, 122.3, 119.8, 118.5, 112.6, 107.9, 107.5, 51.3, 42.5, 21.2, 20.2, 10.7; MS (*m/z*): HRMS (ESI) Calcd. for C₂₄H₂₃N₂O₂ ([M+H]⁺): 371.1754. Found: 371.1765; IR (KBr) ν: 3381, 3019, 2922, 1688, 1608, 1540, 1484, 1359, 1233, 1034, 929, 853, 816, 754 cm⁻¹.

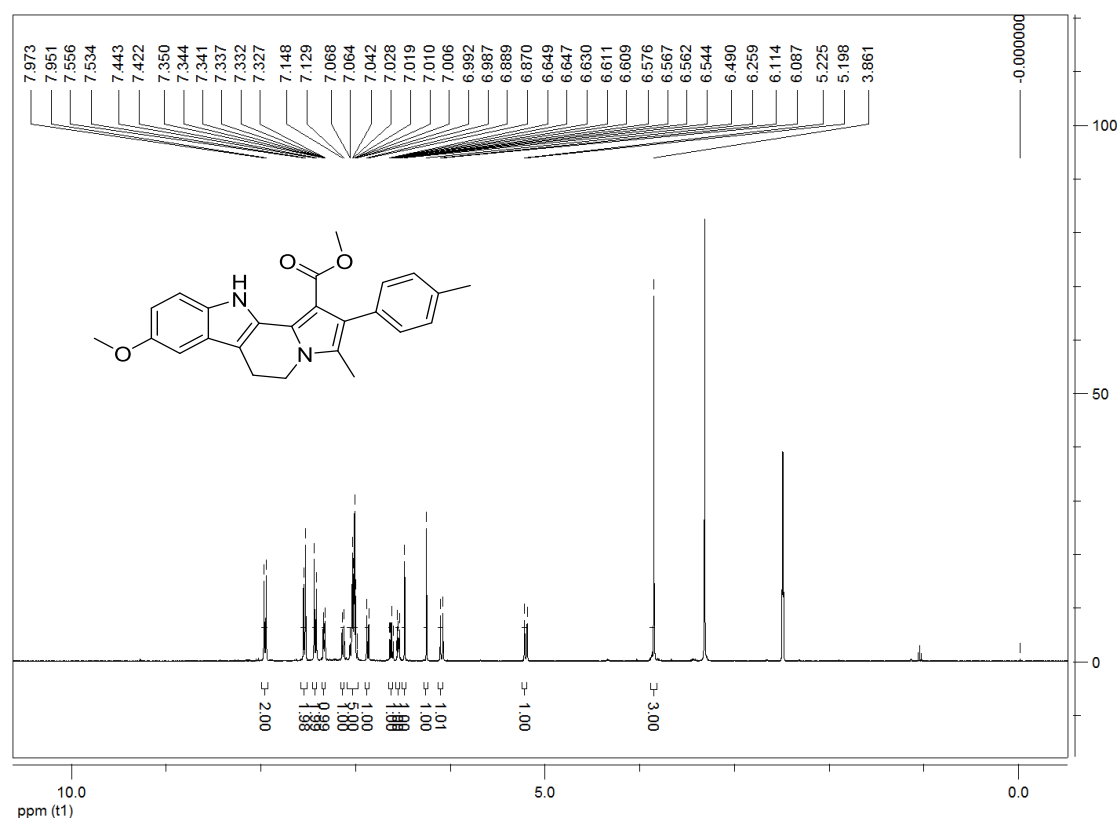


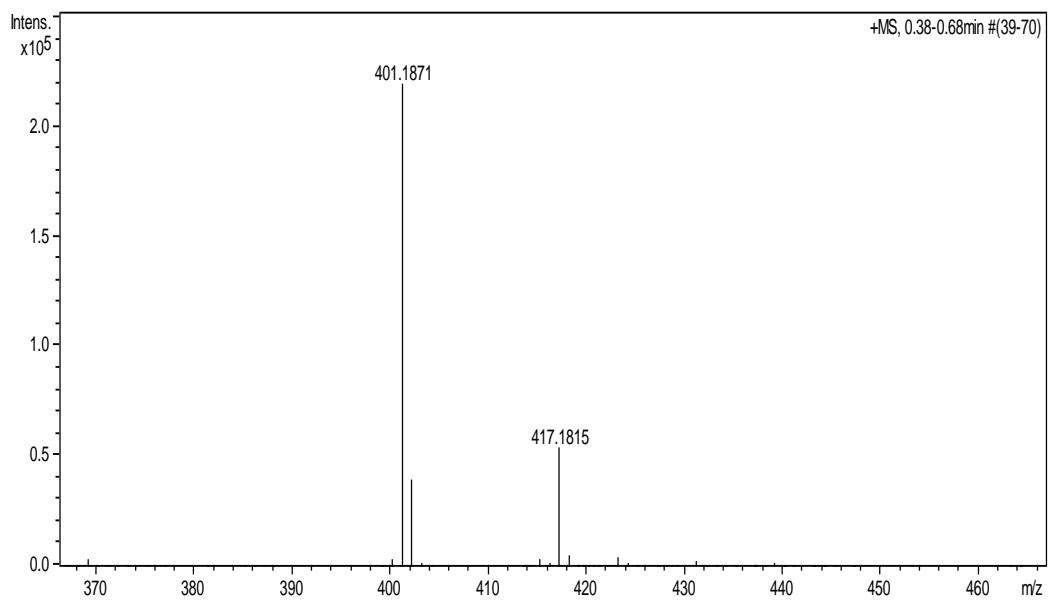
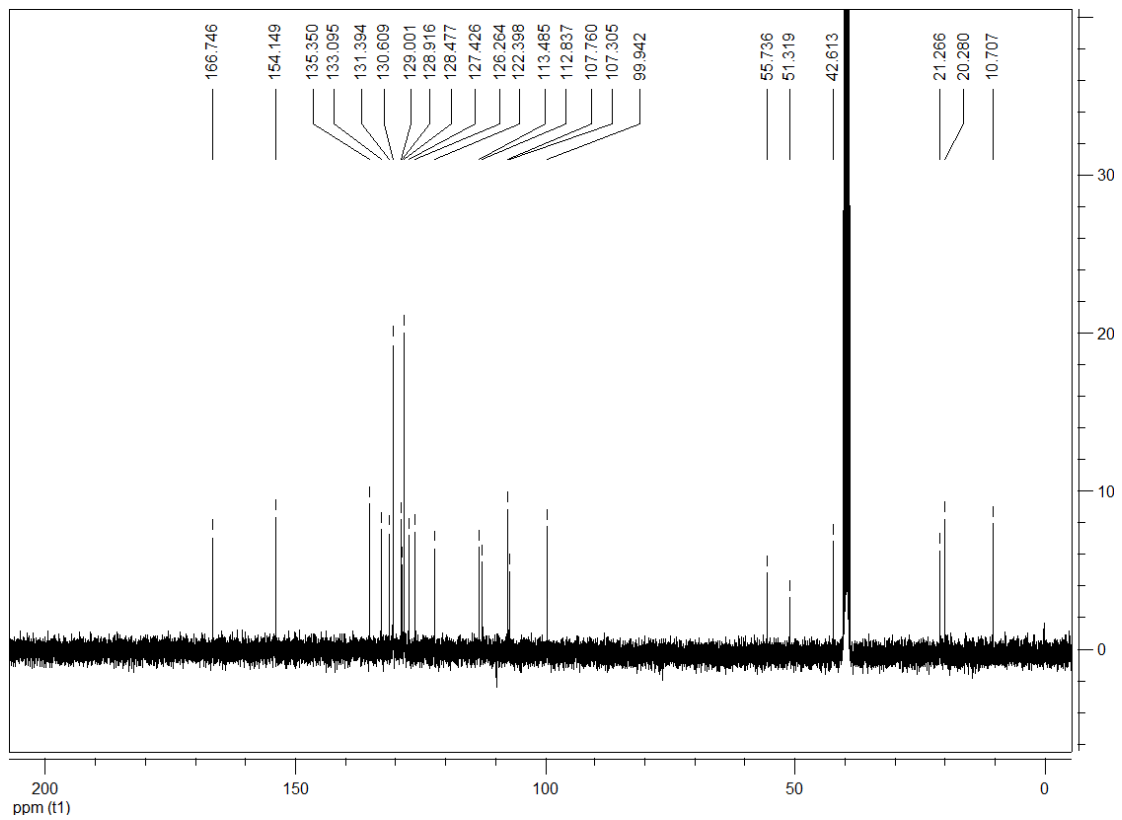


Methyl

8-methoxy-3-methyl-2-(p-tolyl)-6,11-dihydro-5H-indolizino[8,7-b]indole-1-carboxylate (2f):

yellow solid, 82%, m.p. 223-225 °C; ^1H NMR (400 MHz, $\text{DMSO-}d_6$) δ : 10.84 (s, 1H, NH), 7.51 (d, $J = 8.8$ Hz, 1H, ArH), 7.17 (d, $J = 7.6$ Hz, 1H, ArH), 7.11 (d, $J = 8.0$ Hz, 1H, ArH), 7.04 (s, 1H, ArH), 6.77-6.75 (m, 5H, ArH), 4.14 (t, $J = 7.2$ Hz, 2H, CH), 3.79 (s, 3H, OCH_3), 3.54 (s, 3H, OCH_3), 3.13 (t, $J = 7.2$ Hz, 2H, CH), 2.35 (s, 3H, CH_3), 2.13 (s, 3H, CH_3); ^{13}C NMR (100 MHz, CDCl_3) δ : 166.7, 154.1, 135.3, 133.0, 131.3, 130.6, 129.0, 128.9, 128.4, 127.4, 126.2, 122.3, 113.4, 112.8, 107.7, 107.3, 99.9, 55.7, 51.3, 42.6, 21.2, 20.2, 10.7; MS (m/z): HRMS (ESI) Calcd. for $\text{C}_{25}\text{H}_{25}\text{N}_2\text{O}_3$ ($[\text{M}+\text{H}]^+$): 401.1860. Found: 401.1871; IR (KBr) ν : 3376, 3071, 3019, 2919, 2841, 1669, 1591, 1356, 1226, 1106, 946, 889, 837, 743 cm^{-1} .





Methyl

2-(4-bromophenyl)-8-methoxy-3-methyl-6,11-dihydro-5H-indolizino[8,7-b]indole-1-carboxylate (2g):

yellow solid, 77%, m.p. 208-210°C; ^1H NMR (400 MHz, $\text{DMSO-}d_6$) δ : 10.84 (s, 1H, NH), 7.56-7.51 (m, 3H, ArH), 7.19 (d, $J = 8.4$ Hz, 2H, ArH), 7.05-7.04 (m, 1H, ArH), 6.78-6.75 (m, 1H, ArH), 4.15 (t, $J = 7.2$ Hz, 2H, CH_2), 3.79 (s, 3H, OCH_3), 3.56 (s, 3H, OCH_3), 3.14 (t, $J = 7.2$ Hz, 2H, CH), 2.14 (s, 3H, CH_3); ^{13}C NMR (100 MHz, $\text{DMSO-}d_6$) δ : 166.4, 154.1, 135.4, 132.9, 131.4, 130.7, 129.2, 129.2, 127.1, 126.1, 121.1, 119.7, 113.5, 113.0, 108.0, 107.0, 99.9, 55.7, 51.4, 42.6, 20.2, 10.6; MS (m/z): HRMS (ESI) Calcd. for $\text{C}_{24}\text{H}_{22}\text{BrN}_2\text{O}_3$ ($[\text{M}+\text{H}]^+$): 465.0808. Found: 465.0816; IR (KBr) ν : 3382, 3068, 2982, 2930, 2899, 1732, 1578, 1538, 1459, 1408, 1376, 1230, 1171, 905, 882, 817, 747 cm^{-1} .

