

Modular synthesis of thiazoline and thiazole derivatives by using a cascade protocol

Zakeyah A Alsharif,^a Mohammad A. Alam^{a*}

Department of Chemistry and Physics, College of Science and Mathematics, Arkansas State University,
Jonesboro, AR 72467

*Corresponding author

Mohammad A Alam

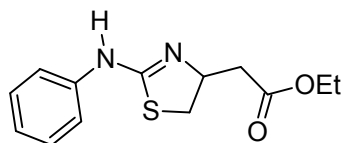
E-mail: malam@astate.edu, Tel: +1-870-973-3319

Materials and instrumentation

All commercial chemicals and solvents are reagent grade and were used without further treatment unless otherwise noted. ¹H NMR spectra were obtained with a Varian Mercury-300MHz with TMS as internal standard. ¹³C NMR spectra were obtained with a Varian Mercury-75MHz with TMS as internal standard. The ESI-FTMS Mass spectra were recorded Bruker ApexII-FTMS system. Low resolution mass spectra were recorded in Shimadzu QQQ instrument.

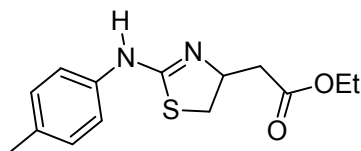
General Procedure

A mixture of thioamide derivative (1.0 mmol), Michael acceptor (1.1 mmol), and sodium acetate (1.1 mmol) in HFIP (5 mL) was for eight hours. Filtration to remove sodium bromide followed by evaporation gave the crude product. Recrystallization with ether or ethyl acetate followed by filtration afforded the pure product.



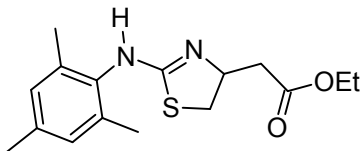
Ethyl (2-anilino-4,5-dihydro-1,3-thiazol-4-yl)acetate (1)

Beige powder, yield = 90%, m. p. = 158.8 °C, ¹H NMR (DMSO-d₆, 300MHz): δ (ppm) 9.39 (s, 1H), 7.51 (s, 5H), 4.90 (s br, 1H), 3.95 (t, J = 9.0 Hz, 1H), 3.86 (q, J = 6.99 Hz, 1H), 3.50 – 3.45 (m, 1H), 2.81 (dd, J = 5.9, 16.2 Hz, 1H), 2.58-2.49 (m, 2H), 1.04 (t, J = 5.0 Hz, 3H); ¹³C NMR (75MHz, DMSO-d₆) δ = 170.1, 169.7, 134.9, 130.7, 130.3, 128.3, 65.0, 60.9, 36.3, 33.5, 14.3. HRMS (ESI-FTMS Mass (m/z): calcd for C₁₃H₁₇N₂O₂S [M + H]⁺ 265.1005, found 265.1009.



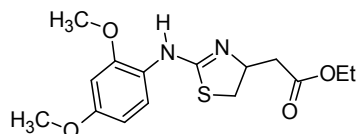
Ethyl [2-(4-methylanilino)-4,5-dihydro-1,3-thiazol-4-yl]acetate (2)

white powder, yield = 88%, m. p. = 140.0 °C, ¹H NMR (DMSO-d₆, 300MHz): δ (ppm) 7.41 – 7.34 (m, 4H), 4.90 – 4.86 (m, 1H), 3.91 (q, J=7.74 Hz, 3H), 3.49 (dd, J = 6.6, 9.9 Hz, 1H), 2.79 (dd, , J = 9.3, 16.8 Hz, 1H), 2.60 – 2.59 (m, 1H), 2.61 (s, 3H), 2.49 (t, J = 1.5 Hz, 3H); ¹³C NMR (75MHz, DMSO-d₆) δ = 170.9, 169.6, 140.5, 131.9, 131.3, 128.1, 65.4, 60.9, 36.2, 33.3, 21.2, 14.2. HRMS (ESI-FTMS Mass (m/z): calcd for C₁₄H₁₉N₂O₂S [M + H]⁺ 279.1162, found 279.1165.



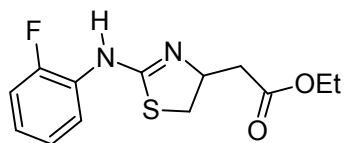
Ethyl [2-(2,4,6-trimethylanilino)-4,5-dihydro-1,3-thiazol-4-yl]acetate (3)

White powder, yield = 95%, m. p. = 154.8 °C, ¹H NMR (DMSO-d₆, 300MHz): δ (ppm) 8.81 (s br, 1H), 7.06 (d, J = 5.2 Hz, 2H), 4.86 – 4.81 (m, 1H), 3.93 (dd, J = 7.2, 11.1Hz, 1H), 3.79 – 3.73 (m, 2H), 3.66 (t, J = 10.8 Hz, 1H), 2.92 (dd, J = 6.4, 16.4 Hz, 1H), 2.42 (d, J = 4.7 Hz, 1H), 2.50 – 2.41 (m, 3H), 2.13 (d, J = 4.1 Hz, 6H), 1.01 (t, J = 6.9 Hz, 3H); ¹³C NMR (75MHz, DMSO-d₆) δ = 170.6, 169.3, 140.4, 137.0, 136.6, 130.5, 130.4, 128.8, 63.9, 60.9, 36.2, 33.9, 21.0, 18.0, 17.8, 14.1. HRMS (ESI-FTMS Mass (m/z): calcd for C₁₆H₂₃N₂O₂S [M + H]⁺ 307.1475, found 307.1478.



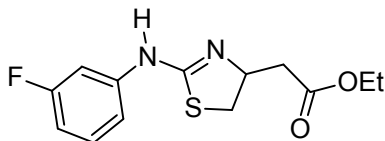
Ethyl [2-(2,4-dimethoxyanilino)-4,5-dihydro-1,3-thiazol-4-yl]acetate (4)

White powder, yield = 96%, m. p. = 190.0 °C, ¹H NMR (DMSO-d₆, 300MHz): δ (ppm) 7.30 (br s, 1H), 6.75 (d, J = 2.4 Hz, 1H), 6.68 (dd, J = 2.4, 8.7 Hz, 1H), 4.73 (br s, 1H), 4.05 – 3.82 (m, 2H), 3.81 (s, 6H), 3.52 – 3.45 (m, 3H), 2.80 (dd, J = 6.5, 16.5 Hz, 1H), 1.09 (t, J = 7.0 Hz, 3H); ¹³C NMR (75MHz, DMSO-d₆) δ = 169.6, 162.5, 156.7, 130.2, 114.7, 106.5, 106.2, 100.3, 99.5, 41.9, 60.9, 56.6, 56.2, 36.5, 33.3, 14.2. HRMS (ESI-FTMS Mass (m/z): calcd for C₁₅H₂₁N₂O₄S [M + H]⁺ 325.1217, found 325.1220.



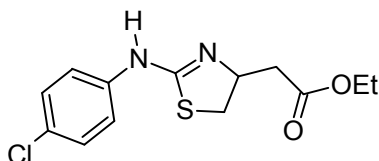
Ethyl [2-(2-fluoroanilino)-4,5-dihydro-1,3-thiazol-4-yl]acetate (5)

White powder, yield = 95%, m. p. = 183.1 °C, ¹H NMR (DMSO-d₆, 300MHz): δ (ppm) 9.18 (s, 1H), 7.66 – 7.59 (m 2H), 7.53 – 7.46 (m, 1H), 7.43 – 7.38 (m, 1H), 4.89 (br s, 1H), 3.96 (t, J = 10.4 Hz, 1H), 3.85 – 3.83 (m, 2H), 3.60 – 3.53 (m, 1H), 2.88 (d, J = 11.4 Hz, 1H), 2.5 (br s, 1H), 1.05 (t, J = 7.0 Hz, 3H); ¹³C NMR (75MHz, DMSO-d₆) δ = 172.0, 169.4, 158.1 (¹J_{C-F} = 249.4 Hz), 133.4 (³J_{C-F} = 7.4 Hz), 130.7, 126.6, 121.6 (³J_{C-F} = 12.90 Hz), 117.9 (²J_{C-F} = 18.9 Hz), 64.9, 60.9, 36.3, 33.8, 14.2. HRMS (ESI-FTMS Mass (m/z): calcd for C₁₃H₁₆FN₂O₂S [M + H]⁺ 283.0911, found 283.0914.



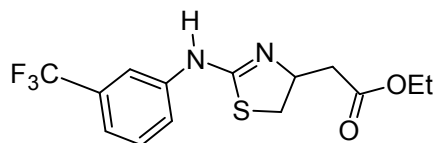
Ethyl [2-(3-fluoroanilino)-4,5-dihydro-1,3-thiazol-4-yl]acetate (6)

Brownish powder, yield = 95%, m. p. = 135.0 °C, ¹H NMR (DMSO-d₆, 300MHz): δ (ppm) 7.59 – 7.55 (m, 3H), 7.48 – 7.43 (m, 1H), 4.10 (q, J = 7.1 Hz, 3H), 3.73 (dd, J = 8.7, 11.2 Hz, 1H), 3.30 (dd, J = 8.0, 11.2 Hz, 1H), 2.79 (dd, J = 1.7, 6.6 Hz, 2H), 1.18 (t, J = 6.9 Hz, 3H); ¹³C NMR (75MHz, DMSO-d₆) δ = 170.8, 168.8, 162.3 (¹J_{C-F} = 243.6 Hz), 133.9, 131.7 (³J_{C-F} = 8.1 Hz), 125.1, 119.7 (²J_{C-F} = 20.7 Hz), 114.8 (²J_{C-F} = 23.0 Hz), 72.3, 60.6, 38.7, 37.9, 14.5. HRMS (ESI-FTMS Mass (m/z): calcd for C₁₃H₁₆FN₂O₂S [M + H]⁺ 283.0911, found 283.0913.



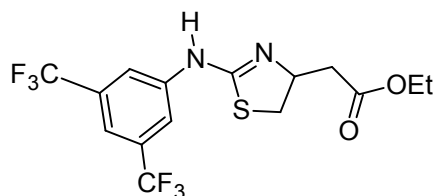
Ethyl [2-(4-chloroanilino)-4,5-dihydro-1,3-thiazol-4-yl]acetate (7)

White powder, yield = 95%, m. p. = 202.3 °C, ¹H NMR (DMSO-d₆, 300MHz): δ (ppm) 7.68 (d, J = 7.41 Hz, 2H), 7.54 (d, J = 7.5 Hz, 2H), 4.96 – 4.87 (m, 1H), 3.96 – 3.89 (m, 3H), 3.52 – 3.35 (m, 1H), 2.84 (dd, J = 9.3, 16.3, 1H), 2.53 (dd, J = 5.2, 16.6 Hz, 1H), 1.10 (t, J = 1.53 Hz, 3H); ¹³C NMR (75MHz, DMSO-d₆) δ = 171.2, 169.7, 135.4, 133.4, 130.9, 130.6, 65.2, 60.9, 36.3, 33.6, 14.2. HRMS (ESI-FTMS Mass (m/z): calcd for C₁₃H₁₆ClN₂O₂S [M + H]⁺ 301.0586, found 301.0588.



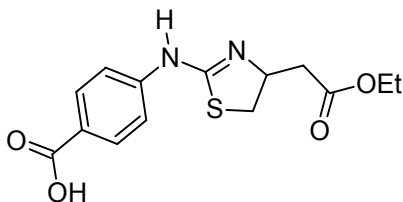
Ethyl [2-[3-(trifluoromethyl)anilino]-4,5-dihydro-1,3-thiazol-4-yl]acetate (8)

White powder, yield = 93%, m. p. = 210.1 °C, ¹H NMR (DMSO-d₆, 300MHz): δ (ppm) 8.92 (br s, 1H), 8.02 (s, 1H), 7.93 (s, 1H), 7.83 – 7.79 (m, 2H), 5.00 (quint, J = 6.9 Hz, 1H), 3.96 (dd, J = 7.8, 11.3 Hz, 1H), 3.86 (q, J = 6.7 Hz, 2H), 3.50 (dd, J = 6.7, 11.3 Hz, 1H), 2.86 (dd, J = 6.7, 16.7 Hz, 1H), 2.66 (dd, J = 5.6, 16.8 Hz, 1H), 1.05 (t, J = 7.0 Hz, 3H); ¹³C NMR (75MHz, DMSO-d₆) δ = 171.6, 169.6, 135.3, 133.2, 132.1, 131.3 (q, ²J_{C-F} = 32.1 Hz), 127.7, 126.1, 123.9 (¹J_{C-F} = 270 Hz), 65.4, 60.9, 36.3, 33.8, 14.2. HRMS (ESI-FTMS Mass (m/z): calcd for C₁₄H₁₆F₃N₂O₂S [M + H]⁺ 333.0879, found 333.0882.



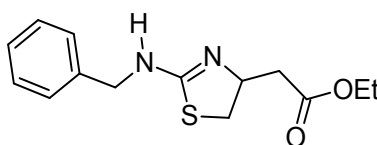
Ethyl {2-[3,5-bis(trifluoromethyl)anilino]-4,5-dihydro-1,3-thiazol-4-yl}acetate (9)

White powder, yield = 87%, m. p. = 148.1 °C, ¹H NMR (DMSO-d₆, 300MHz): δ (ppm) 9.08 (s, 1H), 8.40 (s, 2H), 8.36 (s, 1H), 5.04 (quint, J = 6.5 Hz, 1H), 3.96 (dd, J = 7.7, 11.1 Hz, 1H), 3.82 (q, J = 7.0 Hz, 2H), 3.49 (dd, J = 6.7, 11.2 Hz, 1H), 2.94 (dd, J = 6.4, 16.9 Hz, 1H), 2.76 (dd, J = 6.0, 16.8 Hz, 1H), 1.03 (t, J = 1.2 Hz, 3H); ¹³C NMR (75MHz, DMSO-d₆) δ = 172.1, 169.8, 136.5, 132.6 (²J_{C-F} = 33.6), 131.0, 125.0, 121.4, 65.3, 60.9, 36.3, 34.1, 14.1. HRMS (ESI-FTMS Mass (m/z): calcd for C₁₅H₁₅F₆N₂O₂S [M + H]⁺ 401.0753, found 401.0754.



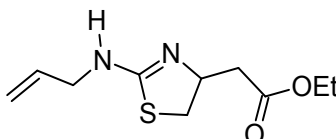
4-{{4-(2-Ethoxy-2-oxoethyl)-4,5-dihydro-1,3-thiazol-2-yl}amino}benzoic acid (10)

White powder, yield = 92%, m. p. = 250.0 °C, ¹H NMR (DMSO-d₆, 300MHz): δ (ppm) 8.09 (d, J = 8.4 Hz, 2H), 7.64 (d, J = 8.4 Hz, 2H), 5.00 – 4.96 (m, 1H), 3.97 – 3.86 (m, 3H), 3.50 (dd, J = 6.3, 11.3 Hz, 1H), 2.85 (dd, J = 7.4, 16.6 Hz, 1H), 2.64 (dd, J = 4.9, 16.5 Hz, 1H), 1.07 (t, J = 7.0 Hz, 3H); ¹³C NMR (75MHz, DMSO-d₆) δ = 170.4, 169.7, 166.9, 138.7, 132.3, 131.6, 128.5, 64.9, 60.9, 36.2, 33.5, 14.2. HRMS (ESI-FTMS Mass (m/z): calcd for C₁₄H₁₇N₂O₄S [M + H]⁺ 309.0904, found 309.0907.



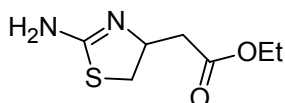
Ethyl [2-(benzylamino)-4,5-dihydro-1,3-thiazol-4-yl]acetate (11)

White powder, yield = 97%, m. p. = 139.3 °C, ¹H NMR (DMSO-d₆, 300MHz): δ (ppm) 9.78 (s, 1H), 7.44 – 7.36 (m, 3H), 7.30 (d, J = 7.5 Hz, 2H), 4.94 (d, J = 16.5 Hz, 1H), 4.69 (d, J = 16.4 Hz, 1H), 4.44 (s br, 1H), 4.04 (q, J = 7.2 Hz, 2H), 3.84 (dd, J = 8.07, 11.19 Hz, 1H), 3.35 (dd, J = 3, 11.4 Hz, 1H), 2.85 – 2.83 (m, 2H), 1.18 (t, J = 7.0 Hz, 3H); ¹³C NMR (75MHz, DMSO-d₆) δ = 170.6, 170.1, 134.3, 129.4, 128.5, 127.7, 62.3, 61.0, 48.4, 35.0, 33.3, 14.3. HRMS (ESI-FTMS Mass (m/z): calcd for C₁₄H₁₉N₂O₂S [M + H]⁺ 279.1162, found 279.1165.



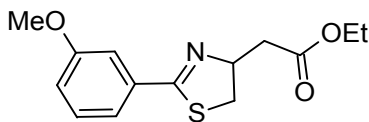
Ethyl {2-[(prop-2-en-1-yl)amino]-4,5-dihydro-1,3-thiazol-4-yl}acetate (12)

White powder, m. p. = 90.4 °C, yield = 78%, ¹H NMR (DMSO-d₆, 300MHz): δ (ppm) 9.56 (s, 1H), 5.86 – 5.76 (m, 1H), 5.29 (t, J = 16.9 Hz, 2H), 4.54 – 4.51 (m, 1H), 4.30 (d, J = 16.8 Hz, 1H), 4.12 – 4.05 (m, 3H), 3.82 (dd, J = 7.9, 11.4 Hz, 1H), 3.37-3.34 (m, 1H), 2.91 – 2.77 (m, 2H), 1.19 (t, J = 7.1 Hz, 3H); ¹³C NMR (75MHz, DMSO-d₆) δ = 170.1, 169.8, 130.7, 119.0, 62.3, 61.0, 47.6, 35.2, 33.3, 14.4. HRMS (ESI-FTMS Mass (m/z): calcd for C₁₀H₁₇N₂O₂S [M + H]⁺ 229.1005, found 229.1007.



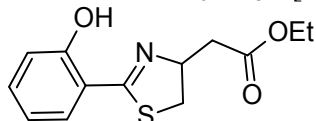
Ethyl (2-amino-4,5-dihydro-1,3-thiazol-4-yl)acetate (13)

Brownish powder, m. p. = 80.0 °C, yield = 69%, ¹H NMR (DMSO-d₆, 300MHz): δ (ppm) 4.49 (quint, J = 7.2 Hz, 1H), 4.09 (q, J = 7.1 Hz, 2H), 3.70 (dd, J = 7.7, 11.3 Hz, 1H), 3.30 (dd, J = 6.3, 11.3 Hz, 1H), 2.75 (d, J = 5.6 Hz, 2H), 1.19 (t, J = 7.0 Hz, 3H); ¹³C NMR (75MHz, DMSO-d₆) δ = 171.6, 170.5, 60.9, 58.6, 37.9, 35.9, 14.4. HRMS (ESI-FTMS Mass (m/z): calcd for C₇H₁₃N₂O₂S [M + H]⁺ 189.0692, found 189.0695.



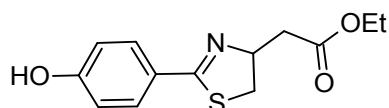
Ethyl [2-(3-methoxyphenyl)-4,5-dihydro-1,3-thiazol-4-yl]acetate (14)

Brownish powder, m. p. = 118.9 °C, yield = 83%, ¹H NMR (DMSO-d₆, 300MHz): δ (ppm) 7.45 - 7.39 (m, 1H), 7.34 - 7.29 (m, 2H), 7.16 - 7.15 (m, 1H), 4.97 - 4.92 (m, 1H), 4.12 (q, J = 7.0 Hz, 2H), 3.79 (s, 3H), 3.68 (dd, J = 10.2, 19.2 Hz, 1H), 3.26 (dd, J = 7.9, 19.1 Hz, 1H), 2.80 - 2.73 (m, 2H), 1.20 (t, J = 7.14 Hz, 3H); ¹³C NMR (75MHz, DMSO-d₆) δ = 170.9, 169.1 159.7, 133.4, 130.6, 121.2, 118.4, 113.1, 72.7, 60.6, 55.8, 38.8, 37.6, 14.5. HRMS (ESI-FTMS Mass (m/z): calcd for C₁₄H₁₈NO₃S [M + H]⁺ 280.1002, found 280.1005.



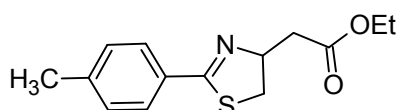
Ethyl [2-(2-hydroxyphenyl)-4,5-dihydro-1,3-thiazol-4-yl]acetate (15)

Brownish powder, m. p. = 162.5 °C, yield = 88%, ¹H NMR (DMSO-d₆, 300MHz): δ (ppm) 7.58 (d, J = 7.9 Hz, 1H), 7.51 (t, J = 8.1 Hz, 1H), 7.05 - 6.96 (m, 2H), 5.02 (quint, J = 7.8 Hz, 1H), 4.10 (q, J = 7.0 Hz, 2H), 3.76 (t, J = 11.1 Hz, 1H), 3.33 (dd, J = 7.6, 11.4 Hz, 1H), 2.87 (d, J = 6.7 Hz, 1H), 2.84-2.79 (m, 1H), 1.17 (t, J = 7.1 Hz, 3H); ¹³C NMR (75MHz, DMSO-d₆) δ = 176.4, 170.6, 159.0, 135.9, 131.1, 120.0, 117.5, 114.5, 68.3, 60.8, 38.3, 35.7, 14.4. HRMS (ESI-FTMS Mass (m/z): calcd for C₁₃H₁₆NO₃S [M + H]⁺ 266.0845, found 266.0849.



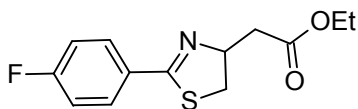
Ethyl [2-(4-hydroxyphenyl)-4,5-dihydro-1,3-thiazol-4-yl]acetate (16)

White powder, m. p. = 115.6 °C, yield = 80%, ¹H NMR (DMSO-d₆, 300MHz): δ (ppm) 7.84 (d, J = 8.7 Hz, 2H), 6.97 (d, J = 1.9 Hz, 2H), 5.04 - 4.99 (m, 2H), 4.10 (q, J = 7.1 Hz, 2H), 3.87 (dd, J = 7.7, 11.3 Hz, 1H), 3.48 (dd, J = 7.7, 11.3 Hz, 1H), 3.06 - 2.72 (m, 1H), 1.18 (t, J = 2.7 Hz, 3H); ¹³C NMR (75MHz, DMSO-d₆) δ = 179.4, 170.2, 164.4, 132.4, 118.6, 116.7, 66.2, 60.9, 37.6, 36.6, 14.4. HRMS (ESI-FTMS Mass (m/z): calcd for C₁₃H₁₆NO₃S [M + H]⁺ 266.0845, found 266.0849.



Ethyl [2-(4-methylphenyl)-4,5-dihydro-1,3-thiazol-4-yl]acetate (17)

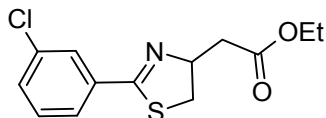
Viscous liquid, yield = ~99%, ¹H NMR (DMSO-d₆, 300MHz): δ (ppm) 7.63 (d, J = 7.4 Hz, 2H), 7.27 (d, J = 7.8 Hz, 2H), 4.89 (q, J = 7.6 Hz, 1H), 4.10 (q, J = 7.0 Hz, 2H), 3.60 (dd, J = 8.5, 10.5 Hz, 1H), 3.16 (dd, J = 8.0, 10.9 Hz, 1H), 2.79-2.64 (m, 2H), 2.33 (s, 3H), 1.19 (t, J = 7.1 Hz, 3H); ¹³C NMR (75MHz, DMSO-d₆) δ = 171.1, 166.3, 141.9, 130.3, 129.7, 128.4, 73.9, 60.5, 39.0, 37.7, 21.4, 14.5. HRMS (ESI-FTMS Mass (m/z): calcd for C₁₃H₁₆NO₃S [M + H]⁺ 264.3626, found 264.3624.



Ethyl [2-(4-fluorophenyl)-4,5-dihydro-1,3-thiazol-4-yl]acetate (18)

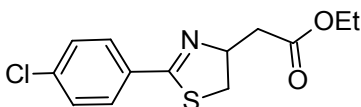
White powder, m. p. = 150.2 °C, yield = 84%, ¹H NMR (DMSO-d₆, 300MHz): δ (ppm) 7.84 (dd, J = 5.6, 7.9 Hz, 2H), 7.35 (t, J = 8.7 Hz, 2H), 4.99 - 4.89 (m, 1H), 4.10 (q, J = 7.0 Hz, 2H), 3.71 (dd, J = 8.7, 11.1 Hz, 1H), 3.28 (dd, J = 8.0, 11.1 Hz, 1H), 2.84-2.76 (m, 2H), 1.11 (t, J = 7.1 Hz, 3H); ¹³C NMR (75MHz, DMSO-d₆) δ =

170.9, 165.0 ($^1J_{C-F} = 248.6$ Hz), 131.2 ($^3J_{C-F} = 8.4$ Hz), 128.6, 116.4 ($^2J_{C-F} = 21.9$ Hz), 72.6, 60.6, 39.0, 38.8, 37.9, 14.5. HRMS (ESI-FTMS Mass (m/z): calcd for $C_{13}H_{15}FNO_2S$ $[M + H]^+$ 268.0802, found 268.0805.



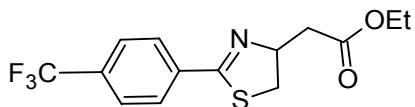
Ethyl [2-(3-chlorophenyl)-4,5-dihydro-1,3-thiazol-4-yl]acetate (19)

Brownish powder, m. p. = 144.9 °C, yield = 70%, 1H NMR (DMSO- d_6 , 300MHz): δ (ppm) ; 7.64 (s, 1H), 7.64 – 7.65 (m, 2H), 7.54 (d, $J = 7.0$ Hz, 1H), 5.01 – 4.91 (m, 1H), 4.09 (q, $J = 7.05$ Hz, 2H), 3.30 (dd, $J = 8.1, 11.1$ Hz, 1H), 2.79 (dd, $J = 7.2, 16.2$ Hz, 1H), 2.76 – 2.71 (m, 2H), 1.19 (t, $J = 6.0$ Hz, 3H); ^{13}C NMR (75MHz, DMSO- d_6) $\delta = 170.8, 168.2, 134.0, 133.8, 132.4, 131.4, 127.7, 127.6, 72.6, 60.6, 38.7, 37.9, 14.5$. HRMS (ESI-FTMS Mass (m/z): calcd for $C_{13}H_{15}ClNO_2S$ $[M + H]^+$ 286.0477, found 286.0481.



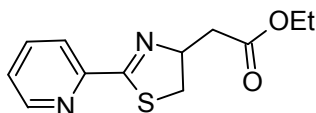
Ethyl [2-(4-chlorophenyl)-4,5-dihydro-1,3-thiazol-4-yl]acetate (20)

White powder, m. p. = 131.9 °C, yield = 75%, 1H NMR (DMSO- d_6 , 300MHz): δ (ppm) 7.95 (d, $J = 1.5$ Hz, 2H), 7.60 (d, $J = 1.6$ Hz, 2H), 5.00 – 4.90 (m, 1H), 4.10 (q, $J = 7.0$ Hz, 2H), 3.75 – 3.68 (m, 1H), 3.29 (dd, $J = 8.1, 11.1$ Hz, 1H), 2.77 (d, $J = 6.9$ Hz, 2H), 1.19 (t, $J = 7.0$ Hz, 3H); ^{13}C NMR (75MHz, DMSO- d_6) $\delta = 170.9, 168.2, 137.3, 130.8, 130.3, 129.5, 72.7, 60.6, 38.8, 37.9, 14.5$. HRMS (ESI-FTMS Mass (m/z): calcd for $C_{13}H_{15}ClNO_2S$ $[M + H]^+$ 286.0477, found 286.0481.



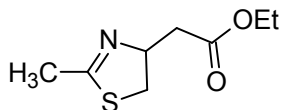
Ethyl [2-[4-(trifluoromethyl)phenyl]-4,5-dihydro-1,3-thiazol-4-yl]acetate (21)

White powder, m. p. = 148.0 °C, yield = 98%, 1H NMR (DMSO- d_6 , 300MHz): δ (ppm) 7.95 (d, $J = 8.4$ Hz, 2H), 7.86 (d, $J = 8.4$ Hz, 2H), 5.00 – 4.92 (m, 1H), 4.09 (q, $J = 7.1$ Hz, 2H), 3.28 (dd, $J = 2.5, 11.19$ Hz, 1H), 3.28 (dd, $J = 8.2, 11.16$ Hz, 1H), 2.78 (dd, $J = 1.8, 10.86$ Hz, 2H), 1.14 (t, $J = 7.0$ Hz, 3H); ^{13}C NMR (75MHz, DMSO- d_6) $\delta = 170.9, 166.3, 136.2, 132.0$ (q, $^{13}J_{C-F} = 31.8$ Hz), 129.2, 126.3 (q, $^{14}J_{C-F} = 3.7$ Hz), 73.8, 60.5, 39.0, 38.1, 14.5. HRMS (ESI-FTMS Mass (m/z): calcd for $C_{14}H_{15}F_3NO_2S$ $[M + H]^+$ 318.077, found 318.0772.



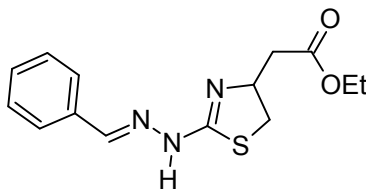
Ethyl [2-(pyridin-2-yl)-4,5-dihydro-1,3-thiazol-4-yl]acetate (22)

Viscous liquid, yield ~ 99%, 1H NMR (DMSO- d_6 + $CDCl_3$, 300MHz): δ (ppm) 8.63 (d, $J = 4.5$ Hz, 1H), 8.00-7.95 (m, 1H), 7.89 (t, $J = 7.5$ Hz, 1H), 7.51 (t, $J = 6.7$ Hz, 1H), 5.00 (quint, $J = 8.0$ Hz, 2H), 4.10 (q, $J = 7.1$ Hz, 2H), 3.54 (dd, $J = 11.2$ Hz, 1H), 3.09 (dd, $J = 8.1, 11.3$ Hz, 1H), 2.83-2.66 (m, 2H), 1.20 (t, $J = 7.1$ Hz, 3H); ^{13}C NMR (75MHz, DMSO- d_6 + $CDCl_3$) $\delta = 170.8, 170.1, 150.4, 149.6, 137.4, 126.4, 121.7, 74.2, 60.5, 39.1, 36.5, 14.5$. HRMS (ESI-FTMS Mass (m/z): calcd for $C_{12}H_{15}N_2O_2S$ $[M + H]^+$ 251.0854, found 251.0854.



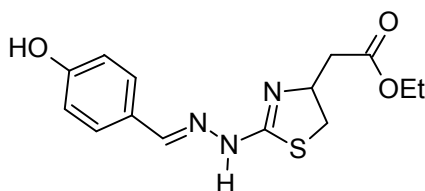
Ethyl (2-methyl-4,5-dihydro-1,3-thiazol-4-yl)acetate (23)

Viscous liquid, yield = 82%, ^1H NMR (DMSO- d_6 + CDCl_3 , 300MHz): δ (ppm) 4.13-3.99 (m, 3H), 2.62-2.55 (m, 2H), 2.50-2.40 (m, 2H), 1.80 (s, 3H), 1.17 (t, $J = 7.0$ Hz, 3H); ^{13}C NMR (75MHz, DMSO- d_6 + CDCl_3) $\delta = 170.8, 169.3, 60.3, 48.6, 37.6, 28.2, 23.0, 14.4$. HRMS (ESI-FTMS Mass (m/z): calcd for $\text{C}_8\text{H}_{14}\text{NO}_2\text{S}$ [$\text{M} + \text{H}$] $^+$ 188.0745, found 188.0848.



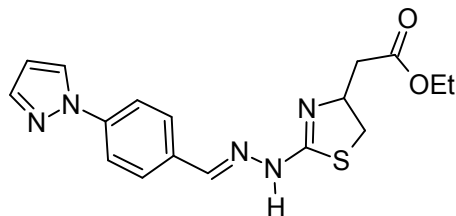
Ethyl {2-[(2E)-2-benzylidenehydrazinyl]-4,5-dihydro-1,3-thiazol-4-yl}acetate (24)

White powder, m. p. = 234.8 °C, yield = 90%, ^1H NMR (DMSO- d_6 + CDCl_3 , 300MHz): δ (ppm) 10.08 (br s, 1H), 8.39 (s, 1H), 8.01 (d, $J = 7.74$ Hz, 2H), 7.51 (s, 3H), 5.45 – 5.41 (m, 1H), 4.11 (q, $J = \text{Hz}$, 2H), 3.94 – 3.88 (m, 1H), 3.53 (d, $J = 11.67$ Hz, 1H), 2.85 – 2.83 (m, 2H), 1.20 (t, $J = 7.0$ Hz, 3H); ^{13}C NMR (75MHz, DMSO- d_6 + CDCl_3) $\delta = 169.5, 168.6, 151.5, 133.1, 131.8, 129.1, 128.9, 61.1, 56.8, 32.5, 32.3, 14.3$. HRMS (ESI-FTMS Mass (m/z): calcd for $\text{C}_{14}\text{H}_{18}\text{N}_3\text{O}_2\text{S}$ [$\text{M} + \text{H}$] $^+$ 292.1114, found 292.1118.



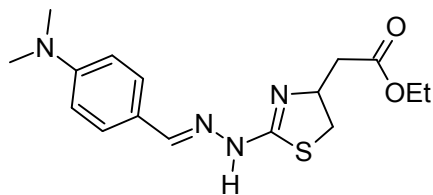
Ethyl (2-[(2E)-2-[(4-hydroxyphenyl)methylidene]hydrazinyl]-4,5-dihydro-1,3-thiazol-4-yl)acetate (25)

Brownish powder, m. p. = 241.4 °C, yield = 80%, ^1H NMR (DMSO- d_6 , 300MHz): δ (ppm) 10.17 (br s, 1H), 9.94 (br s, 1H), 8.27 (s, 1H), 7.84 (d, $J = 7.6$ Hz, 2H), 6.87 (d, $J = 7.5$ Hz, 2H), 5.37 (br s, 1H), 4.08 (q, $J = 7.1$ Hz, 2H), 3.88 (dd, $J = 7.8, 11.3$ Hz, 1H), 3.50 (d, $J = 11.5$ Hz, 1H), 2.86 – 2.73 (m, 2H), 1.19 (t, $J = 7.1$ Hz, 3H); ^{13}C NMR (75MHz, DMSO- d_6) $\delta = 170.0, 167.6, 161.2, 151.4, 131.1, 124.3, 116.1, 61.1, 56.8, 32.4, 32.2, 14.4$. HRMS (ESI-FTMS Mass (m/z): calcd for $\text{C}_{14}\text{H}_{18}\text{N}_3\text{O}_3\text{S}$ [$\text{M} + \text{H}$] $^+$ 308.1063, found 308.1066.



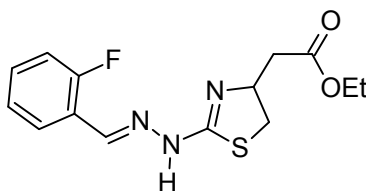
Ethyl {2-[(2E)-2-[(1H-pyrazol-1-yl)phenyl]methylidene]hydrazinyl]-4,5-dihydro-1,3-thiazol-4-yl}acetate (26)

Brownish powder, m. p. = 193.7 °C, yield = 79%, ^1H NMR (DMSO- d_6 , 300MHz): δ (ppm) 10.0 (br s, 1H), 8.65 (d, $J = 2.4$ Hz, 1H), 8.41 (s, 1H), 8.14 (d, $J = 8.5$ Hz, 2H), 8.05 (d, $J = 8.5$ Hz, 2H), 7.81 (s, 1H), 6.60 (s, 1H), 5.43 – 5.40 (m, 1H), 4.11 (q, $J = 7.0$ Hz, 2H), 3.95 – 3.88 (m, 1H), 3.55 – 3.51 (m, 1H), 2.85 (d, $J = 6.0$ Hz, 2H), 1.20 (t, $J = 7.1$ Hz, 3H); ^{13}C NMR (75MHz, DMSO- d_6) $\delta = 170.0, 168.6, 150.1, 142.2, 142.0, 131.0, 130.4, 128.6, 118.6, 109.0, 61.1, 56.8, 32.4, 32.3, 14.4$. HRMS (ESI-FTMS Mass (m/z): calcd for $\text{C}_{17}\text{H}_{20}\text{N}_5\text{O}_2\text{S}$ [$\text{M} + \text{H}$] $^+$ 358.1332, found 358.1335.



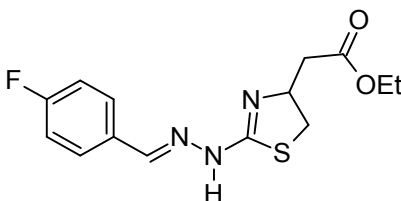
Ethyl 2-((2E)-2-((4-(dimethylamino)phenyl)methylidene)hydrazinyl)-4,5-dihydro-1,3-thiazol-4-ylacetate (26)

Brownish powder, m. p. = 180.6 °C, yield = 67%, ¹H NMR (DMSO-d₆, 300MHz): δ (ppm) 8.21 (s, 1H), 7.78 (d, J = 7.3 Hz, 2H), 6.75 (d, J = 7.4 Hz, 2H), 5.36 (br s, 1H), 4.09 (q, J = 5.5 Hz, 2H), 3.85 (t, J = 10.8 Hz, 2H), 3.00 (s, 6H), 2.85 – 2.76 (m, 2H), 1.21 (t, J = Hz, 5.2, 3H); ¹³C NMR (75MHz, DMSO-d₆) δ = 170.0, 166.7, 152.8, 152.0, 130.6, 120.1, 111.8, 61.1, 56.9, 32.7, 32.0, 14.3. HRMS (ESI-FTMS Mass (m/z): calcd for C₁₆H₂₃N₄O₂S [M + H]⁺ 335.1536, found 335.1541.



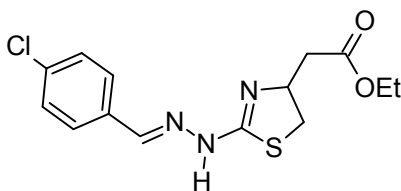
Ethyl 2-((2E)-2-((2-fluorophenyl)methylidene)hydrazinyl)-4,5-dihydro-1,3-thiazol-4-ylacetate (28)

Brownish powder, m. p. = 228.9 °C, yield = 80%, ¹H NMR (DMSO-d₆, 300MHz): δ (ppm) 8.32 (s, 2H), 7.61 – 7.54 (m, 1H), 7.36 – 7.29 (m, 1H), 5.57 – 5.55 (m, 1H), 4.05 (q, J = 7.0 Hz, 3H), 3.91 – 3.85 (m, 2H), 2.83 (d, J = 5.6 Hz, 2H), 1.18 (t, J = 6.0 Hz, 3H); ¹³C NMR (75MHz, DMSO-d₆) δ = 170.0, 169.4, 162.4 (¹J_{C-F} = 251.5 Hz), 144.0, 134.4, 128.2, 125.3, 120.7 (³J_{C-F} = 9.5 Hz), 116.4 (²J_{C-F} = 20.4 Hz), 61.3, 56.7, 38.8, 32.8, 14.3. HRMS (ESI-FTMS Mass (m/z): calcd for C₁₄H₁₇FN₃O₂S [M + H]⁺ 310.102, found 310.1024.



Ethyl 2-((2E)-2-((4-fluorophenyl)methylidene)hydrazinyl)-4,5-dihydro-1,3-thiazol-4-ylacetate (29)

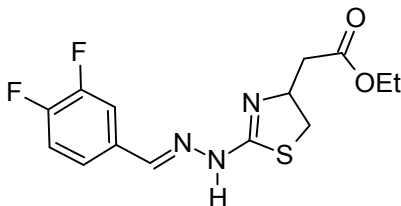
White powder, m. p. = 204.0 °C, yield = 85%, ¹H NMR (DMSO-d₆, 300MHz): δ (ppm) 8.41 (s, 1H), 8.12 – 8.08 (m, 2H), 7.36 (t, J = 8.7 Hz, 3H), 5.39 (s br, 1H), 4.10 (q, J = 6.9 Hz, 2H), 3.94 – 3.88 (m, 1H), 3.53 (d, J = 11.5 Hz, 1H), 2.84 – 2.83 (m, 2H), 1.20 (t, J = 7.1 Hz, 3H); ¹³C NMR (75MHz, DMSO-d₆) δ = 170.0, 168.6, 164.4 (¹J_{C-F} = 248.1 Hz), 149.9, 131.5 (³J_{C-F} = 8.79 Hz), 130.1, 116.4 (²J_{C-F} = 21.73 Hz), 61.1, 56.7, 32.4, 32.3, 14.4. HRMS (ESI-FTMS Mass (m/z): calcd for C₁₄H₁₇FN₃O₂S [M + H]⁺ 310.102, found 310.1024.



Ethyl 2-((2E)-2-((4-chlorophenyl)methylidene)hydrazinyl)-4,5-dihydro-1,3-thiazol-4-ylacetate (30)

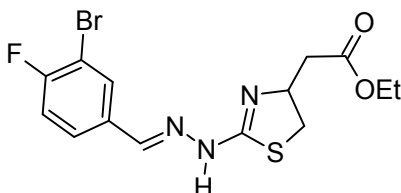
White powder, m. p. = 210.1 °C, yield = 70%, ¹H NMR (DMSO-d₆, 300MHz): δ (ppm) 10.22 (s, 1H), 8.41 (s, 1H), 8.07 (d, J = 7.2 Hz, 2H), 7.59 (d, J = 7.1 Hz, 2H), 5.42 – 5.40 (m, 1H), 4.10 (q, J = 6.5 Hz, 2H), 3.96 – 3.90 (m, 1H), 3.55 (d, J = 11.5 Hz, 1H), 2.85 (d, J = 5.7 Hz, 2H), 1.21 (t, J = 5.8 Hz, 3H); ¹³C NMR (75MHz, DMSO-

d₆) δ = 169.9, 169.1, 150.0, 136.6, 132.3, 130.8, 129.3, 61.1, 56.8, 32.6, 32.2, 14.4. HRMS (ESI-FTMS Mass (m/z): calcd for C₁₄H₁₇ClN₃O₂S [M + H]⁺ 328.0696, found 328.0700.



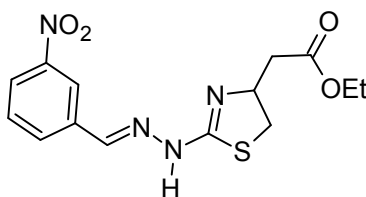
Ethyl (2-((2E)-2-[(3,4-difluorophenyl)methylidene]hydrazinyl)-4,5-dihydro-1,3-thiazol-4-yl)acetate (31)

Brownish powder, m. p. = 169.9 °C, yield = 86%, ¹H NMR (DMSO-d₆, 300MHz): δ (ppm) 10.22 (s, 1H), 8.27 (t, J = 8.3 Hz, 1H), 7.77 (s, 1H), 7.64-7.55 (m, 1H), 5.35 – 5.33 (m, 1H), 4.07 (q, J = 6.9 Hz, 2H), 3.90 (dd, J = 3.6, 11.2 Hz, 1H), 3.91 – 3.88 (m, 1H), 2.84 – 2.82 (m, 2H), 1.18 (t, J = 7.11 Hz, 3H); ¹³C NMR (75MHz, DMSO-d₆) δ = 169.9, 169.3, 153.5 (¹J_{C-F} = 250.4 Hz, ³J_{C-F} = 12.6 Hz), 150.0 (¹J_{C-F} = 258.0 Hz, ³J_{C-F} = 13.4 Hz), 148.6, 131.2, 127.6, 118.5 (²J_{C-F} = 17.6 Hz), 116.5 (²J_{C-F} = 18.8 Hz), 61.1, 56.7, 32.6, 32.0, 14.4. HRMS (ESI-FTMS Mass (m/z): calcd for C₁₄H₁₆F₂N₃O₂S [M + H]⁺ 328.0926, found 328.0929.



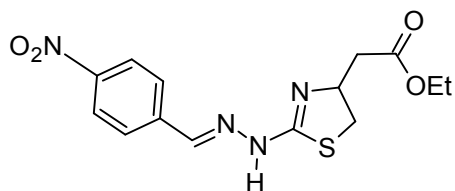
Ethyl (2-((2E)-2-[(3-bromo-4-fluorophenyl)methylidene]hydrazinyl)-4,5-dihydro-1,3-thiazol-4-yl)acetate (32)

White powder, m. p. = 140.1 °C, yield = 80%, ¹H NMR (DMSO-d₆, 300MHz): δ (ppm) 10.28 (s, 1H), 8.52 (d, J = 6.8 Hz, 1H), 8.39 (s, 1H), 8.05 – 8.01 (m, 1H), 7.54 (t, J = 6.7 Hz, 1H), 5.38 – 5.36 (m, 1H), 4.11 (q, J = 5.6 Hz, 2H), 3.93 (t, J = 10.5 Hz, 1H), 3.54 (d, J = 11.6 Hz, 1H), 2.85 – 2.83 (m, 2H), 1.20 (t, J = 4.8 Hz, 3H); ¹³C NMR (75MHz, DMSO-d₆) δ = 169.9, 169.3, 160.0 (¹J_{C-F} = 248.9 Hz), 148.7, 133.2, 131.6, 131.3, 117.6 (²J_{C-F} = 22.90 Hz), 109.5 (²J_{C-F} = 21.4 Hz), 61.1, 56.7, 32.6, 32.0, 14.4. HRMS (ESI-FTMS Mass (m/z): calcd for C₁₄H₁₆BrFN₃O₂S [M + H]⁺ 390.0105, found 390.0108.



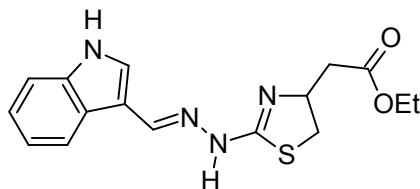
Ethyl (2-((2E)-2-[(3-nitrophenyl)methylidene]hydrazinyl)-4,5-dihydro-1,3-thiazol-4-yl)acetate (33)

White powder, m. p. = 183.9 °C, yield = 84%, ¹H NMR (DMSO-d₆, 300MHz): δ (ppm) 10.38 (s, 1H), 8.87 (s, 1H), 8.56 (s, 1H), 8.50 (d, J = 7.38 Hz, 1H), 8.33 (dd, J = 1.6, 1.6 Hz, 1H), 7.81 (t, J = 7.5 Hz, 1H), 5.43 – 5.36 (m, 1H), 4.11 (q, J = 7.0 Hz, 2H), 3.96 (dd, J = 7.7, 11.6 Hz, 1H), 3.56 (d, J = 11.4 Hz, 1H), 2.90 – 2.87 (m, 2H), 1.21 (t, J = 6.72 Hz, 3H); ¹³C NMR (75MHz, DMSO-d₆) δ = 170.0, 169.6, 149.2, 148.6, 135.1, 134.8, 130.8, 126.1, 123.7, 61.1, 56.9, 32.6, 31.9, 14.4. HRMS (ESI-FTMS Mass (m/z): calcd for C₁₄H₁₇N₄O₄S [M + H]⁺ 337.0965, found 337.0965.



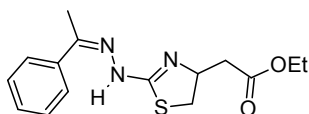
Ethyl 2-((2E)-2-((4-nitrophenyl)methylidene)hydrazinyl)-4,5-dihydro-1,3-thiazol-4-yl}acetate (34)

Yellowish powder, m. p. = 217.8 °C, yield = 86%, ¹H NMR (DMSO-d₆, 300MHz): δ (ppm) 8.44 (s, 1H), 8.32 (d, J = 7.62 Hz, 2H), 8.23 (d, J = 8.7 Hz, 2H), 5.35 (s br, 1H), 4.11 – 4.06 (m, 4H), 2.84 – 2.72 (m, 2H), 1.19 (t, J = 6.99 Hz, 3H); ¹³C NMR (75MHz, DMSO-d₆) δ = 170.0, 168.6, 148.9, 147.6, 139.7, 129.7, 124.3, 61.2, 56.7, 32.3, 32.1, 14.4. HRMS (ESI-FTMS Mass (m/z): calcd for C₁₄H₁₇N₄O₄S [M + H]⁺ 337.0965, found 337.0969.



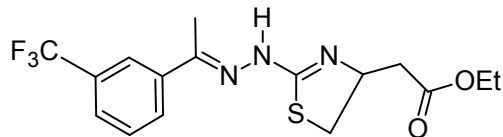
Ethyl 2-((2E)-2-((3H-indol-3-yl)methylidene)hydrazinyl)-4,5-dihydro-1,3-thiazol-4-yl}acetate (35)

Brownish powder, m. p. = 193.1 °C, yield = 75%, ¹H NMR (DMSO-d₆, 300MHz): δ (ppm) 11.93 (s, 1H), 8.56 (s, 1H), 8.27 (d, J = 7.3 Hz, 1H), 8.01 (s, 1H), 7.45 (d, J = 7.6 Hz, 1H), 7.23 – 7.14 (m, 2H), 5.42 (s br, 1H), 4.05 (s, 2H), 4.05 – 4.00 (m, 2H), 3.88 – 3.82 (m, 1H), 2.87 – 2.70 (m, 2H), 1.12 (t, J = 6.9 Hz, 3H); ¹³C NMR (75MHz, DMSO-d₆) δ = 169.9, 166.2, 151.4, 137.5, 135.0, 124.1, 123.6, 122.8, 121.7, 112.5, 110.5, 61.1, 57.8, 33.0, 31.8, 14.3. HRMS (ESI-FTMS Mass (m/z): calcd for C₁₆H₁₉N₄O₂S [M + H]⁺ 331.1223, found 331.1226.



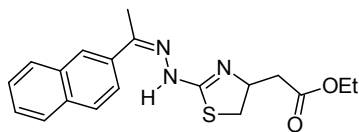
Ethyl 2-((2Z)-2-(1-phenylethylidene)hydrazinyl)-4,5-dihydro-1,3-thiazol-4-yl}acetate (36)

White powder, m. p. = 166.0 °C, yield = 85%, ¹H NMR (DMSO-d₆, 300MHz): δ (ppm) 7.96 (d, J = 8.1 Hz, 2H), 7.61 – 7.58 (m, 1H), 7.54 – 7.49 (m, 2H), 4.84 – 4.80 (m, 1H), 3.94 – 3.88 (m, 3H), 3.55 – 3.51 (m, 2H), 2.88 – 2.77 (m, 2H), 2.44 (s, 3H), 1.07 (t, J = 7.1 Hz, 3H); ¹³C NMR (75MHz, DMSO-d₆) δ = 180.5, 169.9, 166.0, 135.5, 132.7, 128.8, 128.4, 64.2, 61.0, 35.6, 31.7, 17.7, 14.2. HRMS (ESI-FTMS Mass (m/z): calcd for C₁₅H₂₀N₃O₂S [M + H]⁺ 306.1271, found 306.1275.



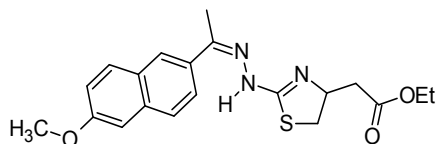
Ethyl 2-((2E)-2-((2-(3-(trifluoromethyl)phenyl)propylidene)hydrazinyl)-4,5-dihydro-1,3-thiazol-4-yl}acetate (37)

White powder, m. p. = 95.1 °C, yield = 76%, ¹H NMR (DMSO-d₆, 300MHz): δ (ppm) 9.61 (bs a, 1H), 8.24-8.22 (m, 2H), 7.98 (d, J = 7.5 Hz, 1H), 7.75 (t, J = 7.8 Hz, 1H), 4.84 – 4.80 (m, 1H), 3.94 – 3.87 (m, 3H), 3.51 (dd, J = 6.0, 11.3 Hz, 1H), 2.92 – 2.83 (m, 2H), 2.50 (s, 3H), 1.07 (t, J = 7.0 Hz, 3H); ¹³C NMR (75MHz, DMSO-d₆) δ = 179.0, 170.0, 165.9, 134.5 (¹J_{C-F} = 310 Hz), 130.2, 129.6 (²J_{C-F} = 32.0 Hz), 128.8, 126.2, 124.6, 122.6, 64.1, 60.8, 35.8, 31.7, 18.0, 14.2. HRMS (ESI-FTMS Mass (m/z): calcd for C₁₆H₁₉F₃N₃O₂S [M + H]⁺ 374.1145, found 374.1144.



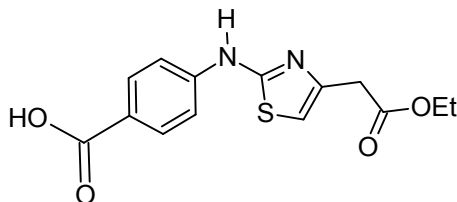
Ethyl (2-((2E)-2-[2-(naphthalen-2-yl)propylidene]hydrazinyl)-4,5-dihydro-1,3-thiazol-4-yl)acetate (38)

White powder, m. p. = 191.0 °C, yield = 70%, ¹H NMR (DMSO-d₆, 300MHz): δ (ppm) 9.70 (br s, 1H), 8.60 (s, 1H), 8.09 – 8.07 (m, 2H), 8.00 – 7.98 (m, 2H), 7.62 (s, 2H), 4.87 (br s, 1H), 3.96 – 3.87 (m, 3H), 3.53 – 3.45 (m, 2H), 2.96-2.82 (m, Hz, 2H), 2.57 (s, 2H), 1.01 (t, J = 3.9 Hz, 3H); ¹³C NMR (75MHz, DMSO-d₆) δ = 180.3, 169.9, 166.0, 134.9, 132.9, 132.6, 130.1, 129.6, 128.6, 128.1, 128.0, 127.3, 124.3, 64.3, 60.9, 35.7, 31.8, 17.8, 14.2. HRMS (ESI-FTMS Mass (m/z): calcd for C₁₉H₂₂N₃O₂S [M + H]⁺ 356.1427, found 356.143.



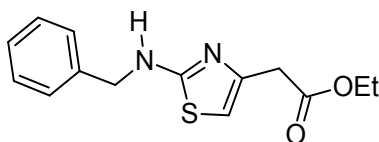
Ethyl (2-((2Z)-2-[1-(6-methoxynaphthalen-2-yl)ethylidene]hydrazinyl)-4,5-dihydro-1,3-thiazol-4-yl)acetate (39)

White powder, m. p. = 216.2 °C, yield = 68%, ¹H NMR (DMSO-d₆, 300MHz): δ (ppm) 8.48 (s, 1H), 8.02 (dd, J = 8.7, 13.4 Hz, 2H), 7.88 (d, J = 8.7 Hz, 1H), 7.40 (s, 1H), 7.25 (dd, J = 2.1, 8.9 Hz, 1H), 4.82-4.77 (m, 1H), 3.91-3.85 (s, 6H), 3.52-3.50 (m, 1H), 2.85 (m, 2H), 2.50 (s, 3H), 1.03 (t, J = 7.0 Hz, 3H); ¹³C NMR (75MHz, DMSO-d₆) δ = 179.1, 170.0, 165.2, 159.4, 136.7, 131.2, 130.7, 129.7, 127.9, 127.0, 124.8, 119.8, 106.4, 64.1, 60.9, 55.8, 35.9, 31.5, 17.4, 14.2. HRMS (ESI-FTMS Mass (m/z): calcd for C₂₀H₂₄N₃O₃S [M + H]⁺ 386.1533, found 386.1536.



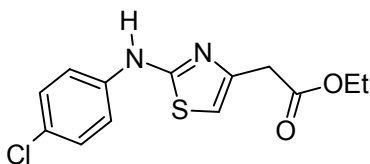
4-[[4-(2-Ethoxy-2-oxoethyl)-1,3-thiazol-2-yl]amino]benzoic acid (40)

White powder, m. p. = 273.0 °C, yield = 90%, ¹H NMR (DMSO-d₆, 300MHz): δ (ppm) 8.14 (d, J = 8.4 Hz, 2H), 7.62 (d, J = 8.4 Hz, 2H), 7.07 (s, 1H), 3.85 (q, J = 7.0 Hz, 2H), 3.56 (s, 2H), 0.97 (t, J = 7.1 Hz, 3H); ¹³C NMR (75MHz, DMSO-d₆) δ = 169.7, 168.2, 166.8, 136.3, 134.2, 133.7, 131.8, 129.5, 107.1, 61.4, 33.6, 14.1. HRMS (ESI-FTMS Mass (m/z): calcd for C₁₄H₁₅N₂O₄S [M + H]⁺ 307.0747, found 307.0751.



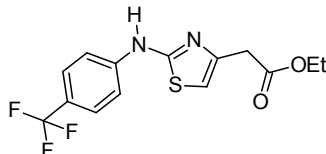
Ethyl [2-(benzylamino)-1,3-thiazol-4-yl]acetate (41)

White powder, m. p. = 220.0 °C, yield = 85%, ¹H NMR (DMSO-d₆, 300MHz): δ (ppm) 9.69 (br s, 1H), 7.41 – 7.33 (m, 3H), 7.08 (d, J = 7.0 Hz, 2H), 7.01 (s, 1H), 5.30 (s, 2H), 3.84 (q, J = Hz, 2H), 3.76 (s, 2H), 1.06 (t, J = 7.0 Hz, 3H); ¹³C NMR (75MHz, DMSO-d₆) δ = 169.6, 168.3, 134.5, 133.7, 129.2, 128.5, 126.5, 107.4, 61.5, 48.7, 33.1, 14.2. HRMS (ESI-FTMS Mass (m/z): calcd for C₁₄H₁₇N₂O₂S [M + H]⁺ 277.1005, found 277.1008.



Ethyl {2-[(4-chlorophenyl)amino]-1,3-thiazol-4-yl}acetate (42)

Brownish solid, m. p. = 220.0 °C, yield = 99%, ¹H NMR (DMSO-d₆, 300MHz): 7.90 (d, J = 8.4 Hz, 2H), 7.56 (s, 1H), 7.53 (d, J = 8.4 Hz, 2H), 4.11 (q, J = 6.9 Hz, 2H), 3.87 (s, 2H), 1.18 (t, J = 7.0 Hz, 3); ¹³C NMR (75MHz, CDCl₃) δ = 169.9, 166.0, 149.6, 135.4, 131.5, 128.6, 127.3, 115.9, 60.7, 36.6, 13.7. HRMS (ESI-FTMS Mass (m/z): calcd for C₁₃H₁₄N₂O₂S [M + H]⁺ 297.7799, found 297.7797.

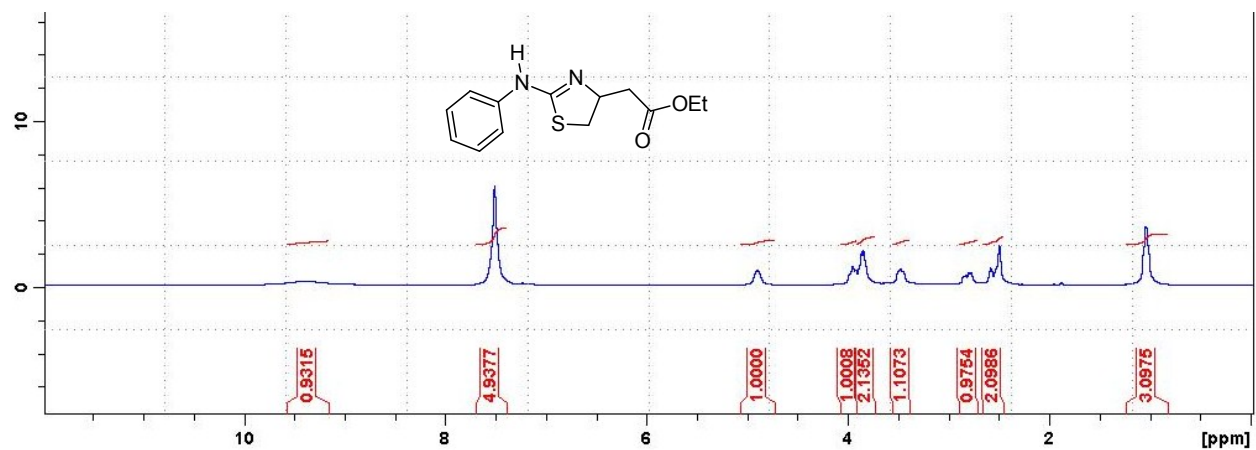


Ethyl (2-{[4-(trifluoromethyl)phenyl]amino}-1,3-thiazol-4-yl)acetate (43)

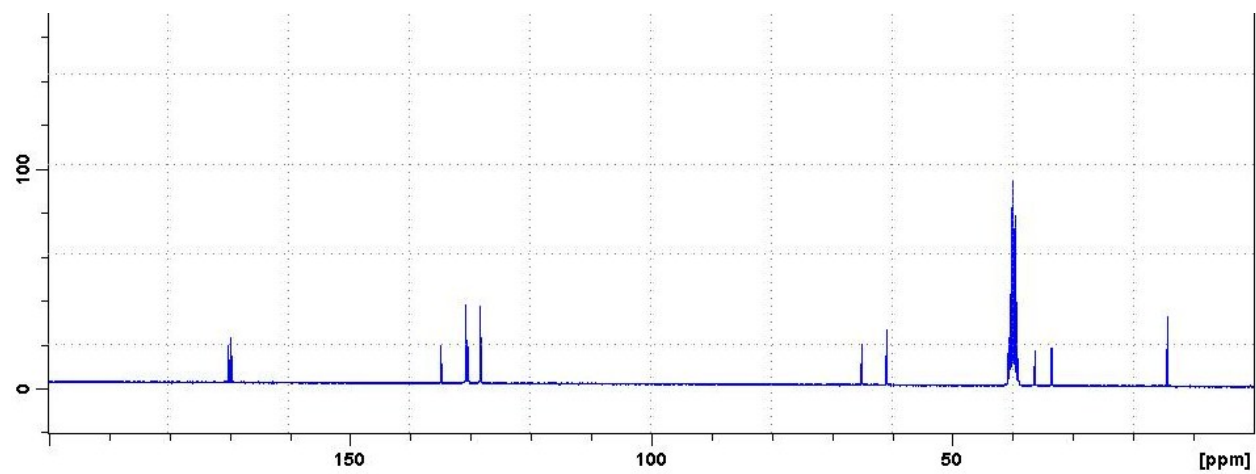
Viscous liquid, yield = 99%, ¹H NMR (CDCl₃, 300MHz): 8.06 (d, J = 8.2 Hz, 2H), 7.69 (d, J = 8.2 Hz, 2H), 7.29 (s, 1H), 4.23 (q, J = 7.1 Hz, 2H), 3.92 (s, 2H), 1.41 (t, J = 7.3 Hz, 3H); ¹³C NMR (75MHz, CDCl₃) δ = 170.3, 165.9, 150.4, 136.5, 131.5 (²J = 32.5 Hz), 126.7, 125.9 (³J = 3.7 Hz), 117.2, 61.2, 37.0, 14.2. HRMS (ESI-FTMS Mass (m/z): calcd for C₁₄H₁₄F₃N₂O₂S [M + H]⁺ 331.3328, found 331.3328.

Ethyl (2-anilino-4,5-dihydro-1,3-thiazol-4-yl)acetate (1)

¹H NMR of 1

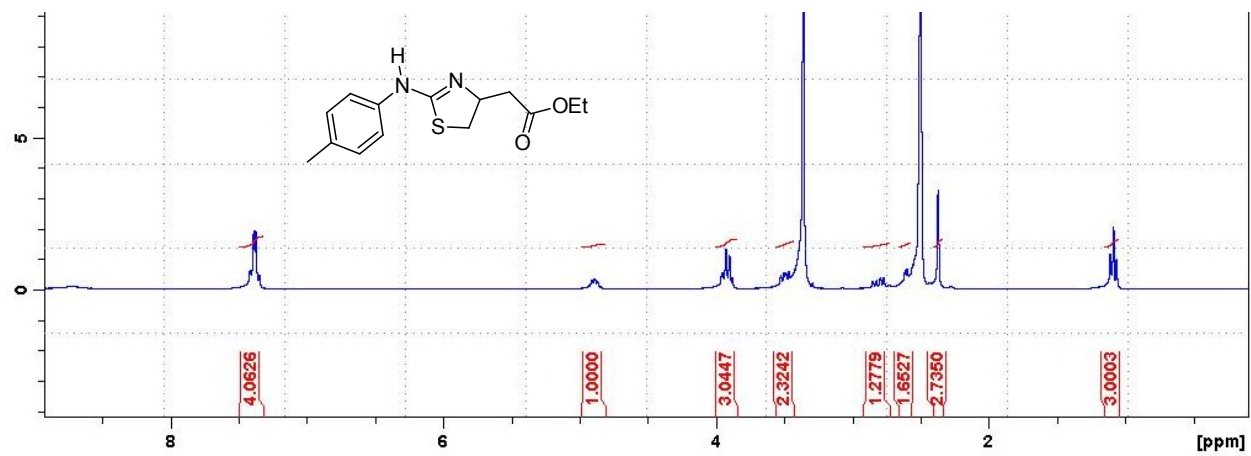


¹³C NMR of 1

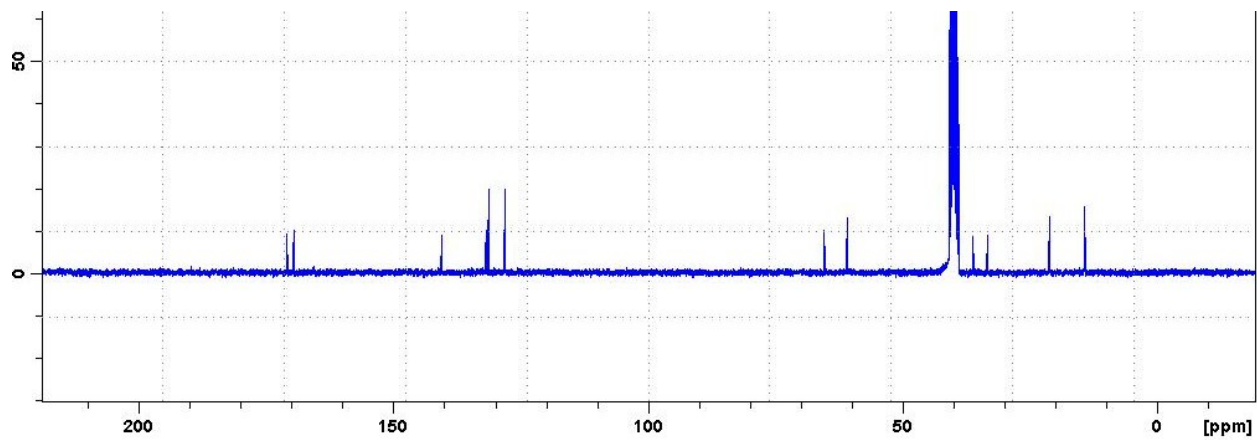


Ethyl [2-(4-methylanilino)-4,5-dihydro-1,3-thiazol-4-yl]acetate (2)

¹H NMR of 2

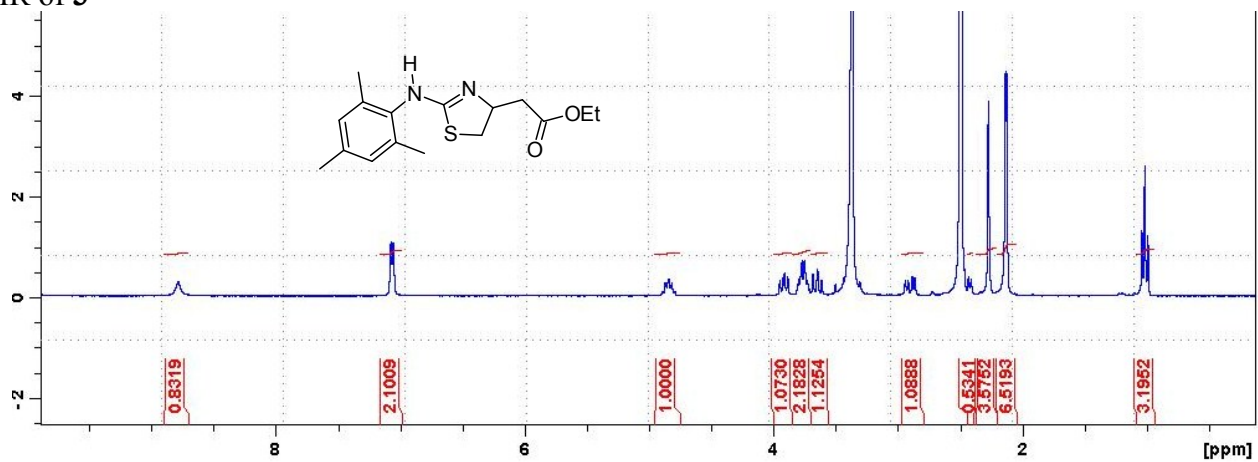


¹³C NMR of 2

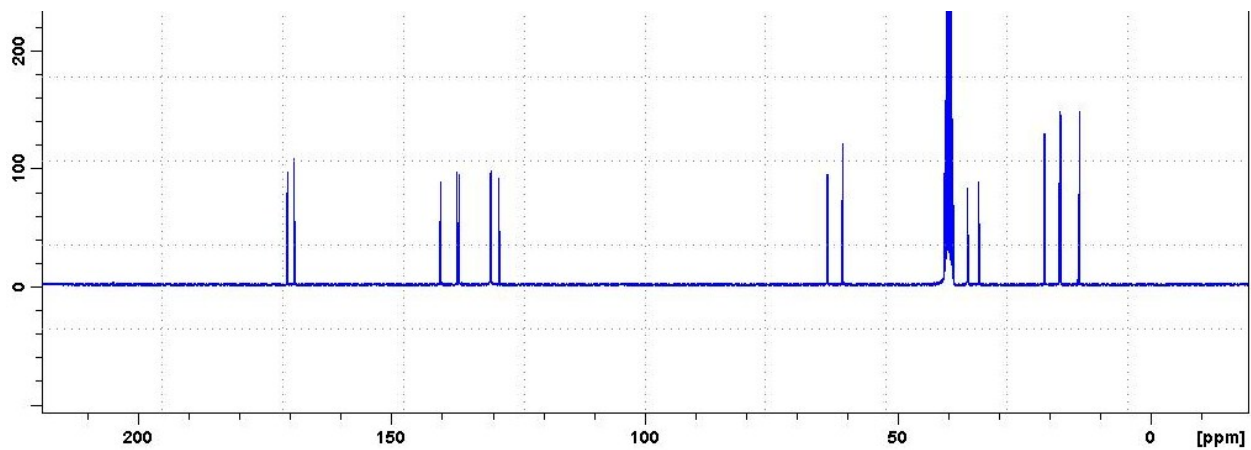


Ethyl [2-(2,4,6-trimethylanilino)-4,5-dihydro-1,3-thiazol-4-yl]acetate (3)

¹H NMR of 3

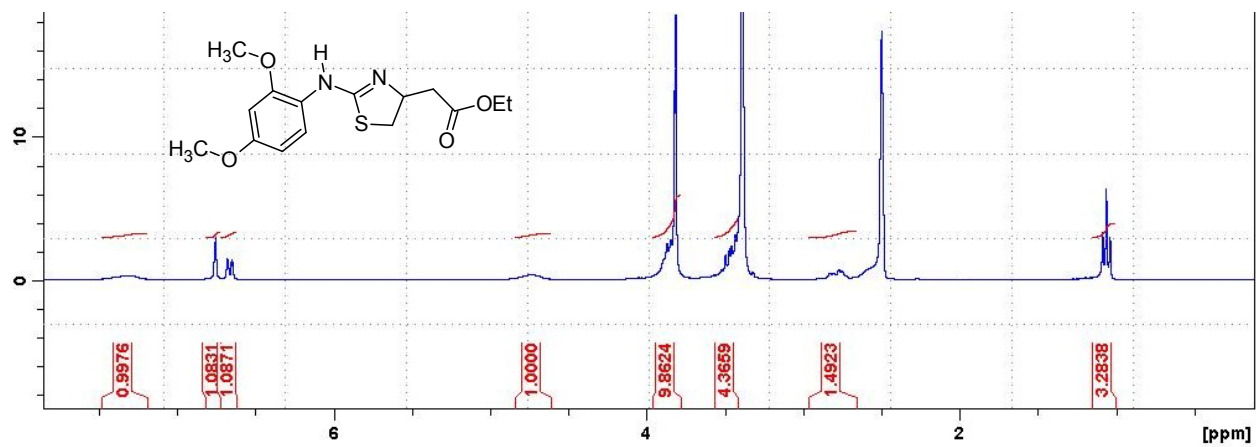


¹³C NMR of 3

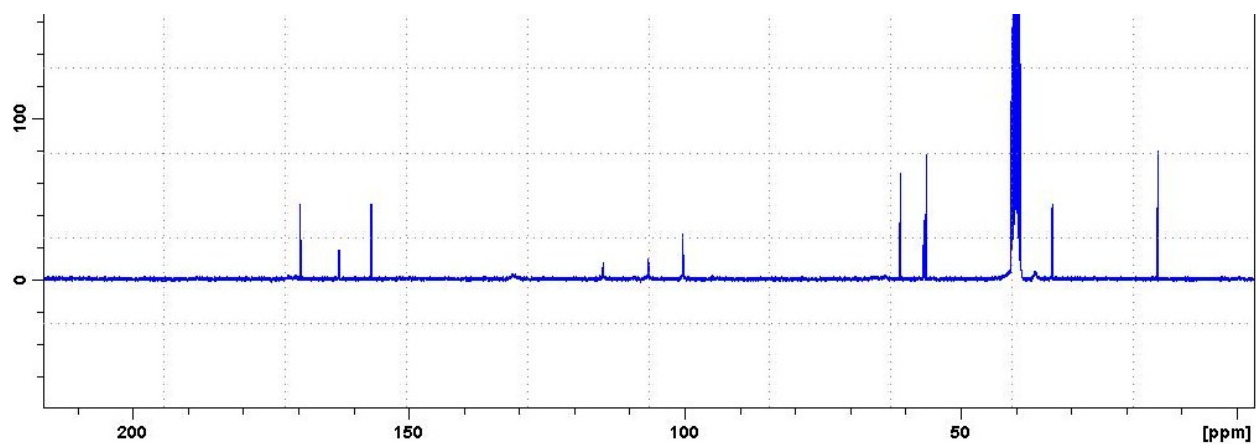


Ethyl [2-(2,4-dimethoxyanilino)-4,5-dihydro-1,3-thiazol-4-yl]acetate (4)

¹H NMR of 4

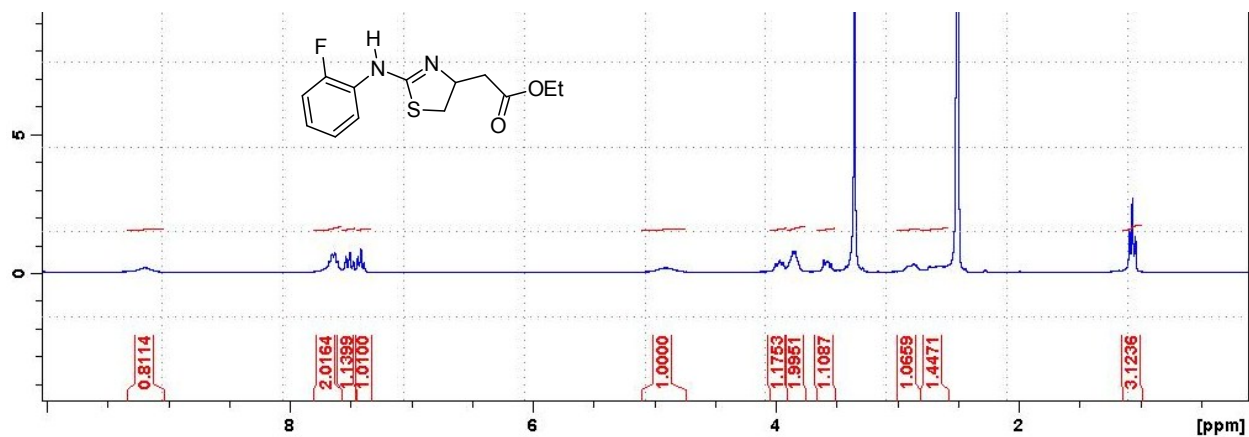


¹³C NMR of 4

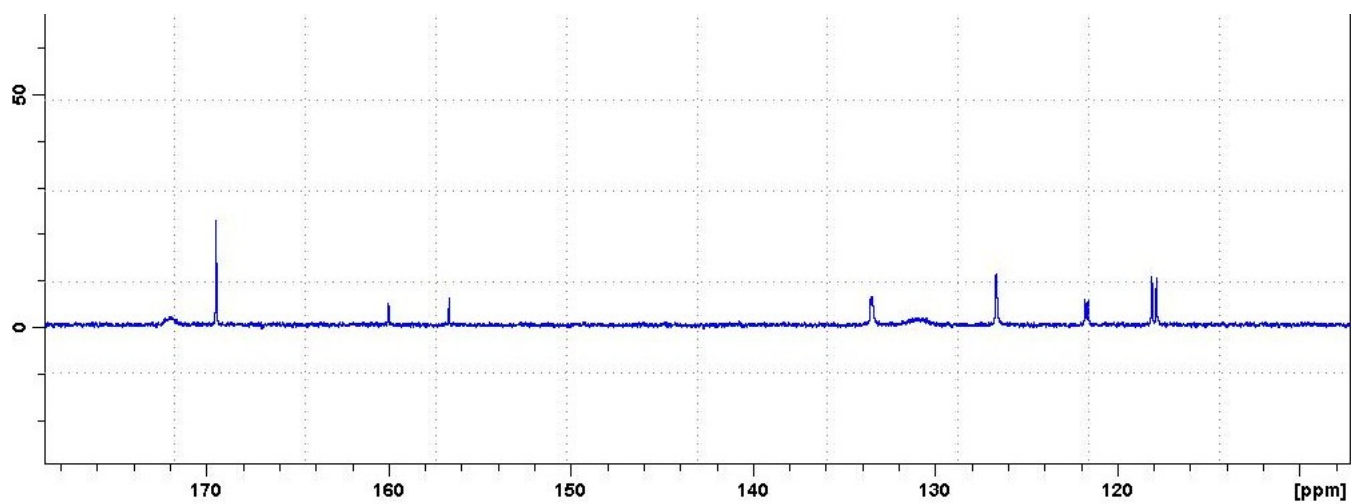
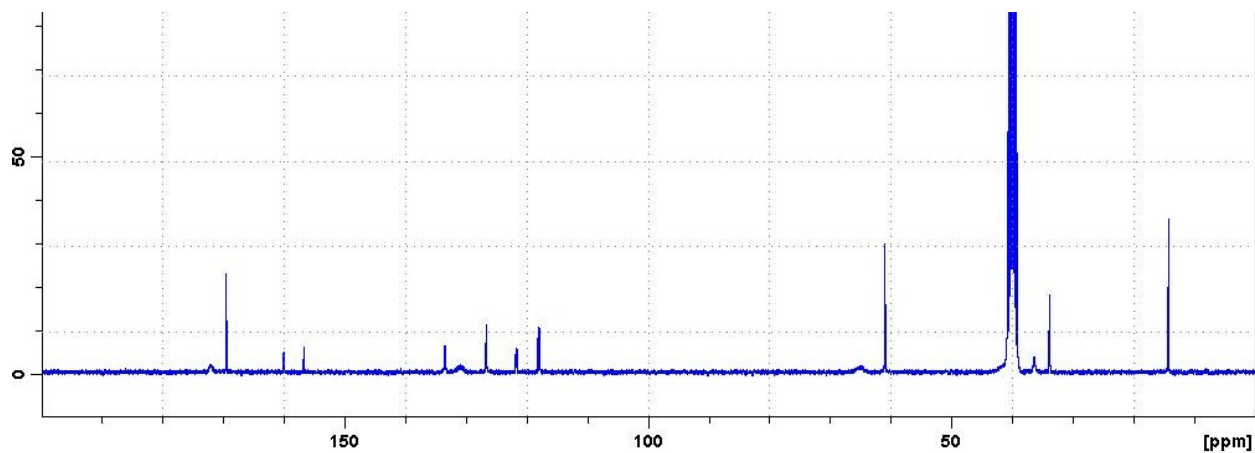


Ethyl [2-(2-fluoroanilino)-4,5-dihydro-1,3-thiazol-4-yl]acetate (5)

¹H NMR of 5

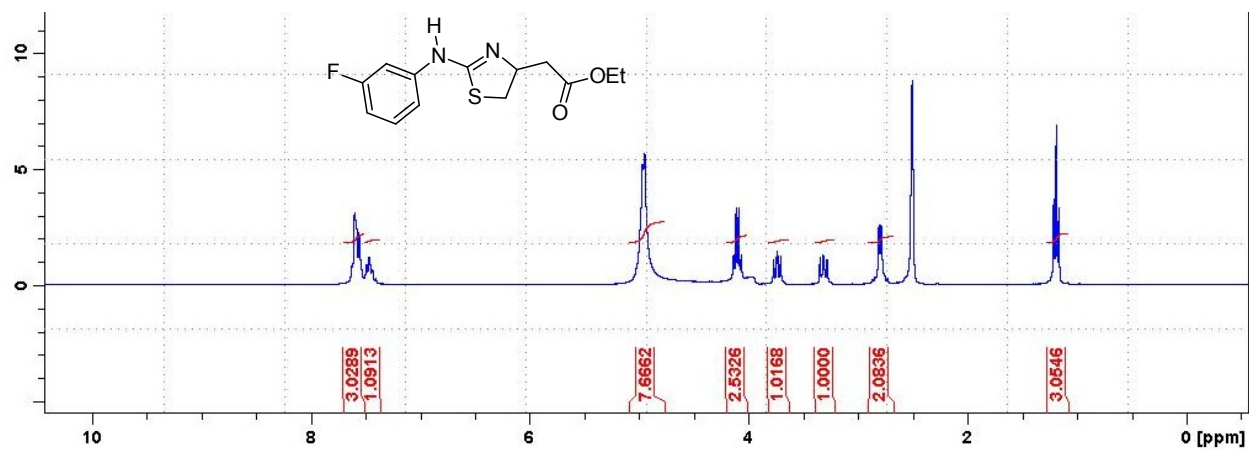


¹³C NMR of 5

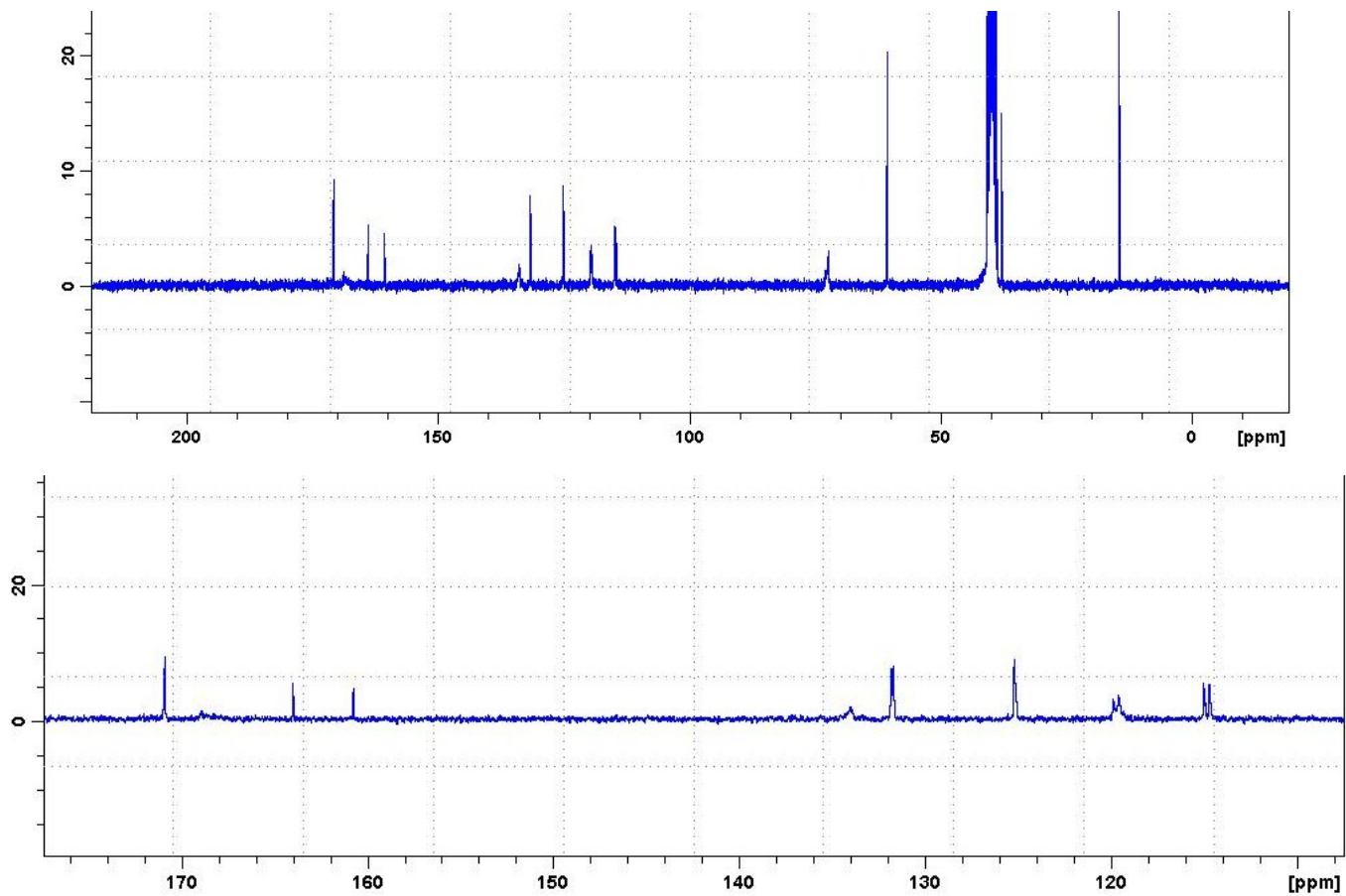


Ethyl [2-(3-fluoroanilino)-4,5-dihydro-1,3-thiazol-4-yl]acetate (6)

¹H NMR of 6

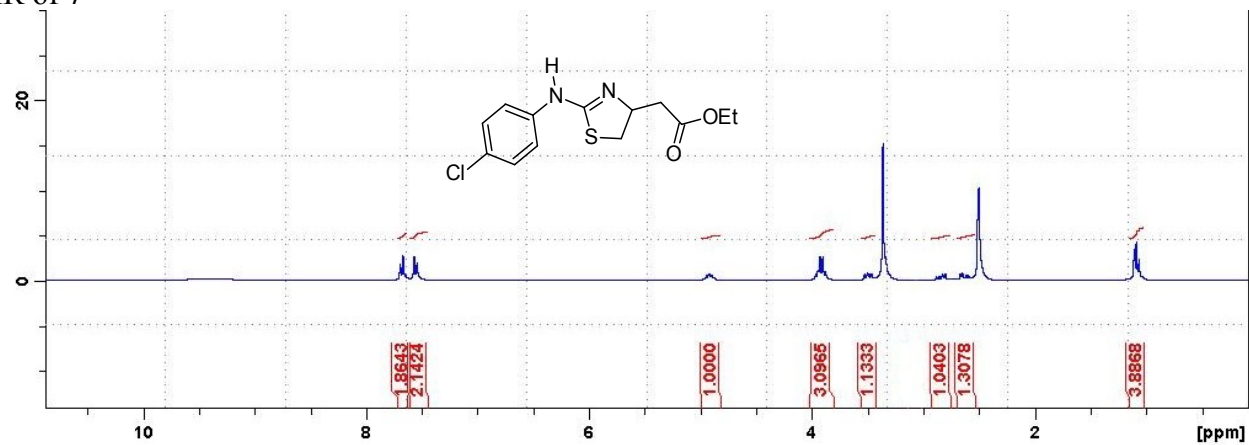


¹³C NMR of 6

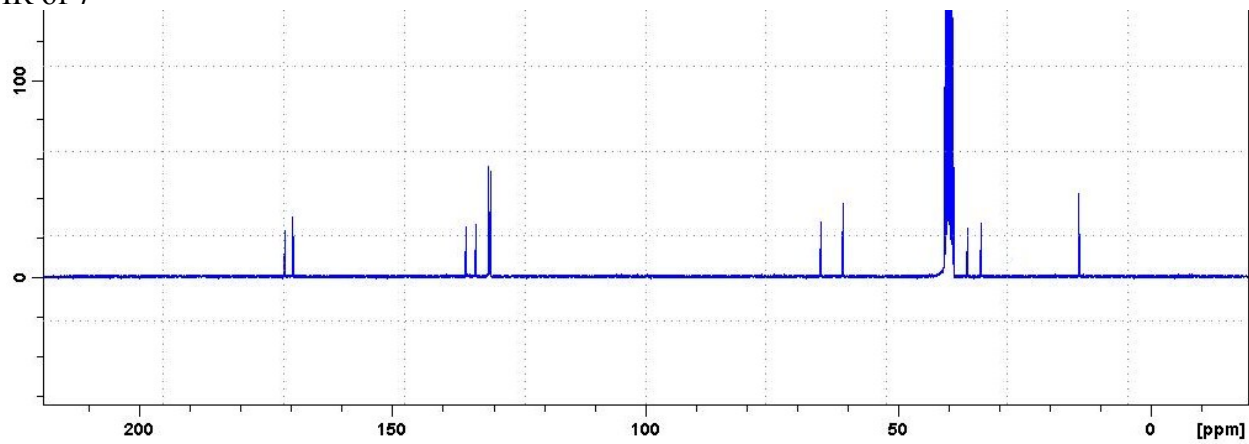


Ethyl [2-(4-chloroanilino)-4,5-dihydro-1,3-thiazol-4-yl]acetate (7)

¹H NMR of 7

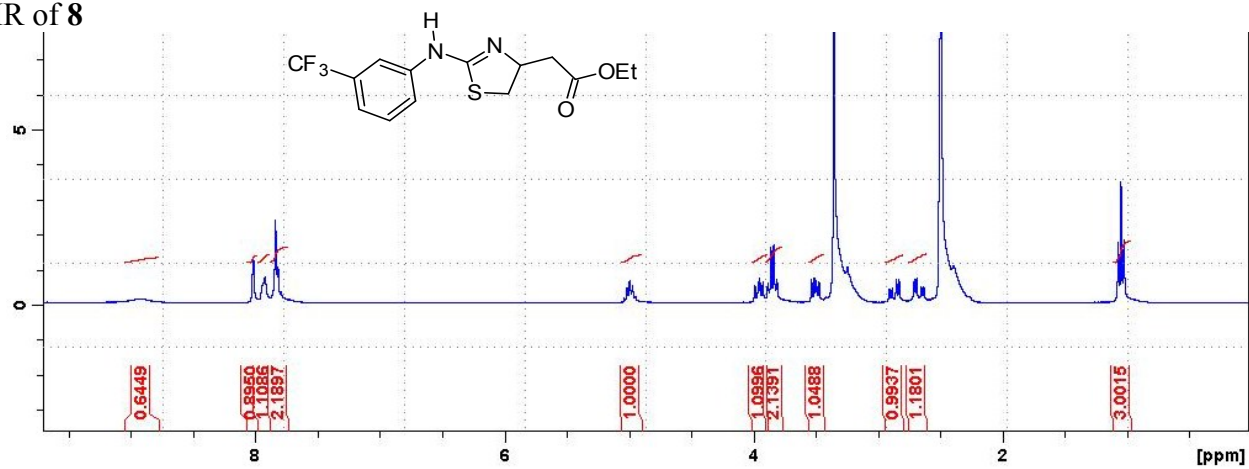


¹³C NMR of 7

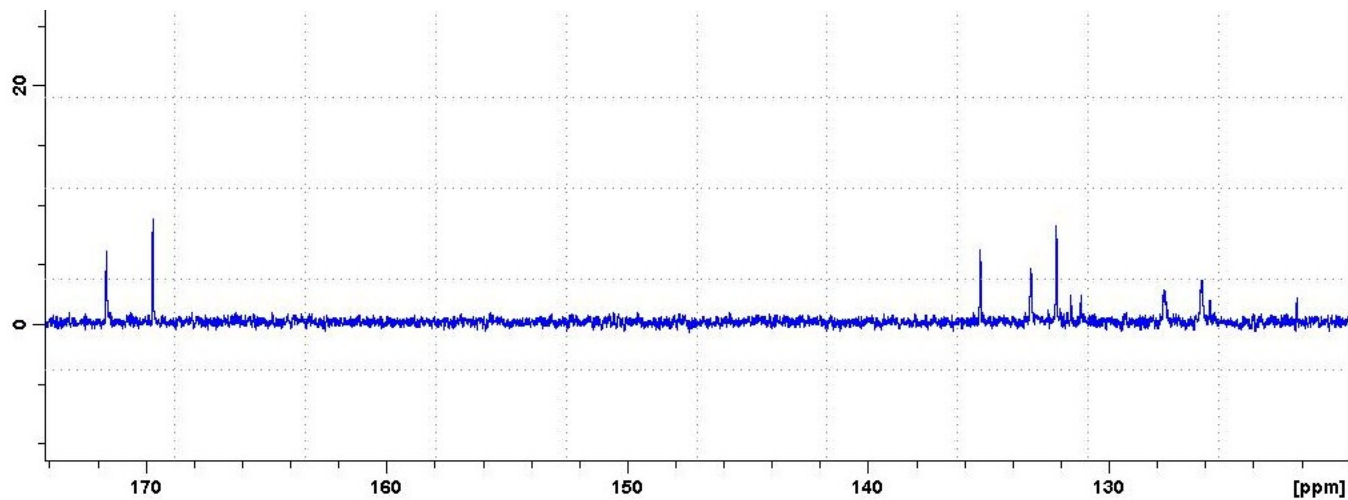
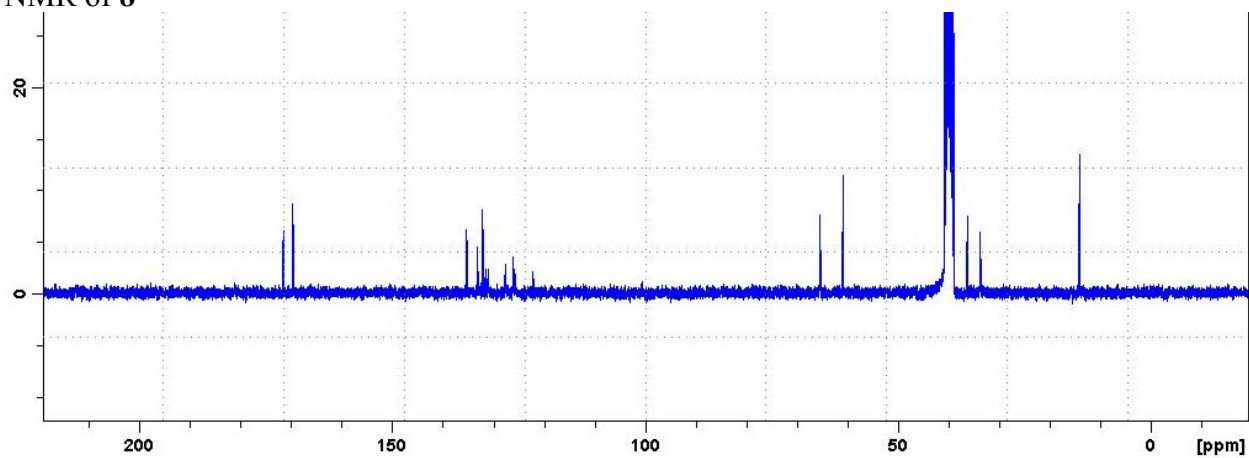


Ethyl {2-[3-(trifluoromethyl)anilino]-4,5-dihydro-1,3-thiazol-4-yl}acetate (8)

¹H NMR of 8

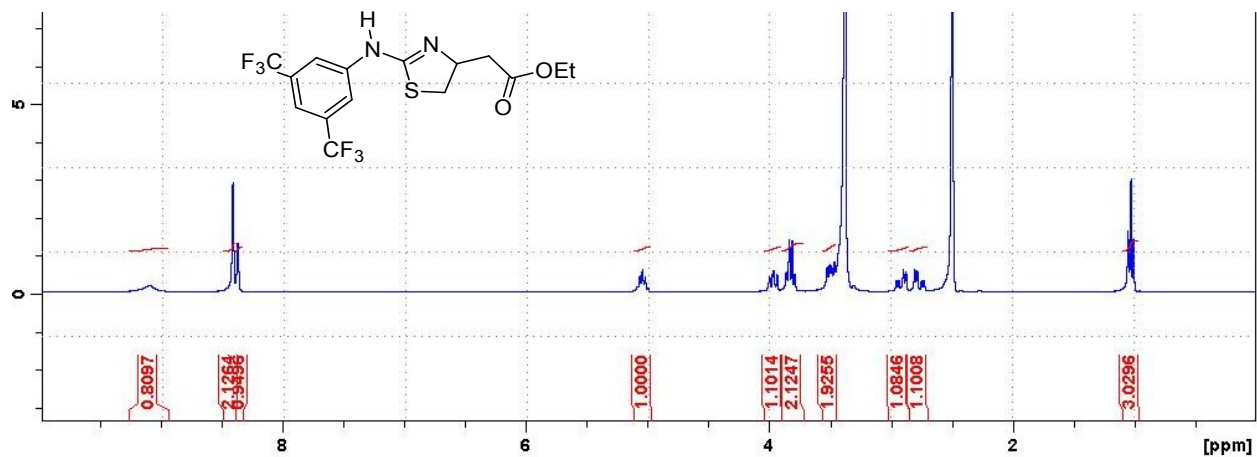


¹³C NMR of 8

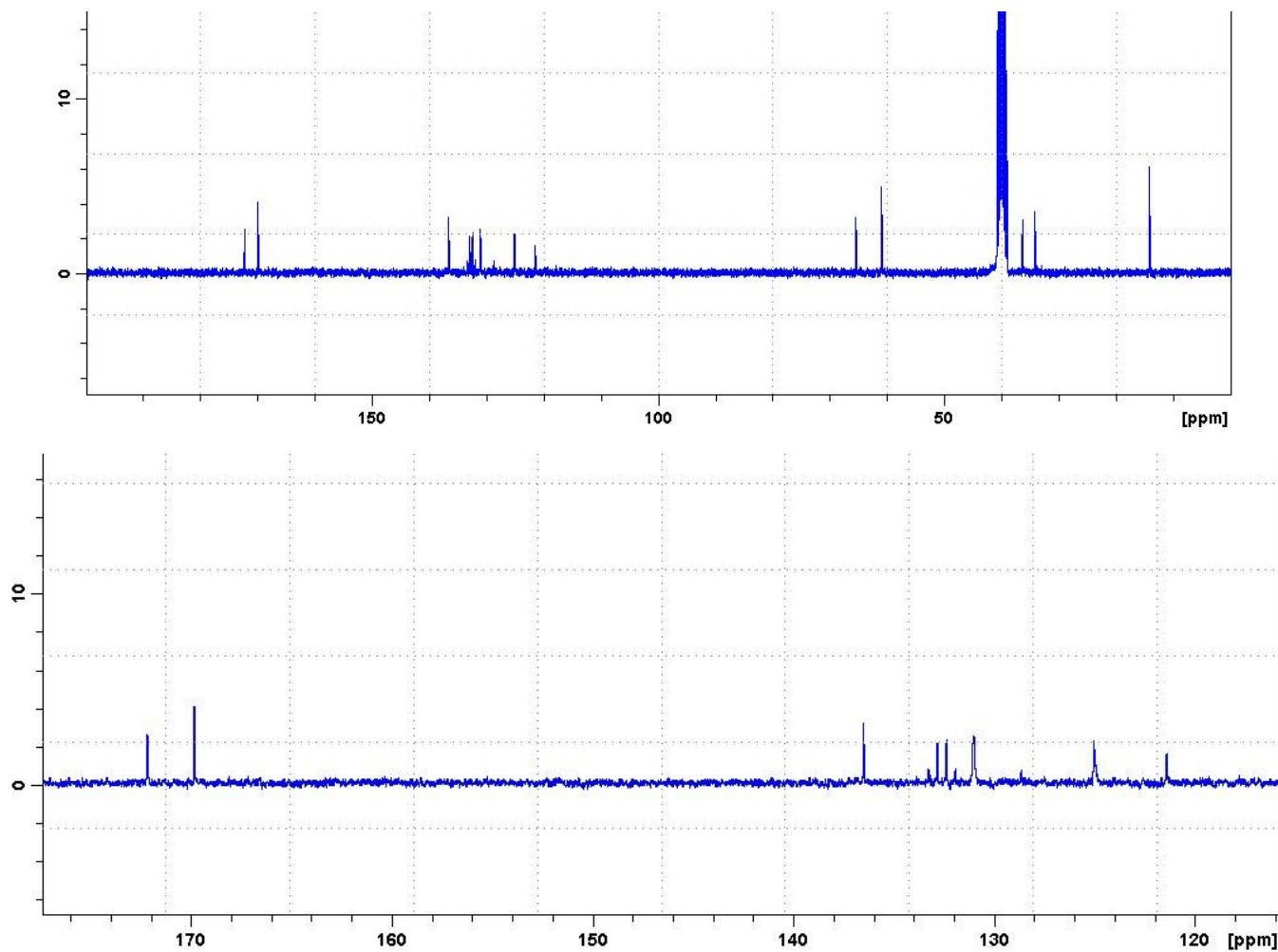


Ethyl {2-[3,5-bis(trifluoromethyl)anilino]-4,5-dihydro-1,3-thiazol-4-yl}acetate (9)

¹H NMR of 9

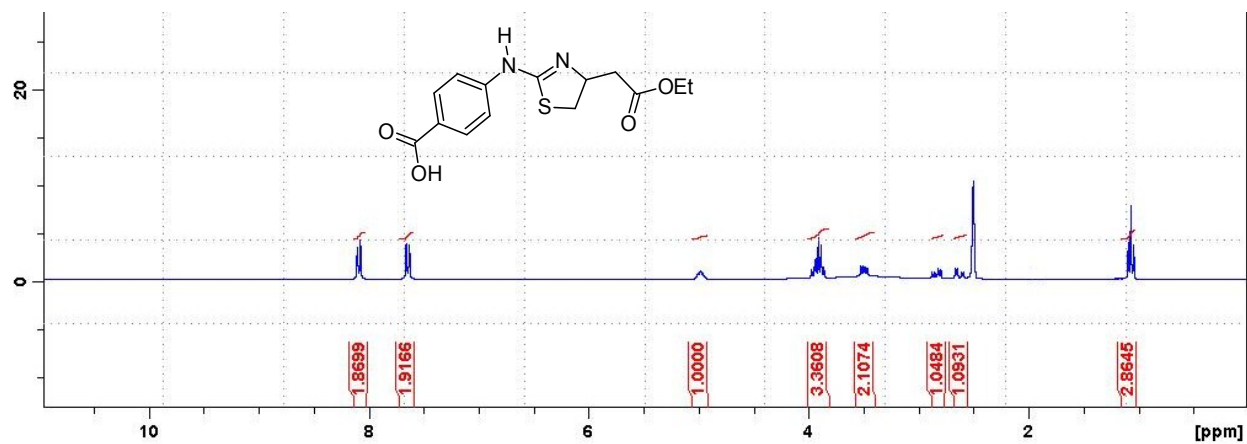


¹³C NMR of 9

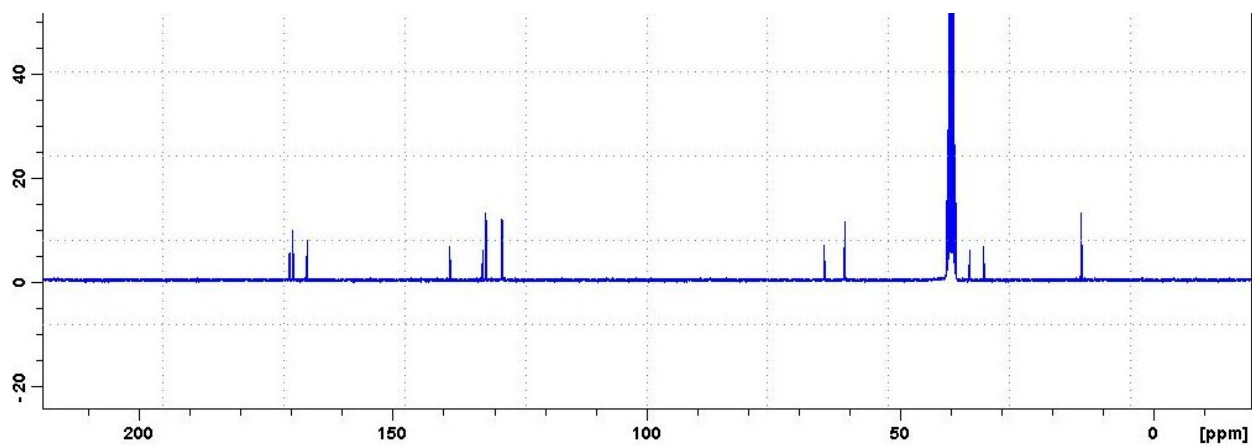


4-{{4-(2-Ethoxy-2-oxoethyl)-4,5-dihydro-1,3-thiazol-2-yl}amino}benzoic acid (10)

¹H NMR of 10

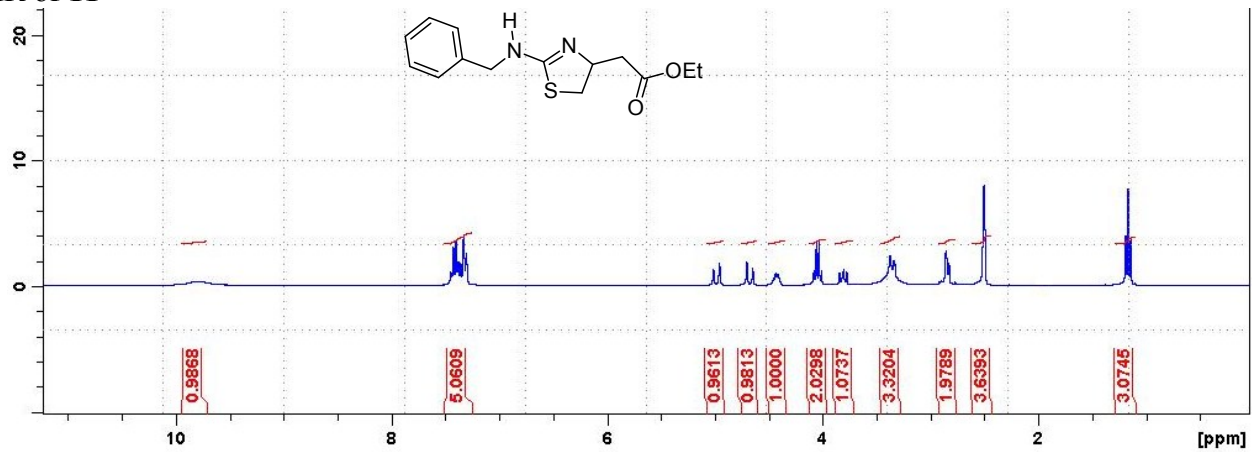


¹³C NMR of 10

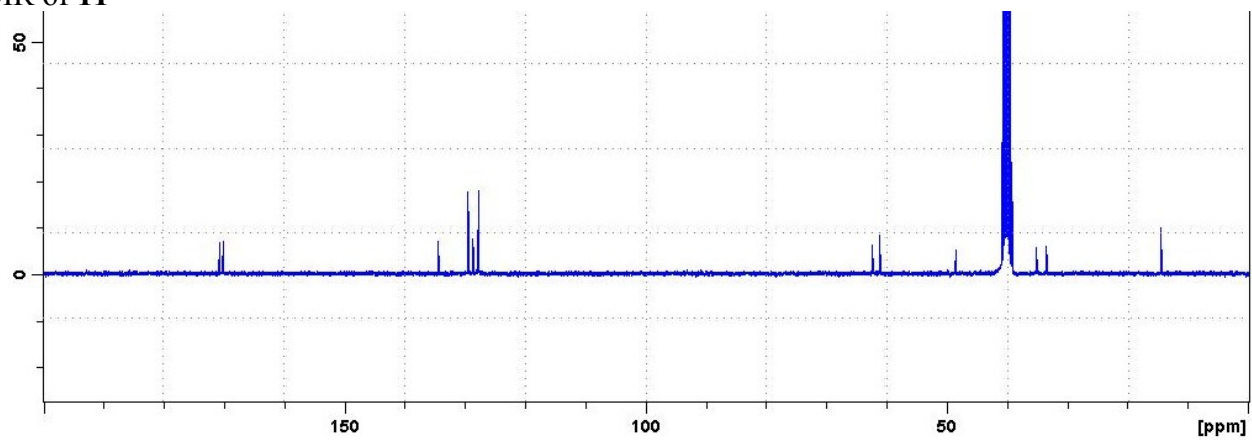


Ethyl [2-(benzylamino)-4,5-dihydro-1,3-thiazol-4-yl]acetate (11)

¹H NMR of **11**

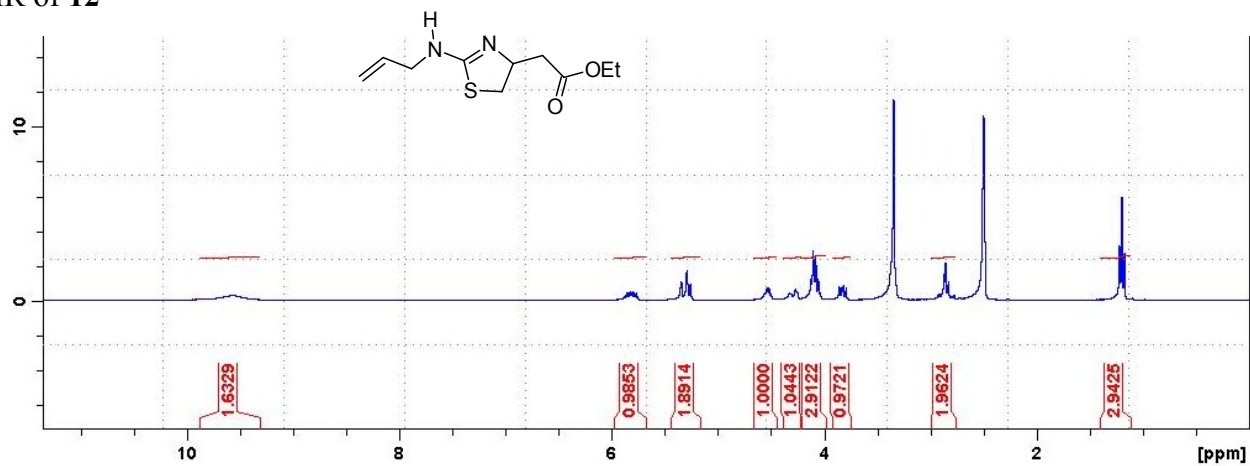


¹³C NMR of **11**

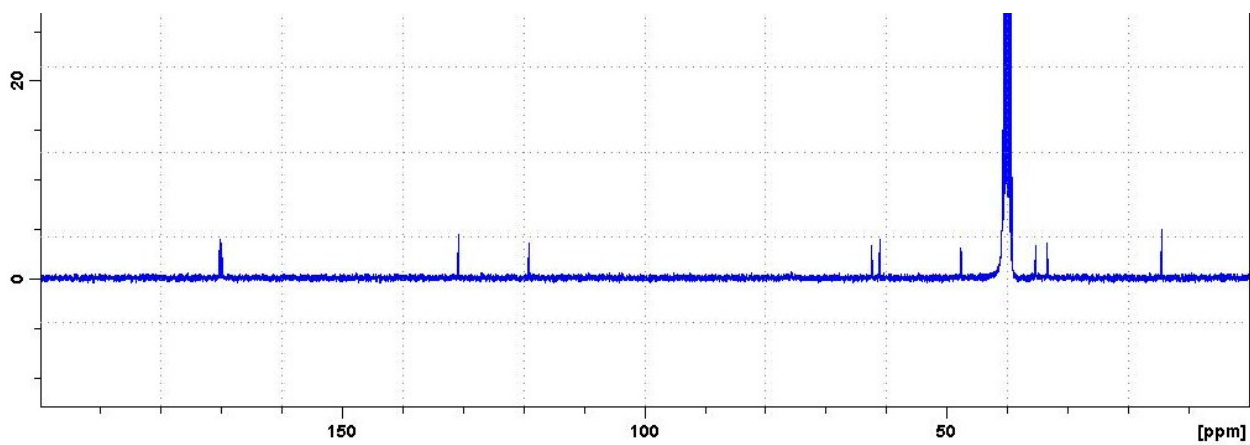


Ethyl {2-[(prop-2-en-1-yl)amino]-4,5-dihydro-1,3-thiazol-4-yl}acetate (12)

¹H NMR of 12

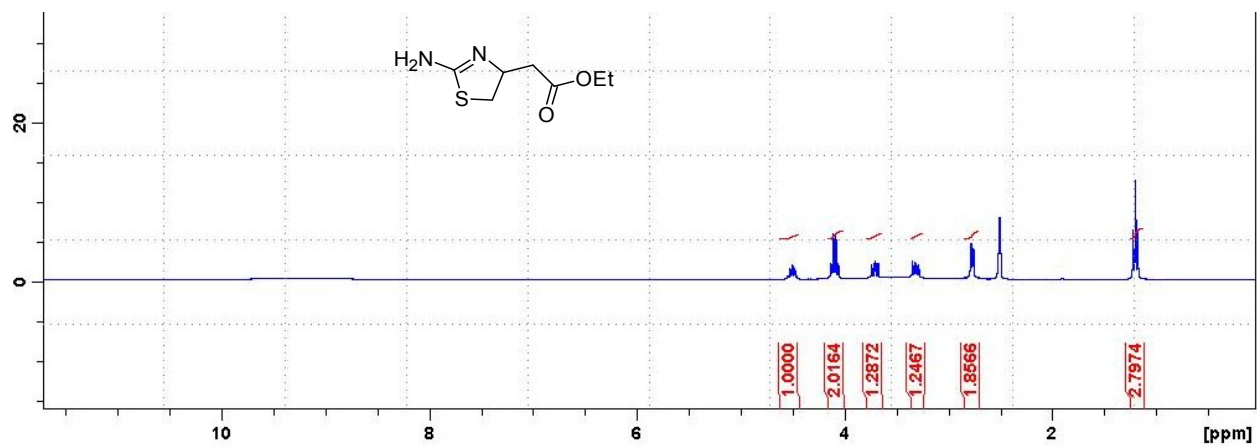


¹³C NMR of 12

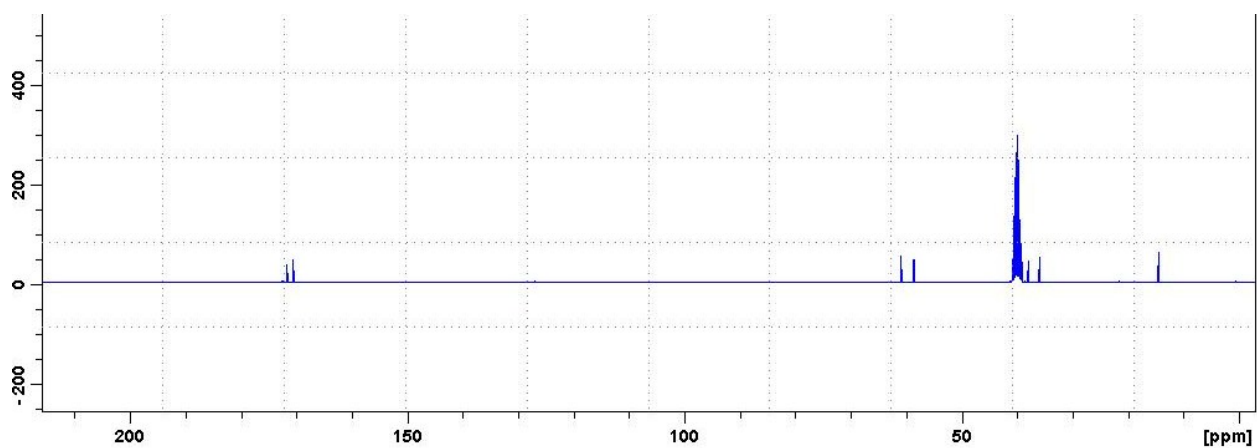


Ethyl (2-amino-4,5-dihydro-1,3-thiazol-4-yl)acetate (13)

^1H NMR of 13

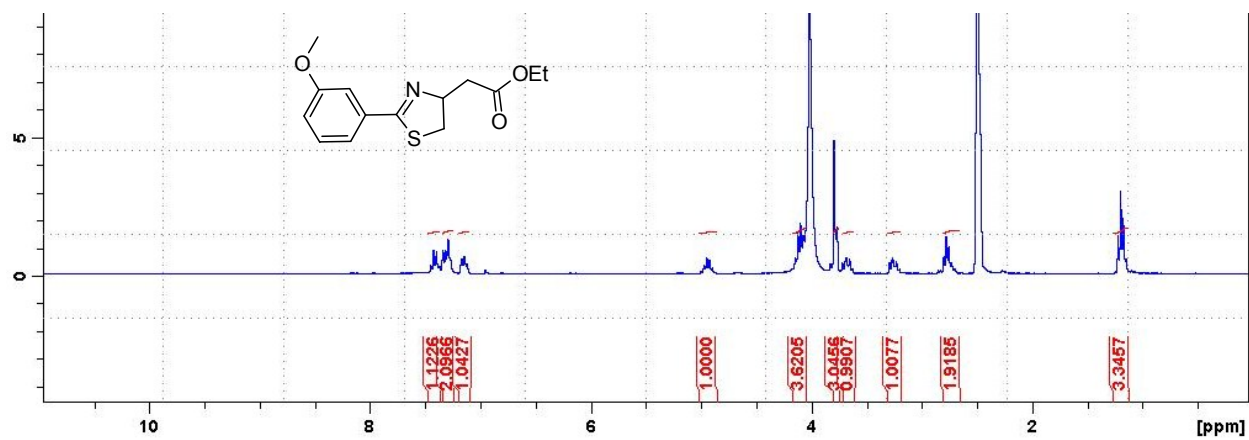


^{13}C NMR of 13

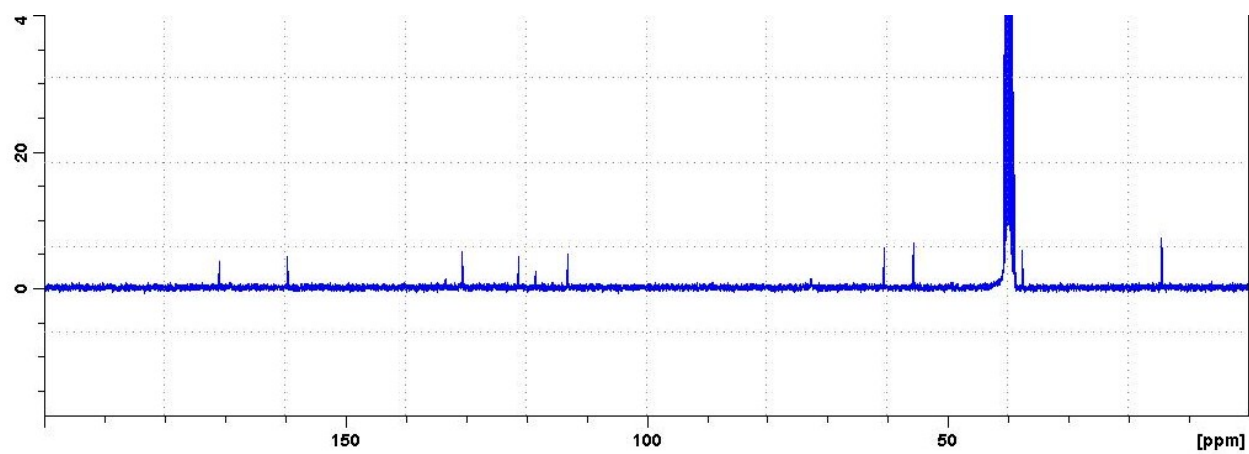


Ethyl [2-(3-methoxyphenyl)-4,5-dihydro-1,3-thiazol-4-yl]acetate (14)

¹H NMR of 14

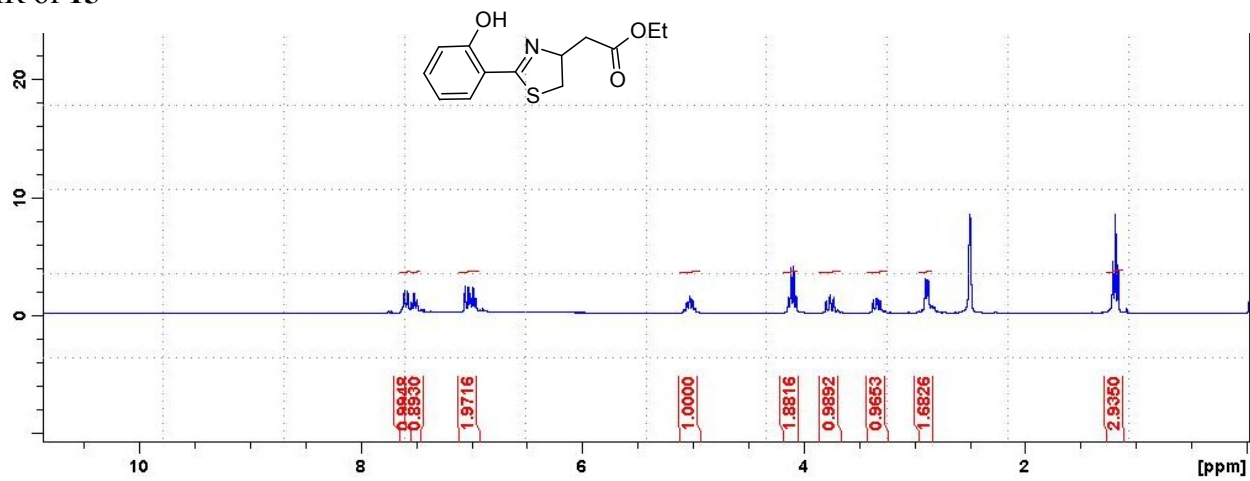


¹³C NMR of 14

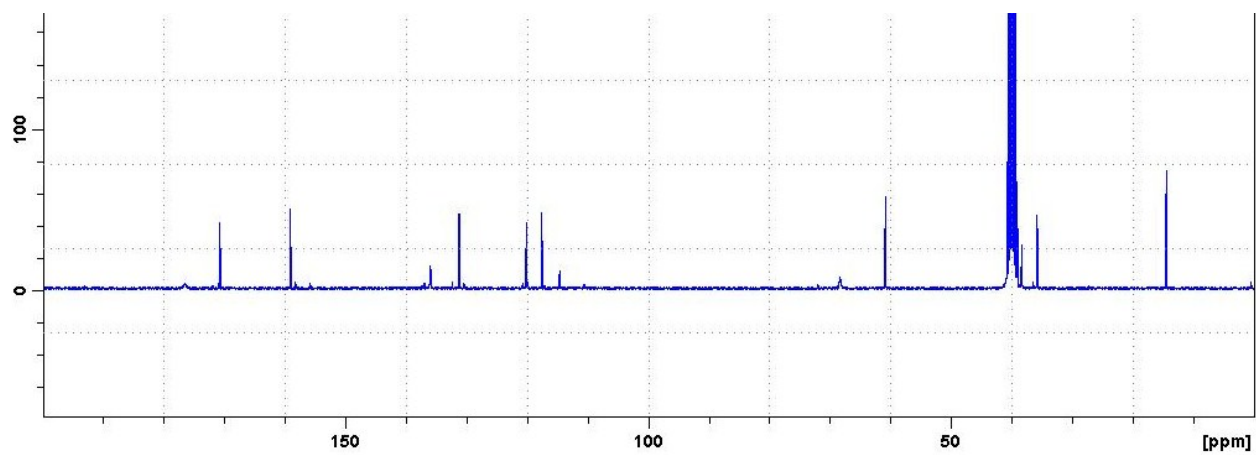


Ethyl [2-(2-hydroxyphenyl)-4,5-dihydro-1,3-thiazol-4-yl]acetate (15)

¹H NMR of 15

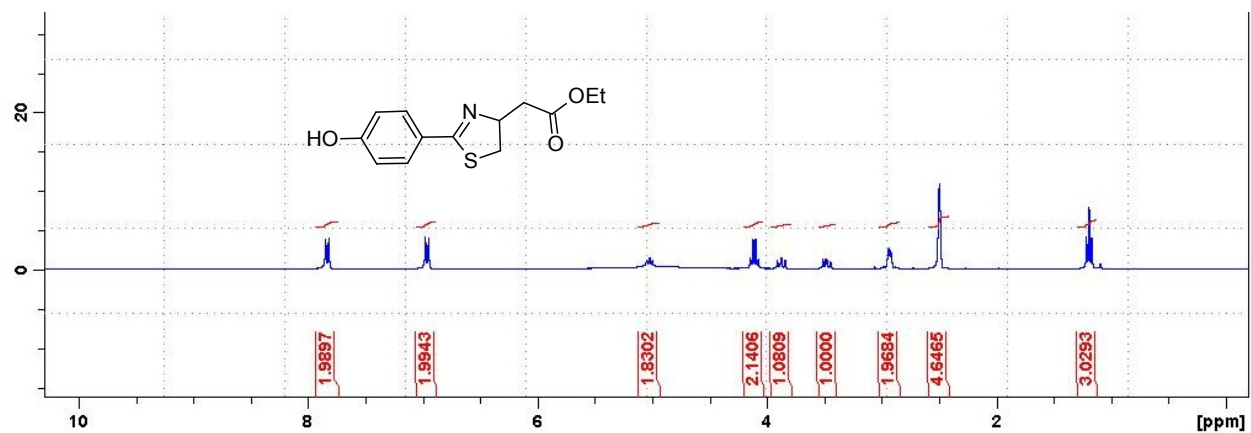


¹³C NMR of 15

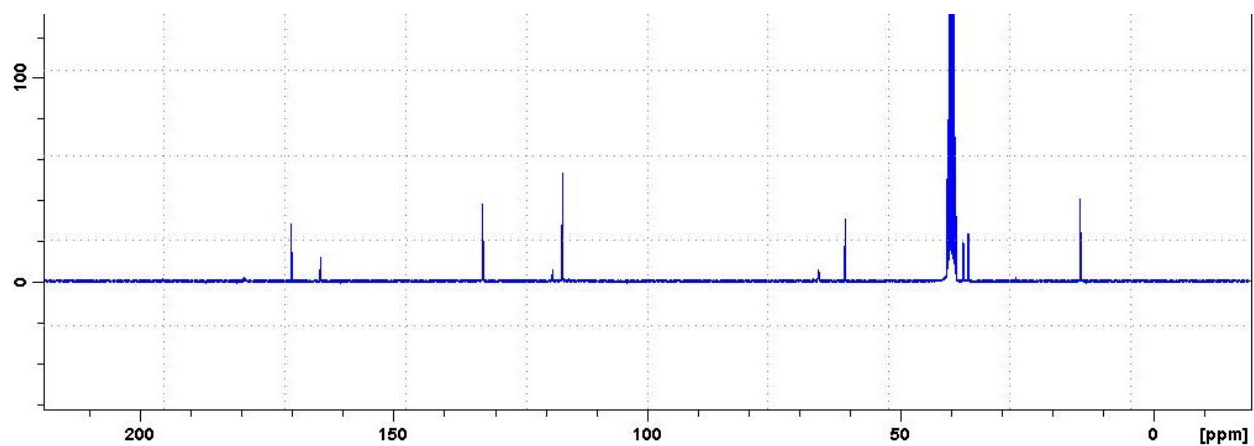


Ethyl [2-(4-hydroxyphenyl)-4,5-dihydro-1,3-thiazol-4-yl]acetate (16)

¹H NMR of 16

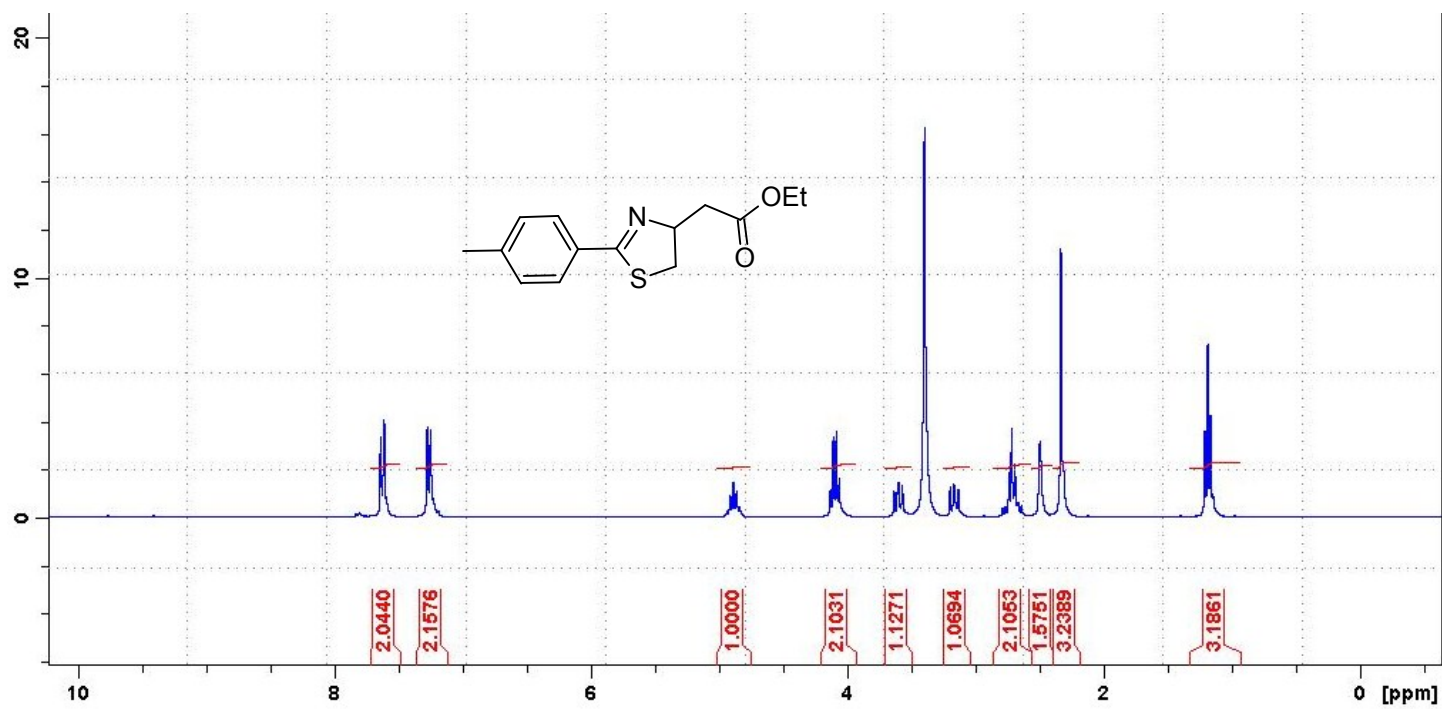


¹³C NMR of 16

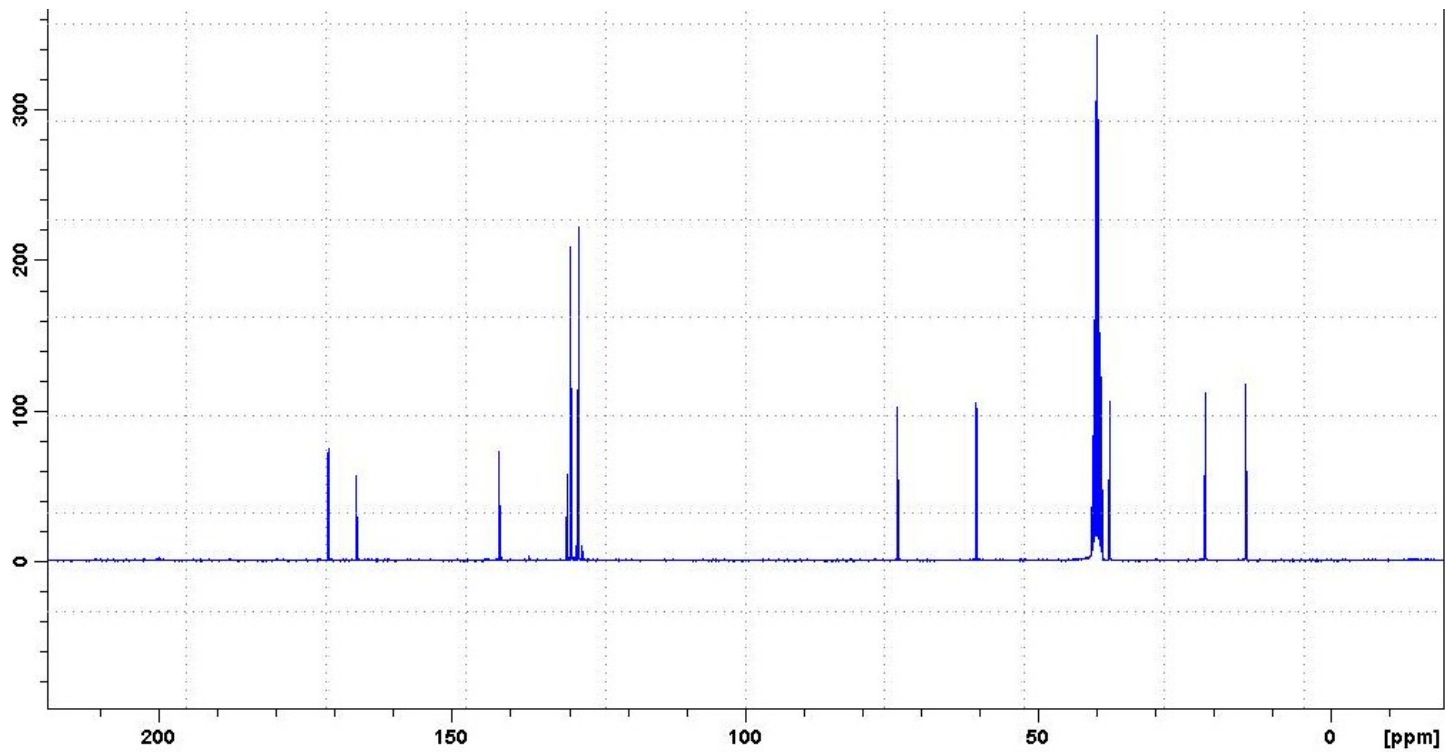


Ethyl [2-(4-methylphenyl)-4,5-dihydro-1,3-thiazol-4-yl]acetate (17)

¹H NMR of 17

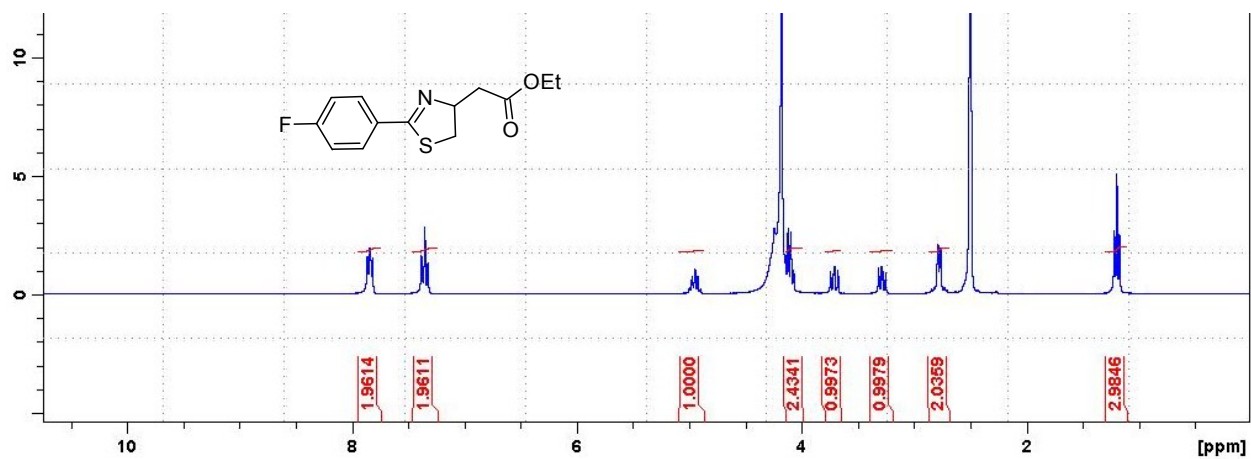


¹³C NMR of 17

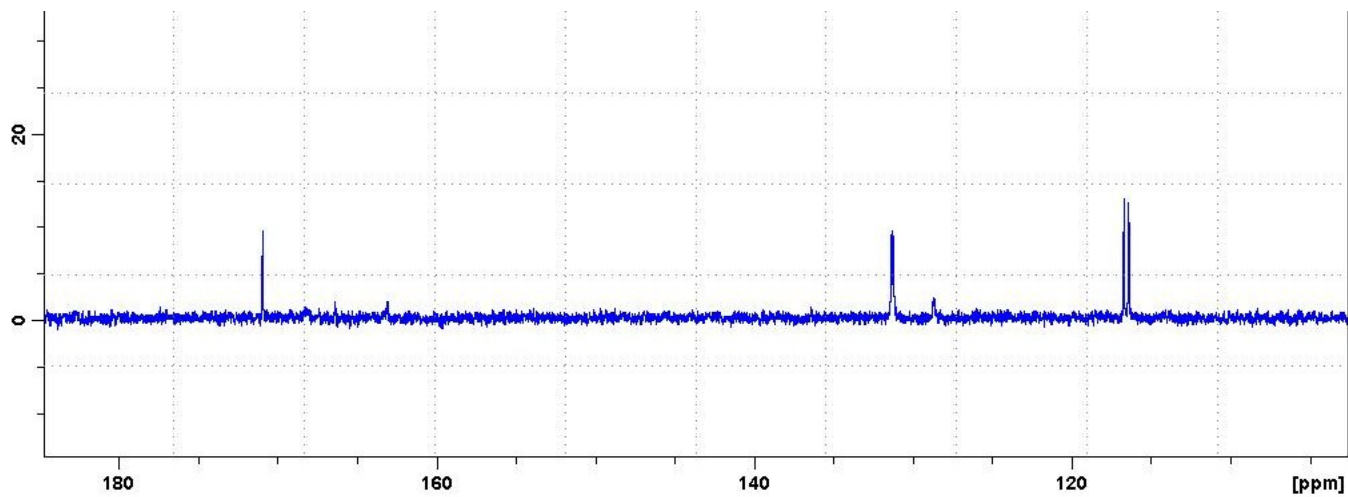
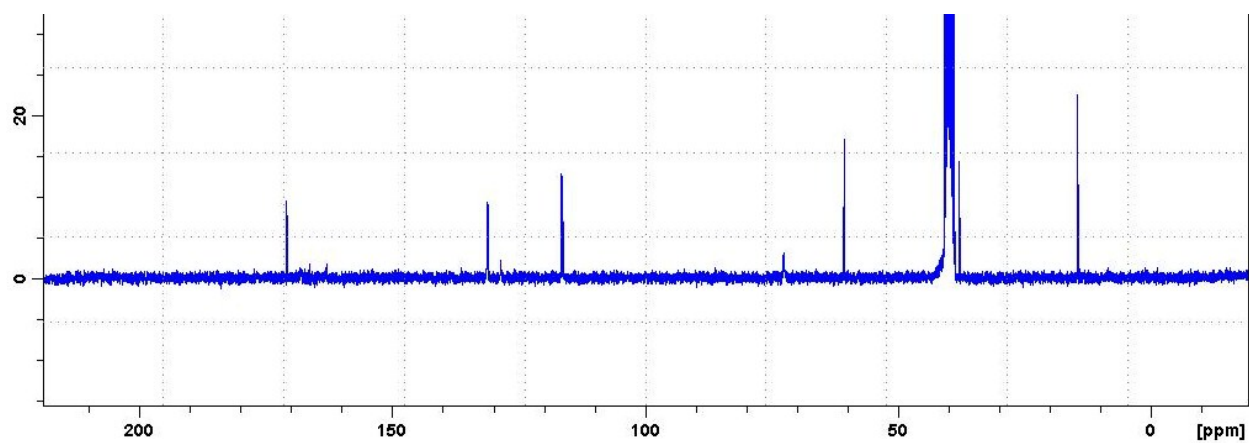


Ethyl [2-(4-fluorophenyl)-4,5-dihydro-1,3-thiazol-4-yl]acetate (18)

¹H NMR of 18

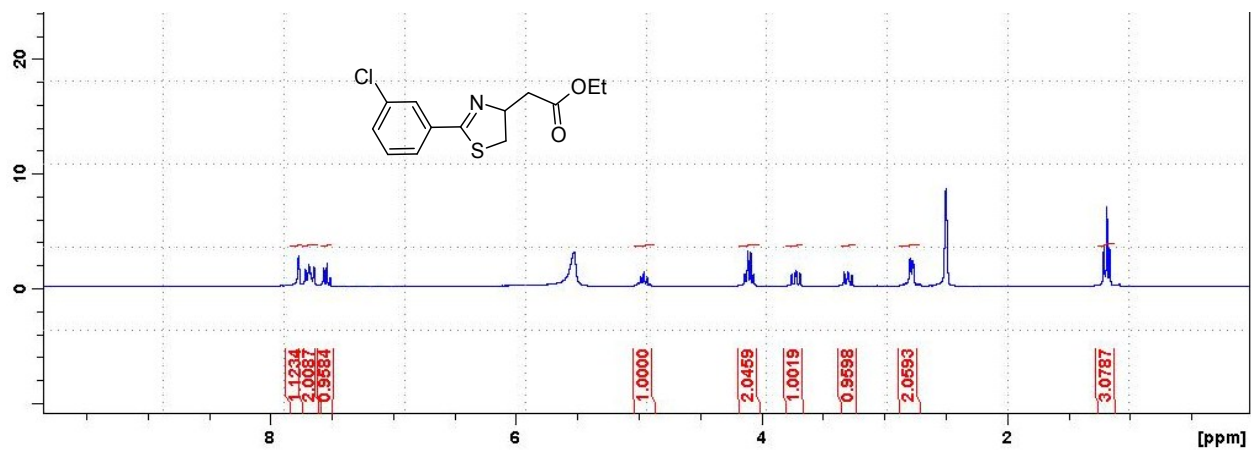


¹³C NMR of 18

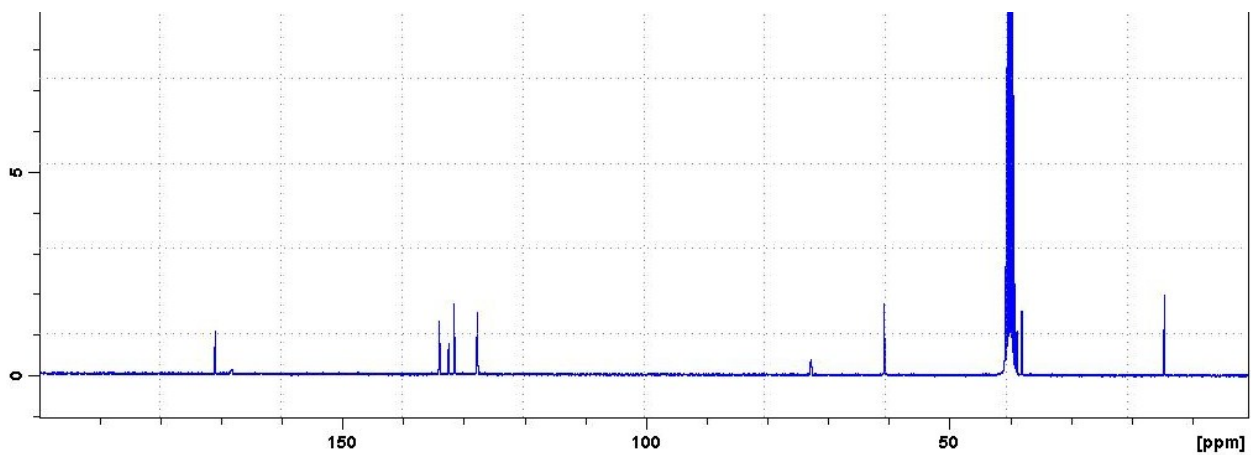


Ethyl [2-(3-chlorophenyl)-4,5-dihydro-1,3-thiazol-4-yl]acetate (19)

¹H NMR of 19

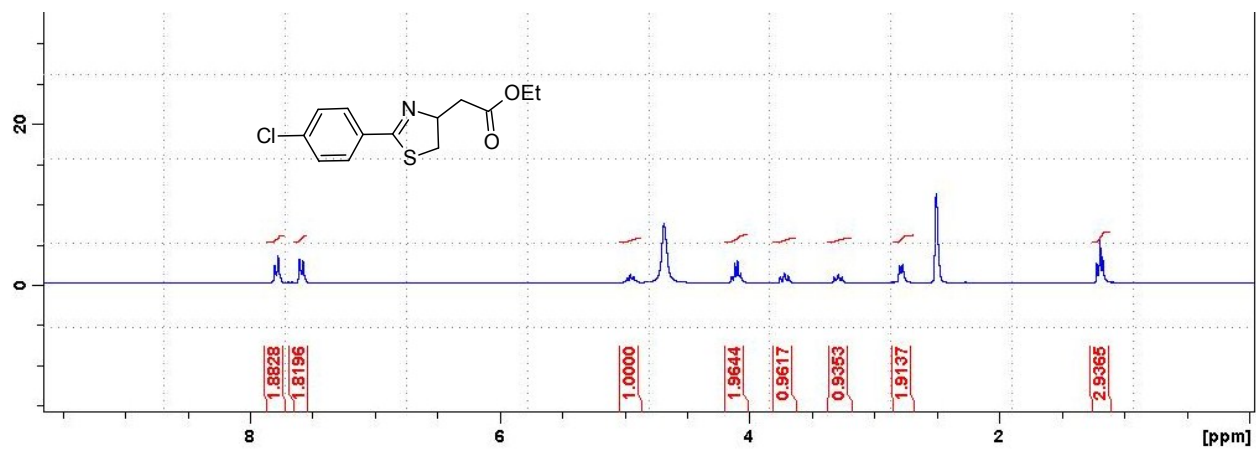


¹³C NMR of 19

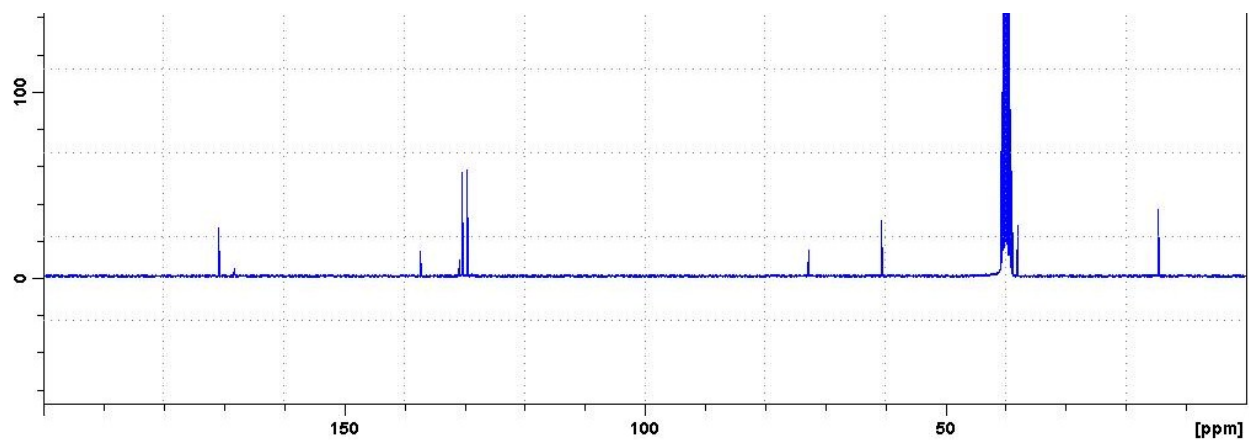


Ethyl [2-(4-chlorophenyl)-4,5-dihydro-1,3-thiazol-4-yl]acetate (20)

¹H NMR of 20

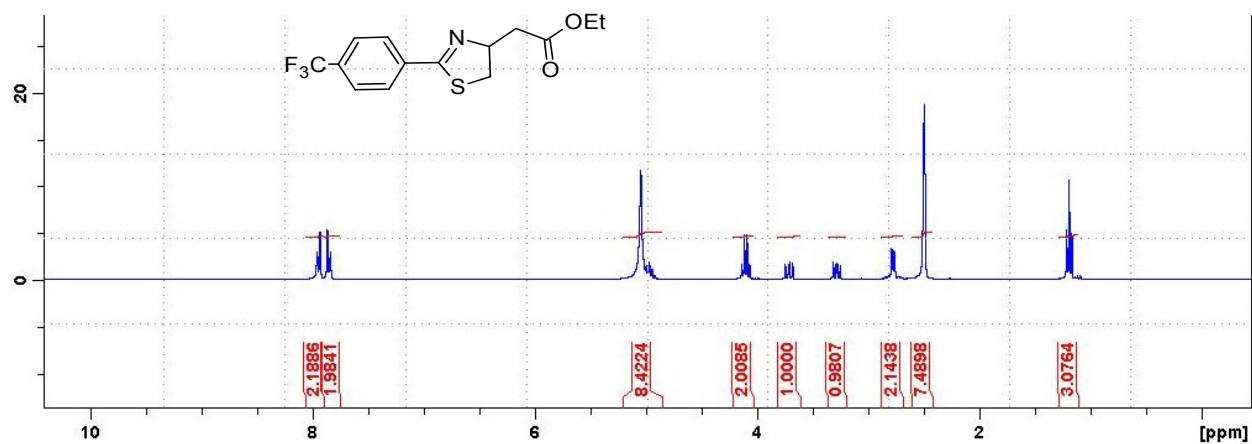


¹³C NMR of 20

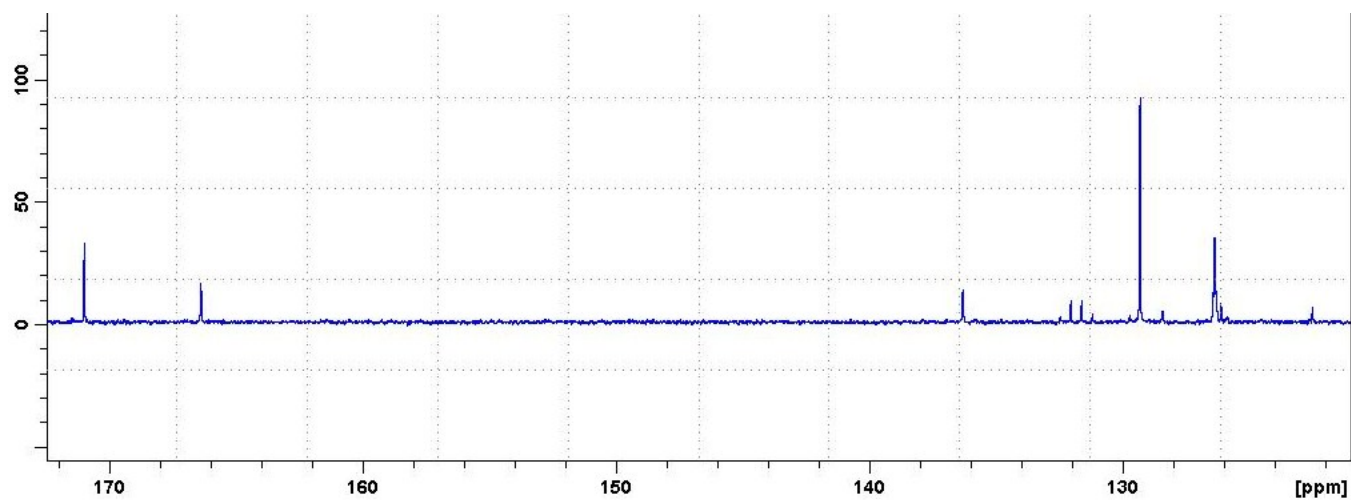
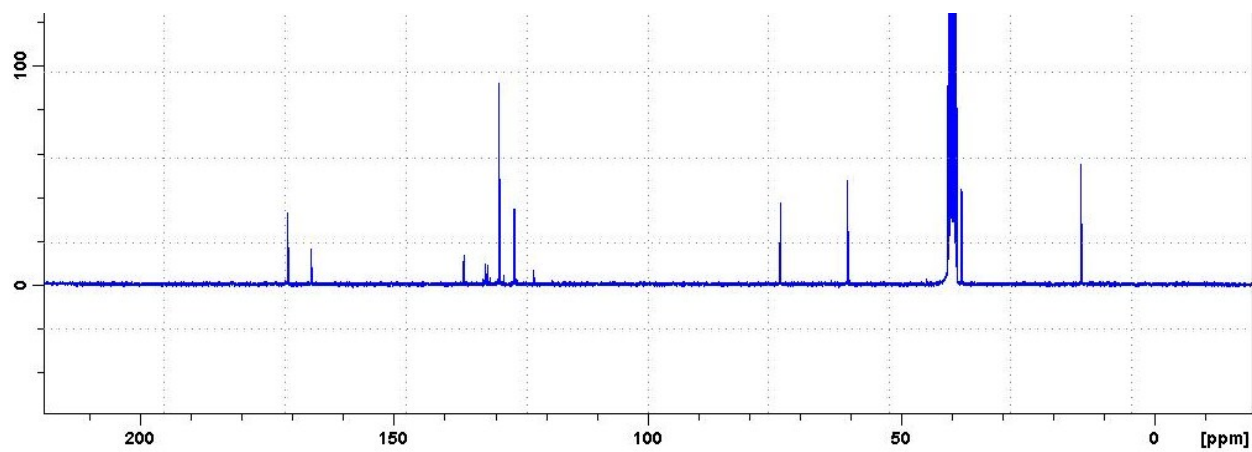


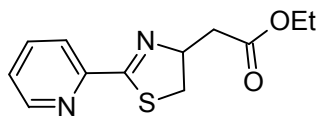
Ethyl {2-[4-(trifluoromethyl)phenyl]-4,5-dihydro-1,3-thiazol-4-yl}acetate (21)

¹H NMR of 21



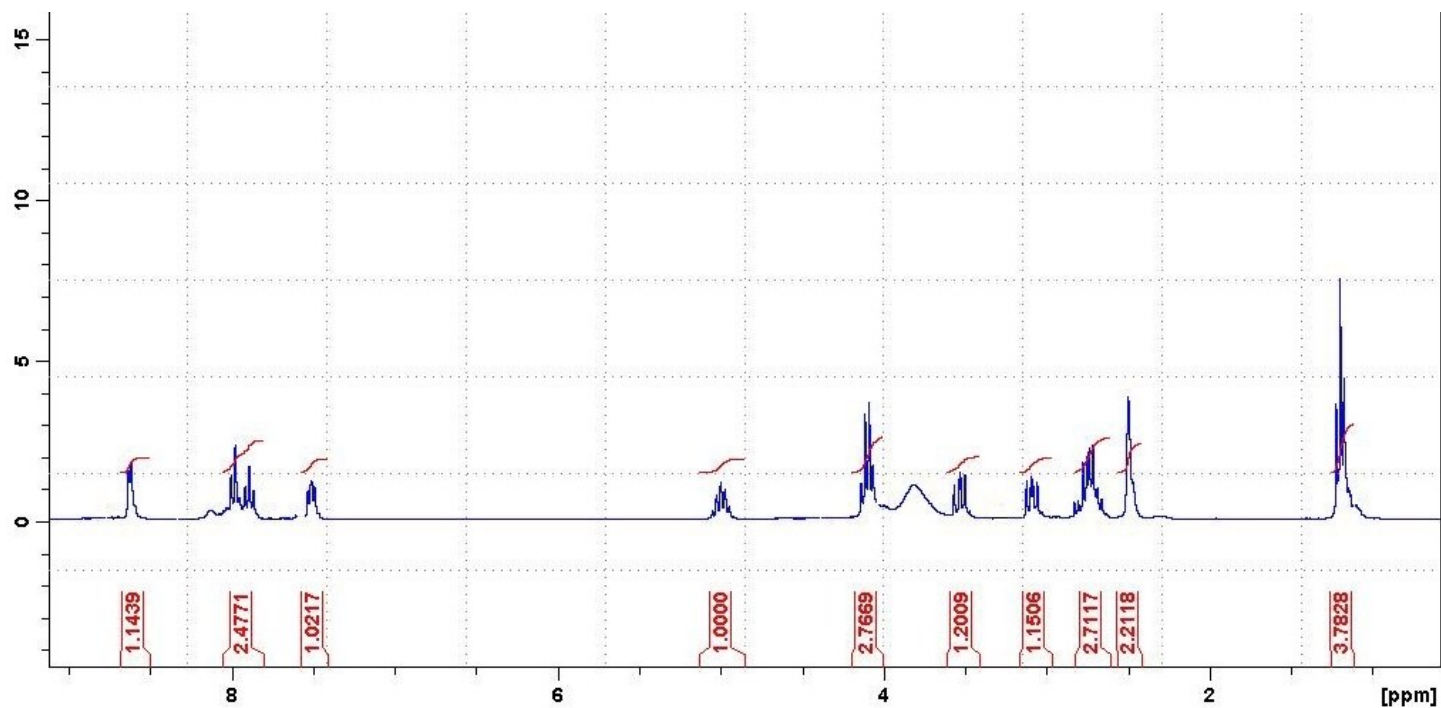
¹³C NMR of 21



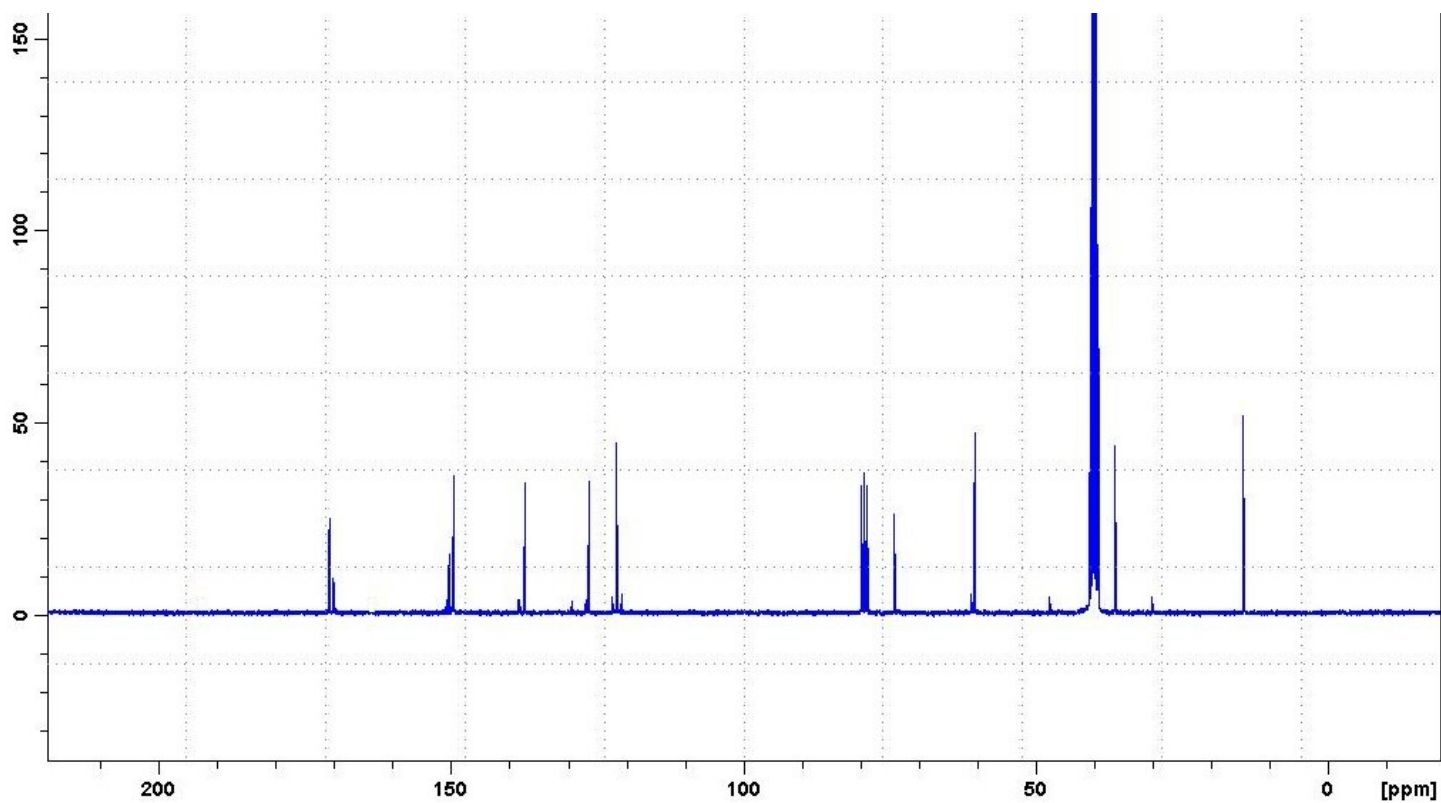


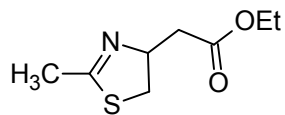
Ethyl [2-(XXXyridine-2-yl)-4,5-dihydro-1,3-thiazol-4-yl]acetate (22)

^1H NMR of 22



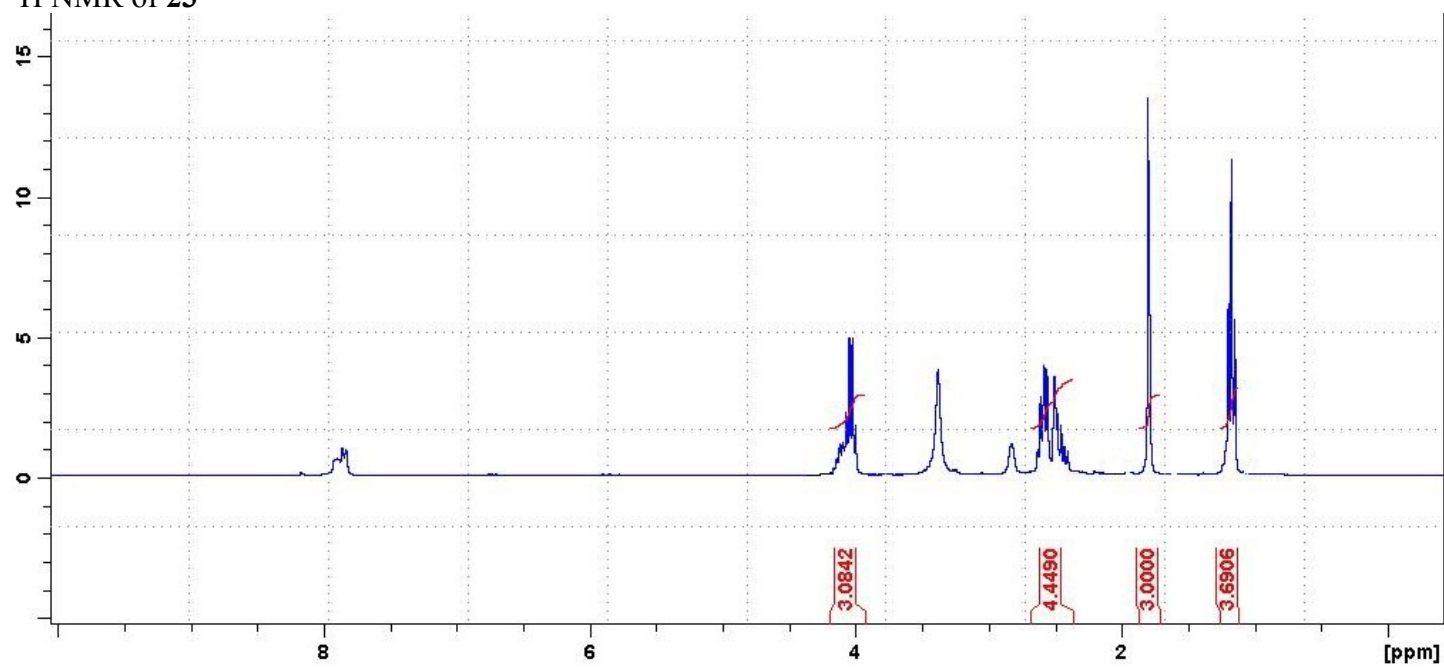
^{13}C NMR of 22



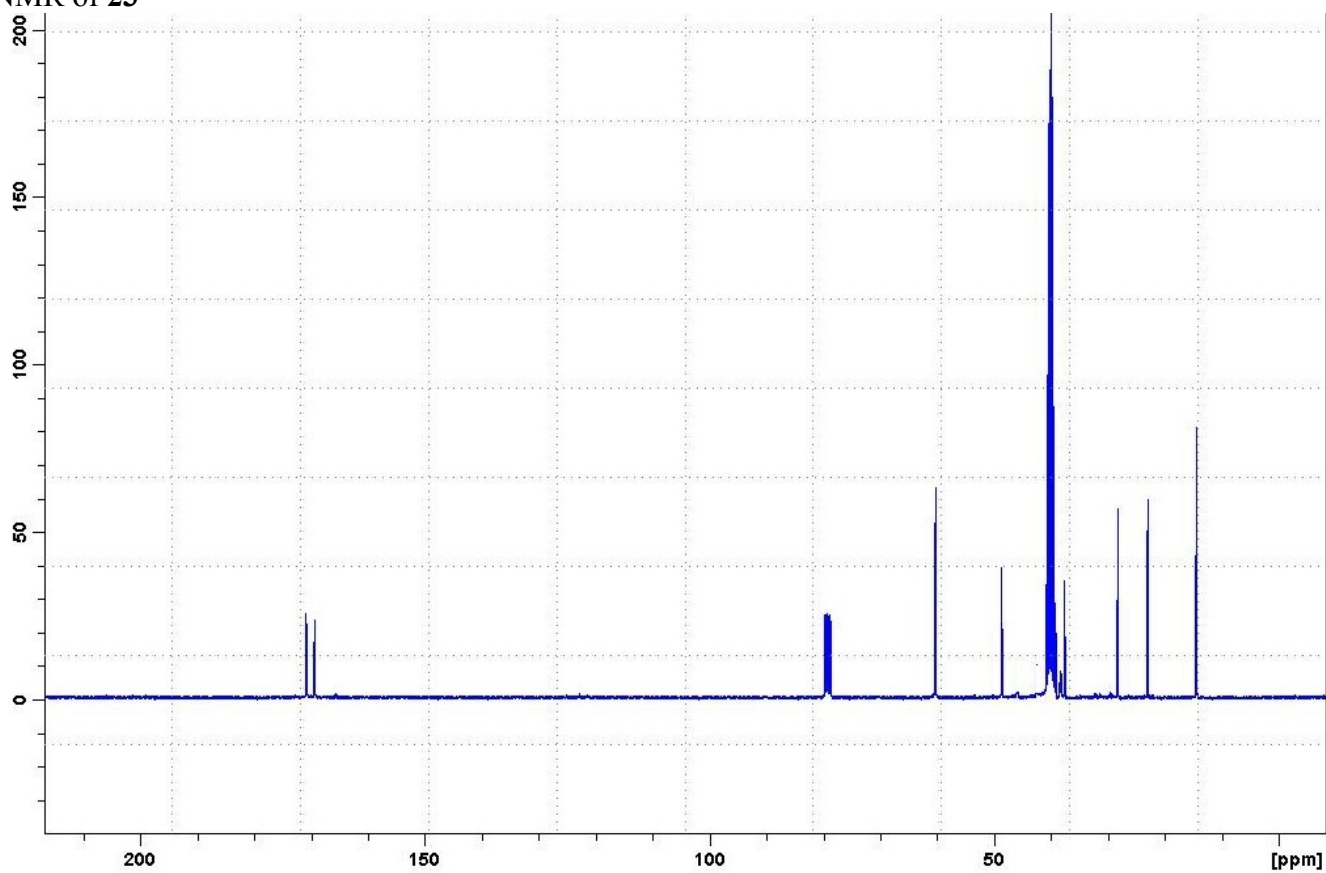


Ethyl (2-methyl-4,5-dihydro-1,3-thiazol-4-yl)acetate (23)

¹H NMR of 23

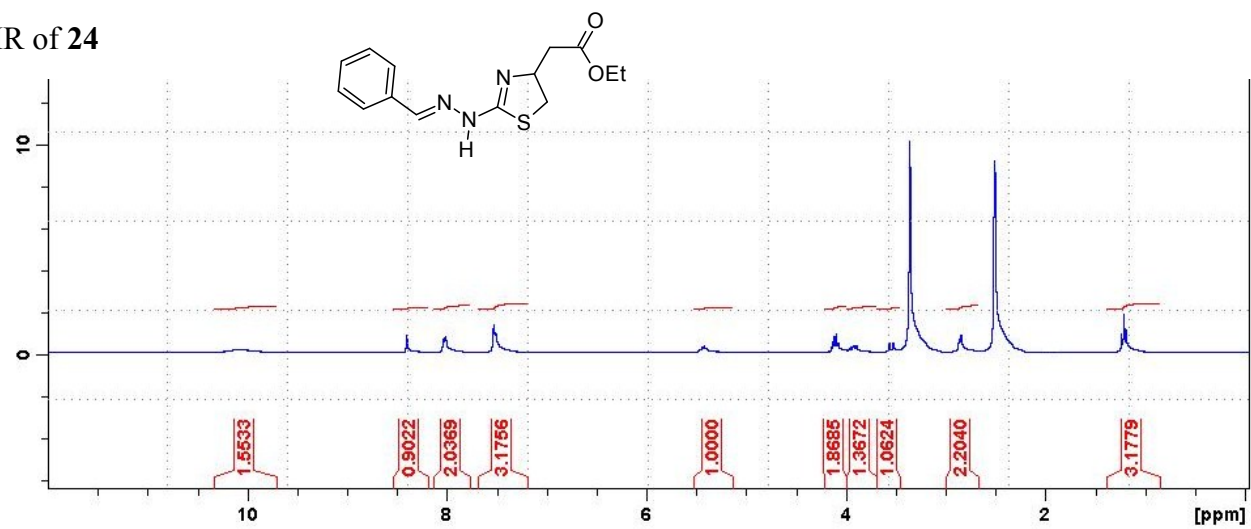


¹H NMR of 23

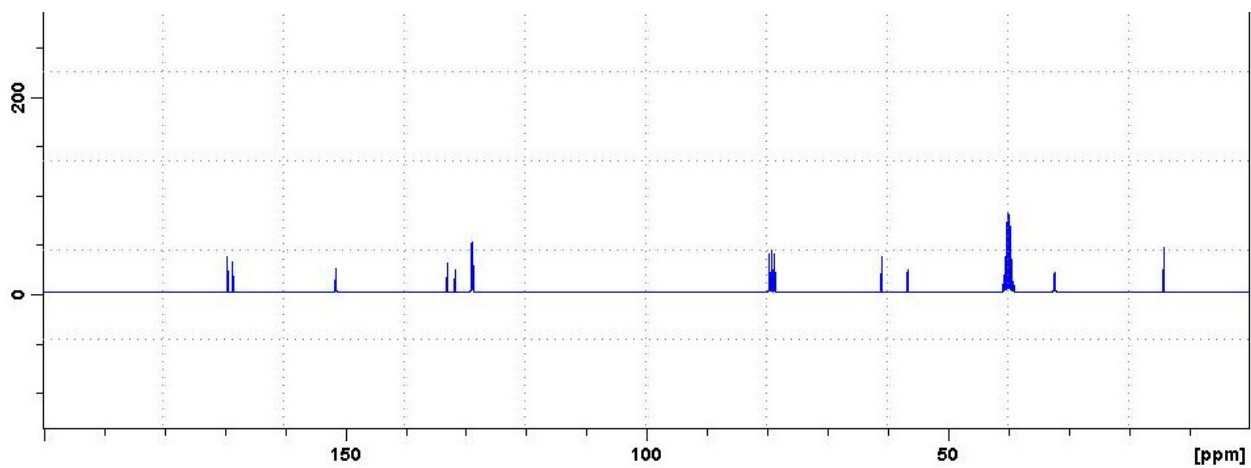


Ethyl {2-[(*E*)-2-benzylidenehydrazinyl]-4,5-dihydro-1,3-thiazol-4-yl}acetate (**24**)

¹H NMR of **24**

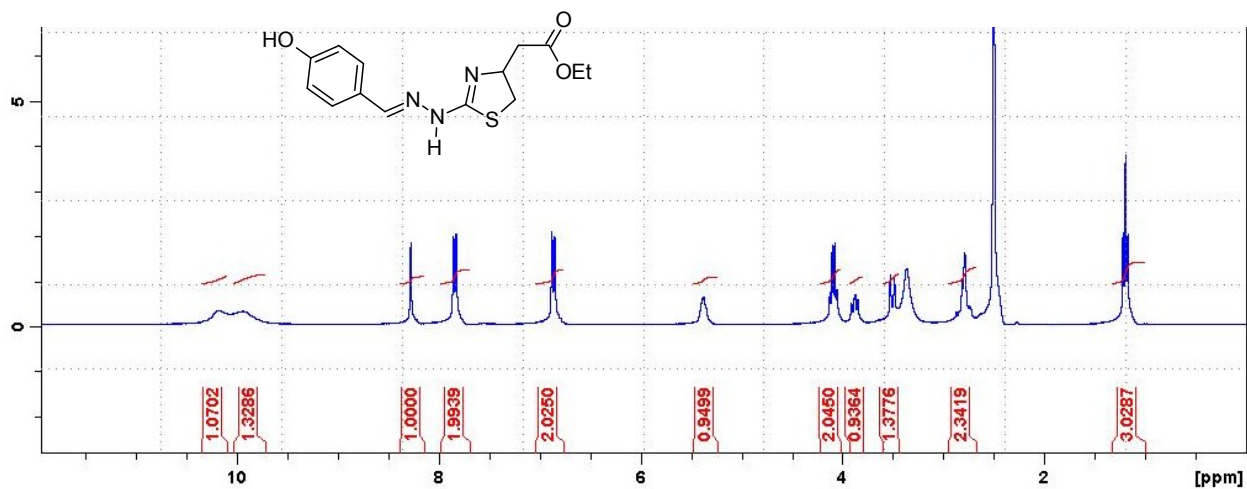


¹³C NMR of **24**

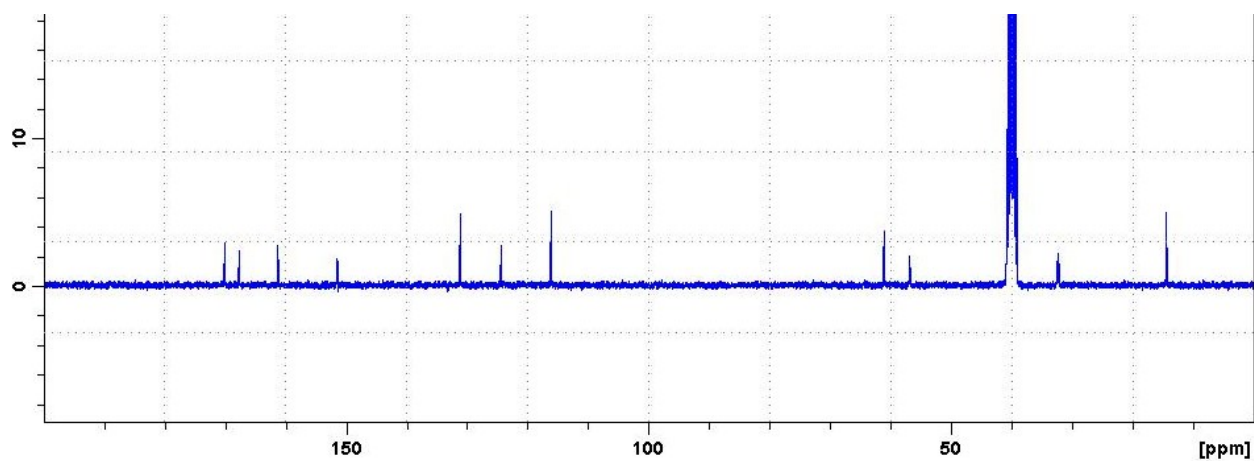


Ethyl (2-((2E)-2-[(4-hydroxyphenyl)methylidene]hydrazinyl)-4,5-dihydro-1,3-thiazol-4-yl)acetate (25)

¹H NMR of 25

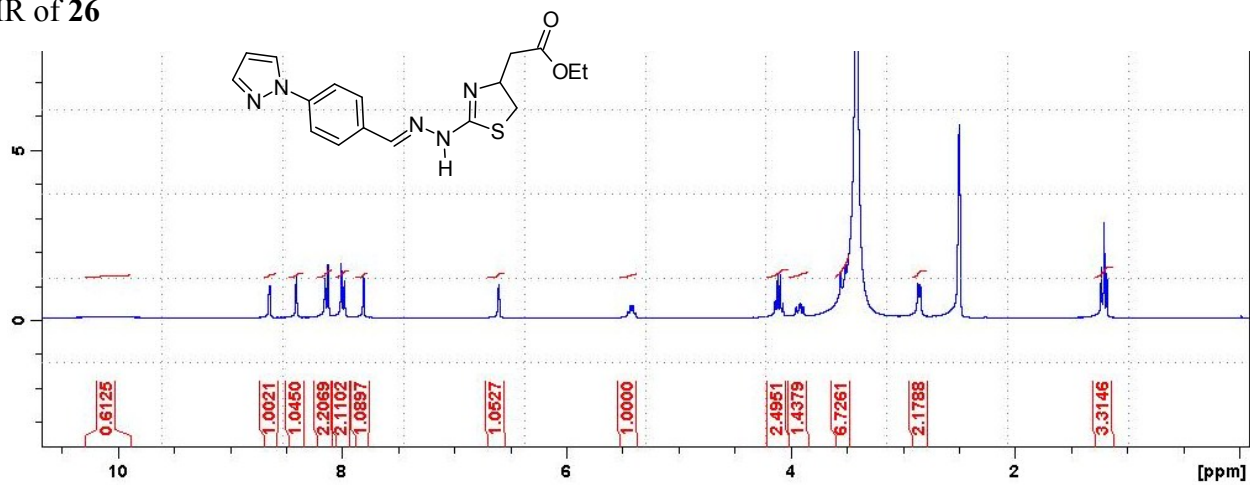


¹³C NMR of 25

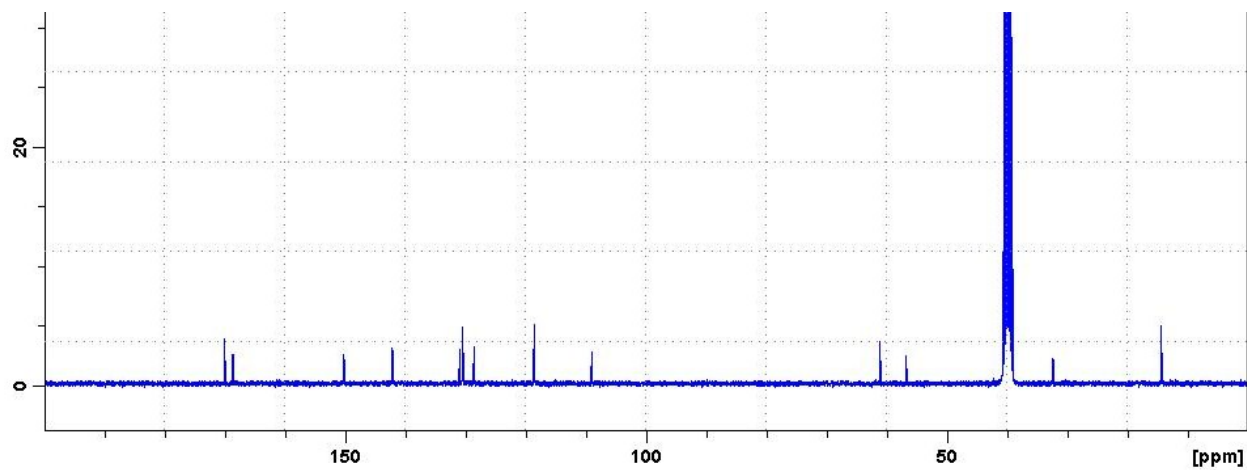


Ethyl {2-[(2E)-2-{4-(1H-pyrazol-1-yl)phenyl}methylidene}hydrazinyl]-4,5-dihydro-1,3-thiazol-4-yl}acetate (26)

¹H NMR of 26

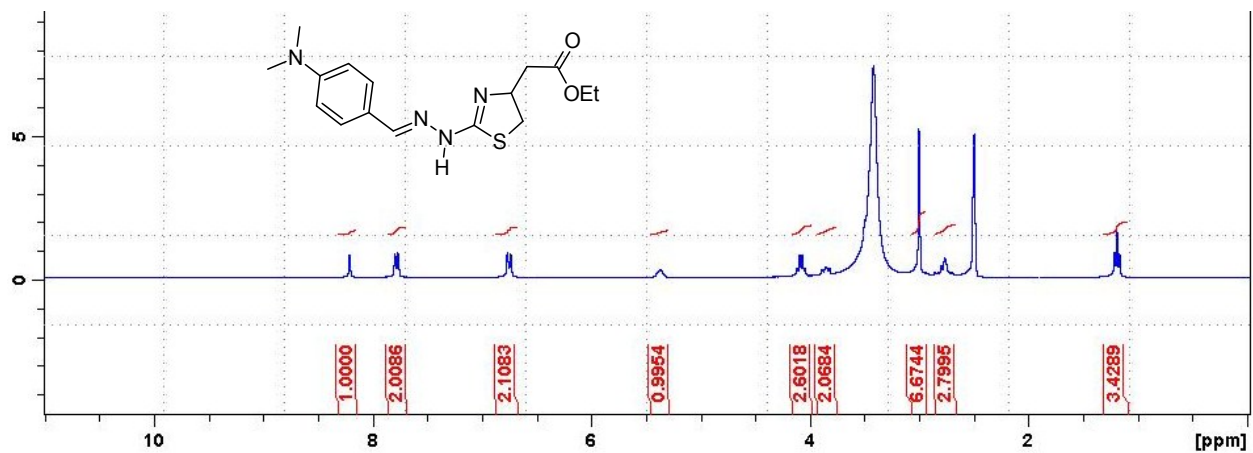


¹³C NMR of 26

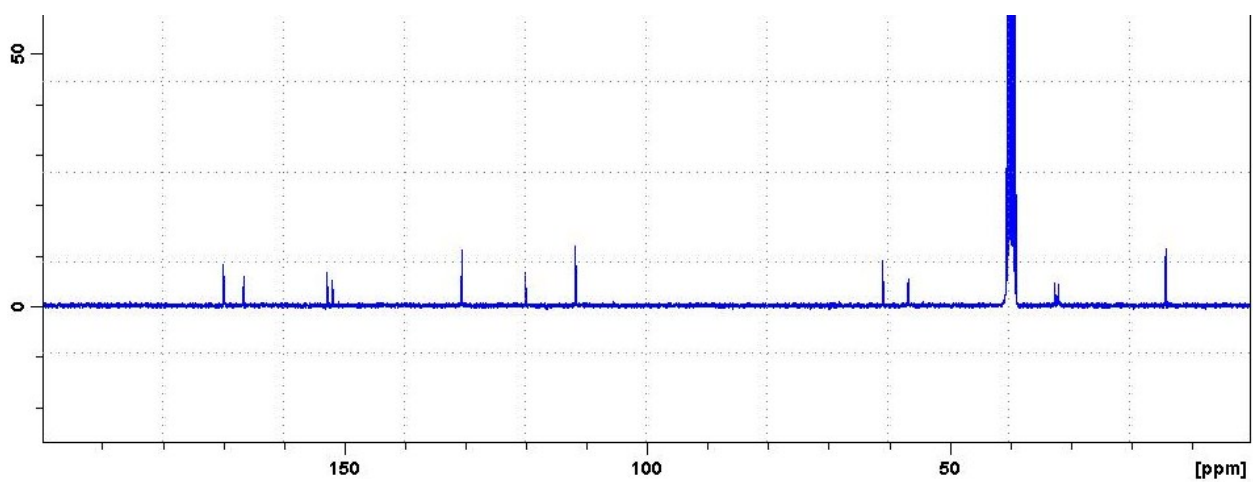


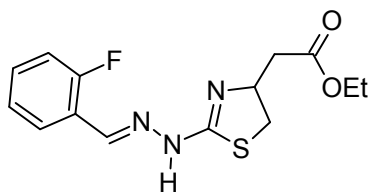
Ethyl {2-[(2E)-2-{4-(dimethylamino)phenyl}methylidene}hydrazinyl]-4,5-dihydro-1,3-thiazol-4-yl}acetate (27)

¹H NMR of 27

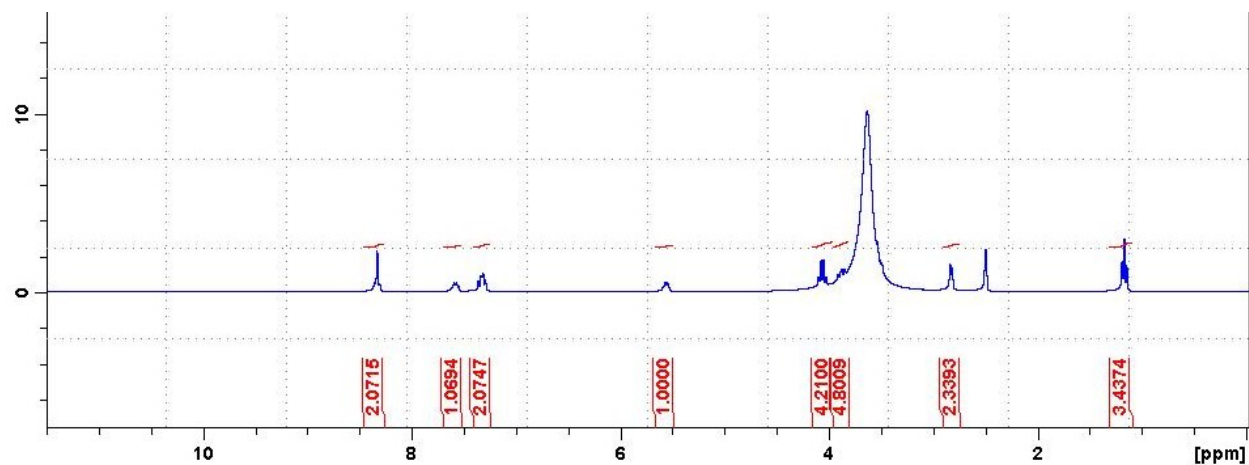


¹³C NMR of 27

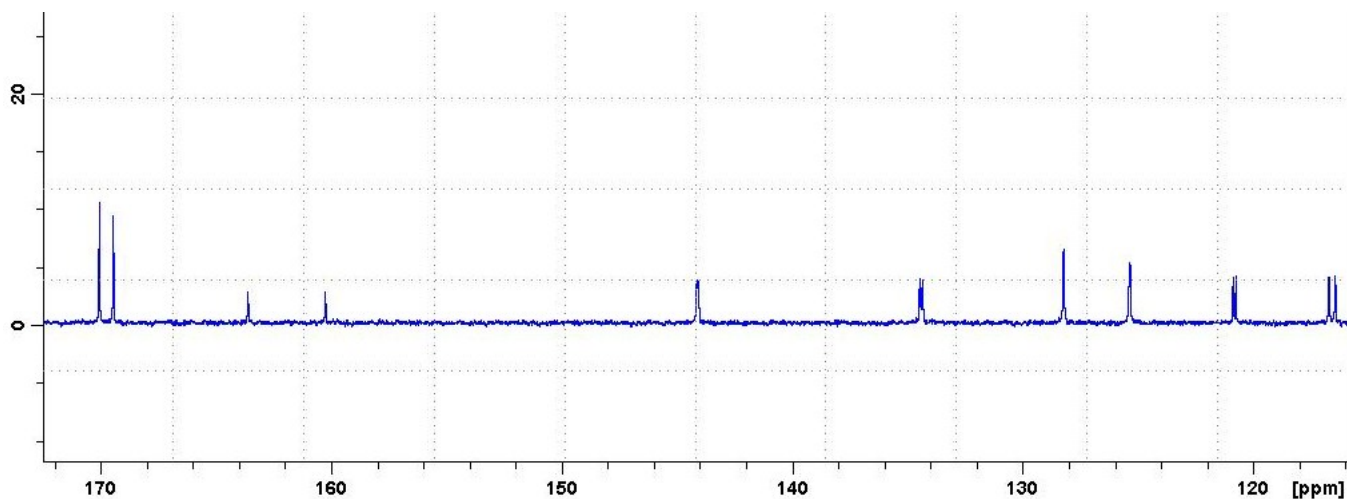
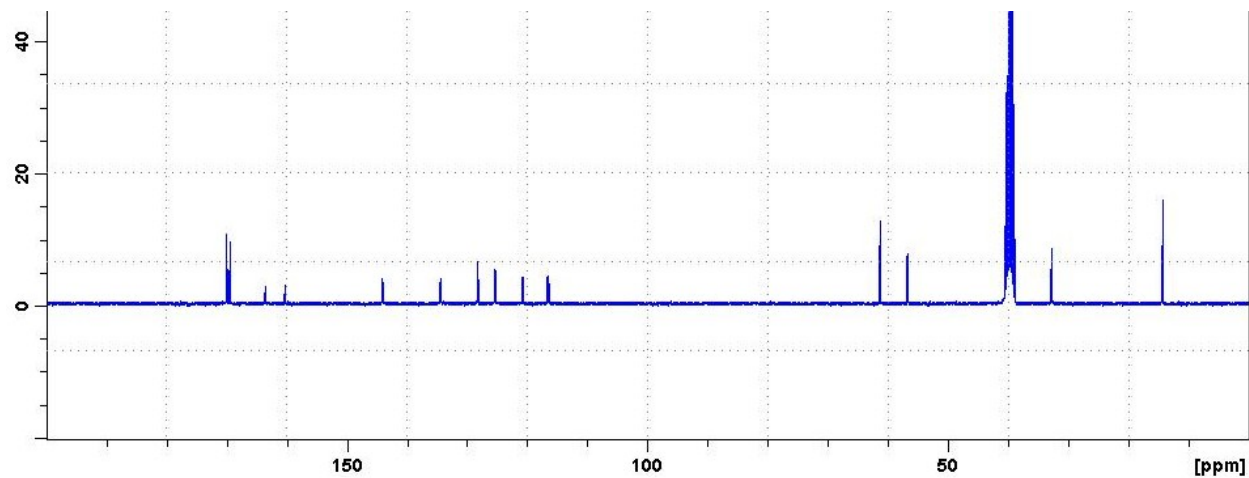




Ethyl (2-{{(2*E*)-2-[(2-fluorophenyl)methylidene]hydrazinyl}-4,5-dihydro-1,3-thiazol-4-yl)acetate (**28**)
¹H NMR of **28**

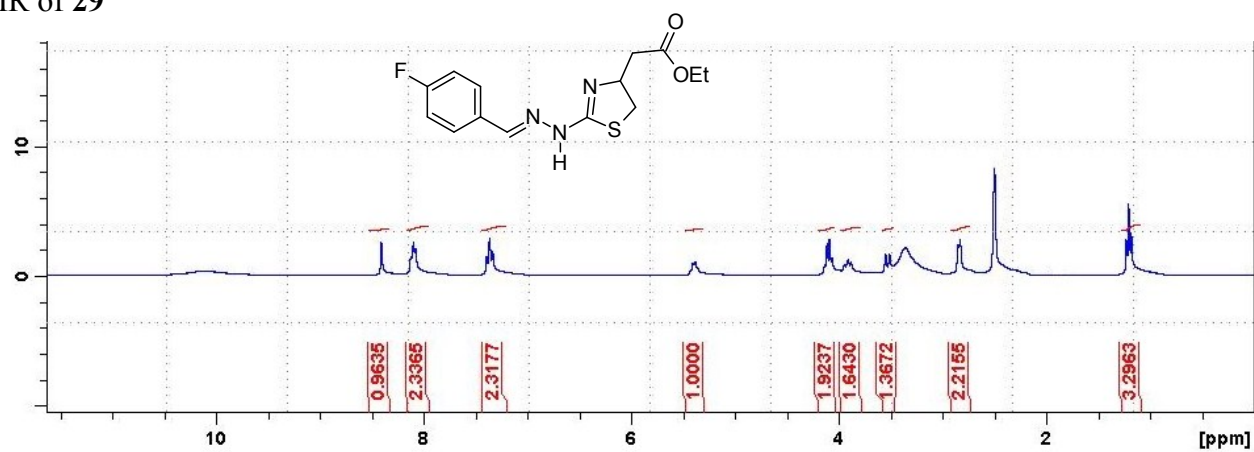


¹³C NMR of **28**

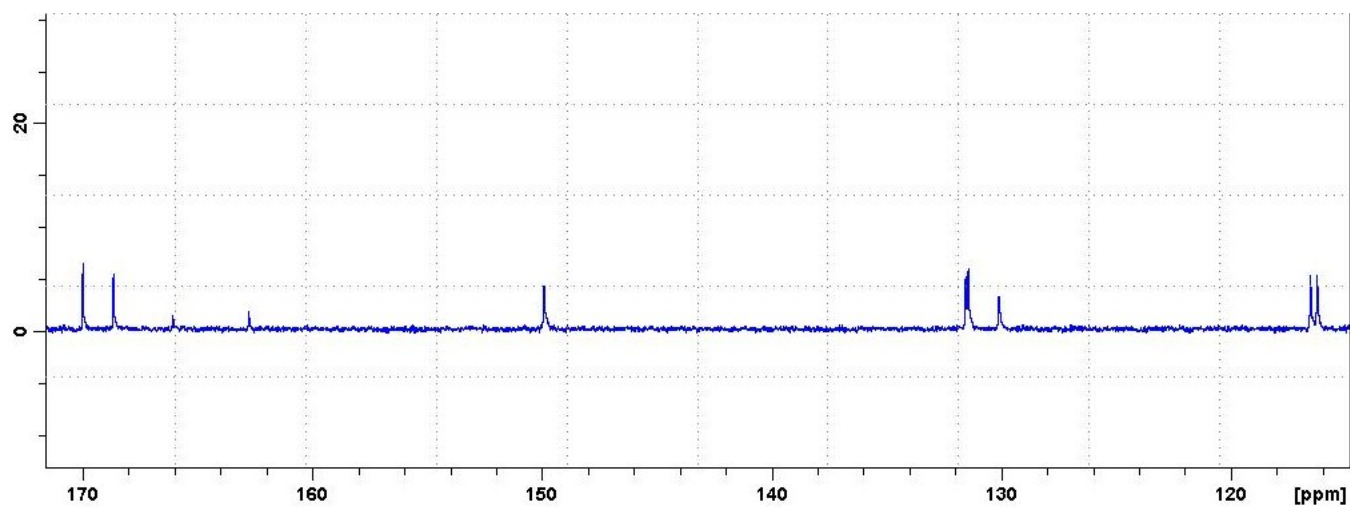
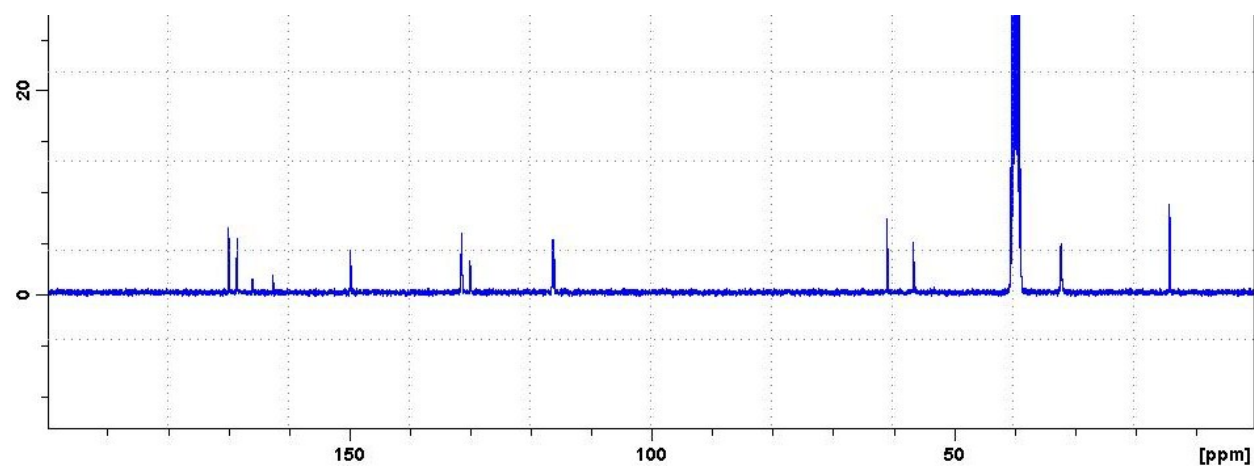


Ethyl (2-((2E)-2-[(4-fluorophenyl)methylidene]hydrazinyl)-4,5-dihydro-1,3-thiazol-4-yl)acetate (29)

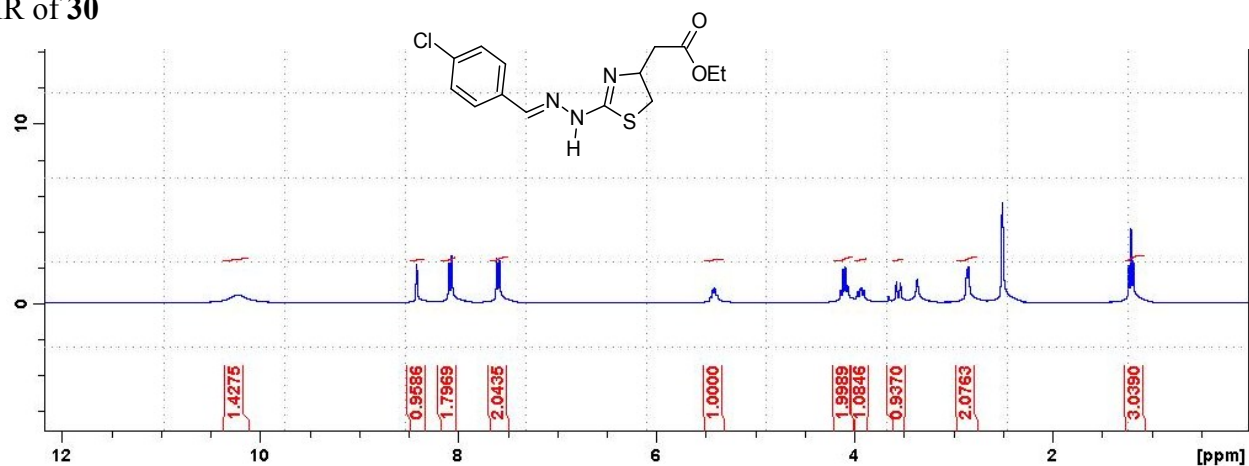
^1H NMR of 29



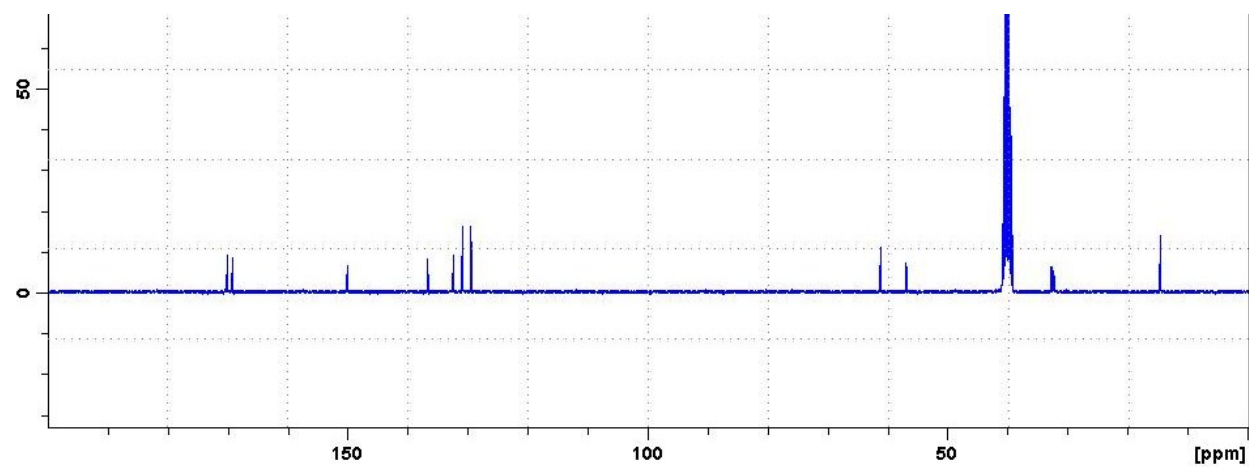
^{13}C NMR of 29



Ethyl (2-((2E)-2-[(4-chlorophenyl)methylidene]hydrazinyl)-4,5-dihydro-1,3-thiazol-4-yl)acetate (30)
¹H NMR of 30

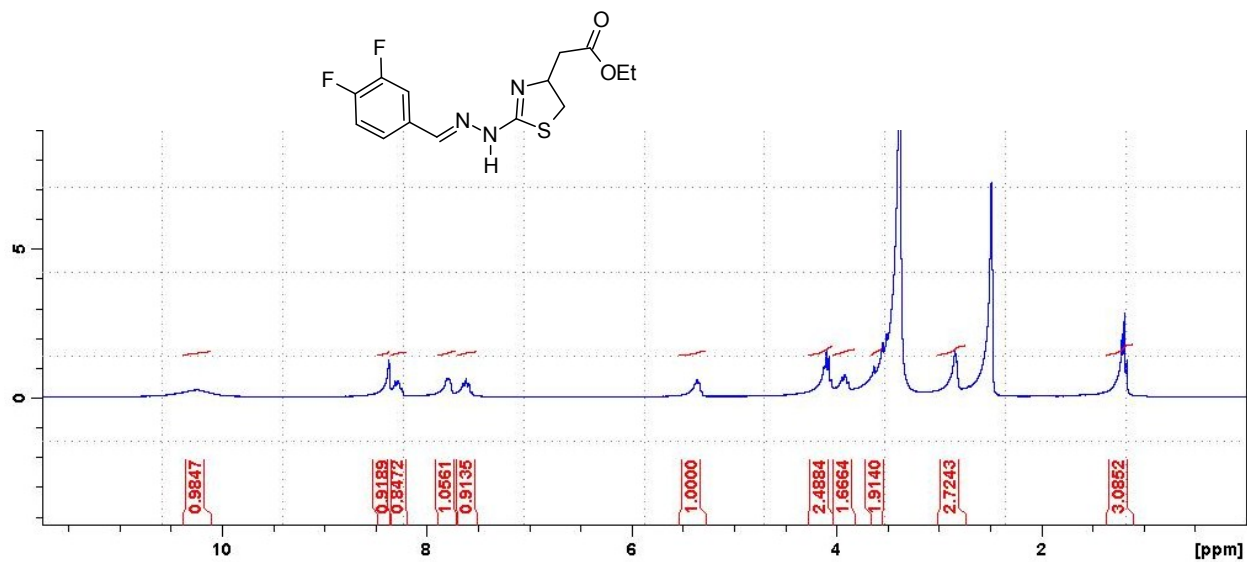


¹³C NMR of 30

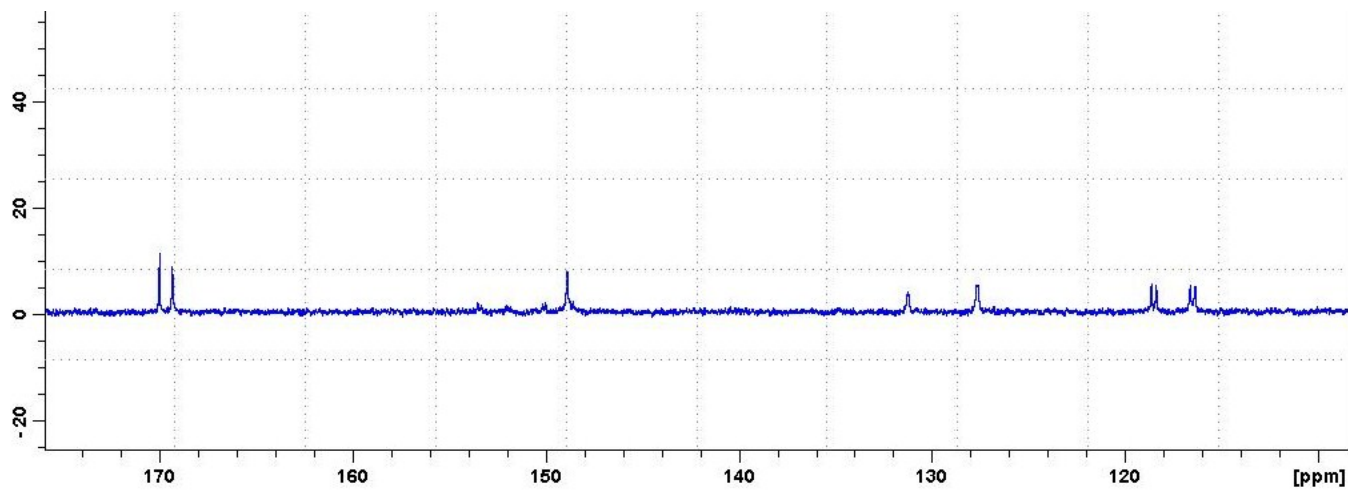
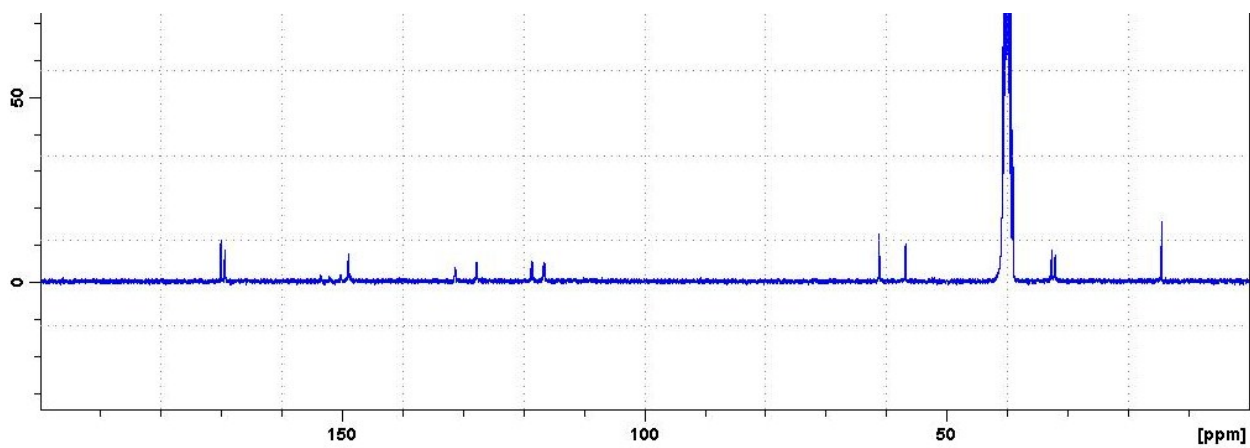


Ethyl (2-((2E)-2-[(3,4-difluorophenyl)methylidene]hydrazinyl)-4,5-dihydro-1,3-thiazol-4-yl)acetate (31)

¹H NMR of 31

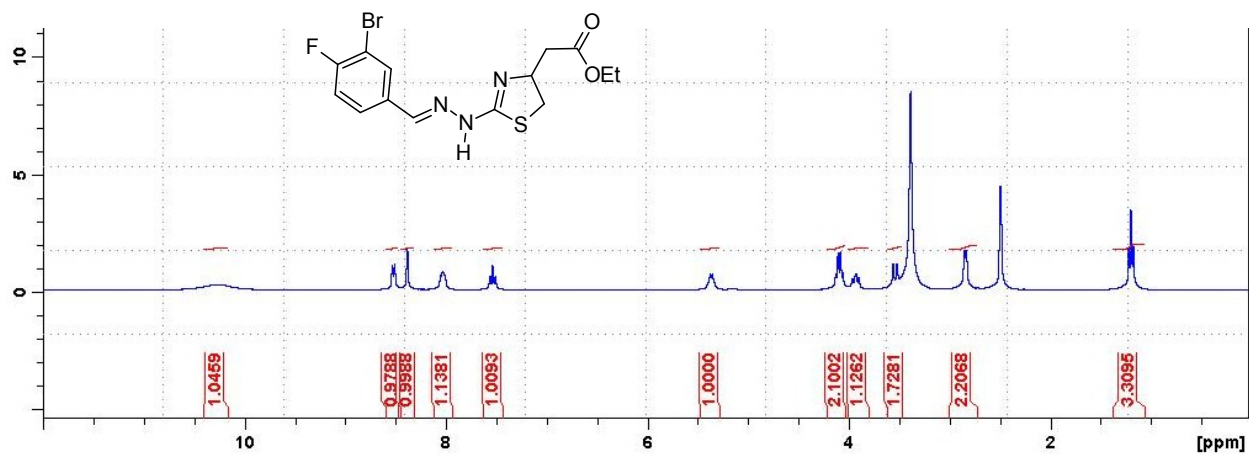


¹³C NMR of 31

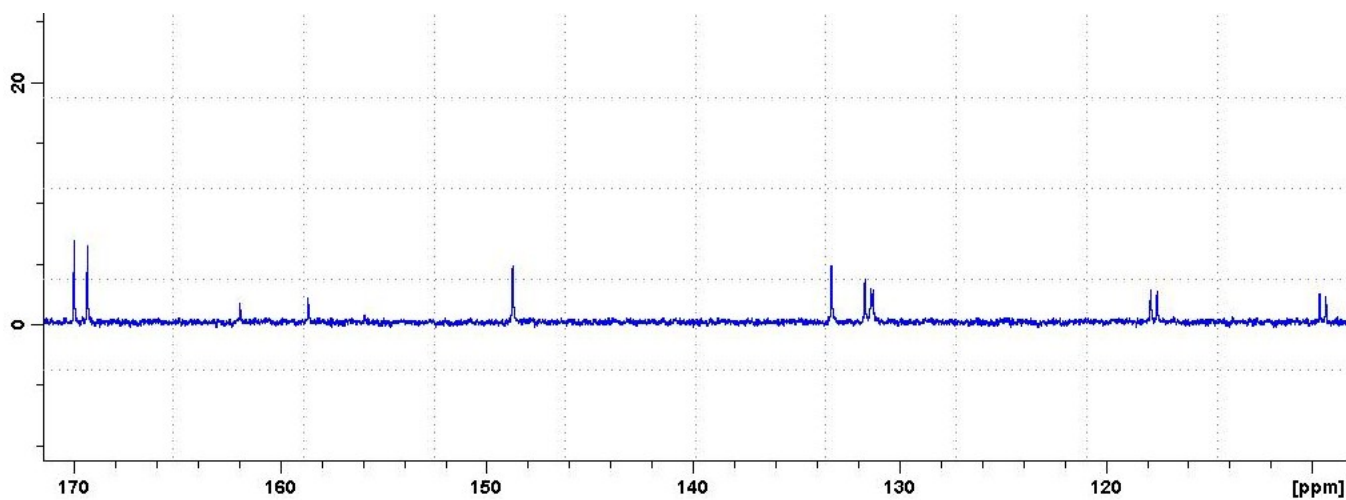
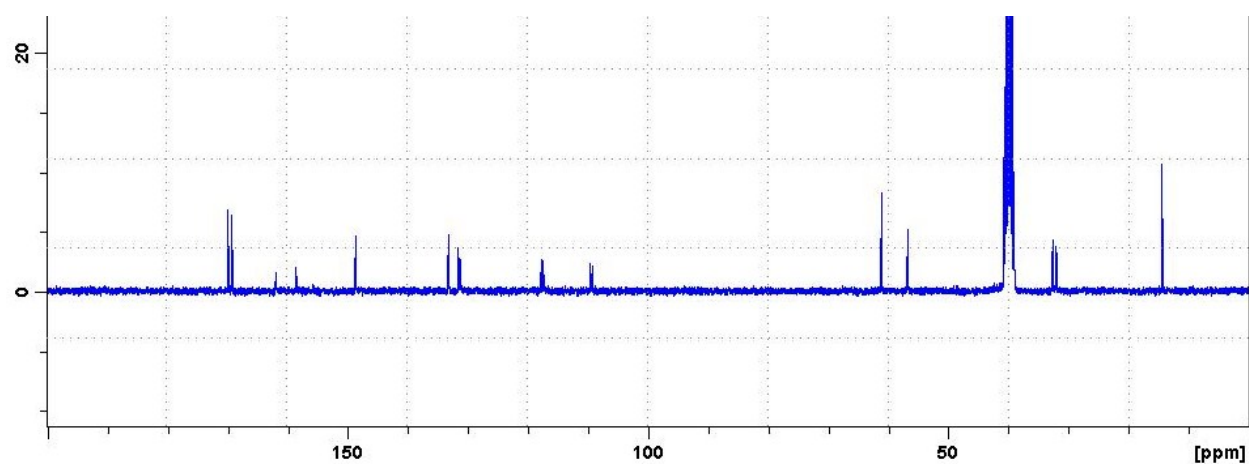


Ethyl (2-((2E)-2-[(3-bromo-4-fluorophenyl)methylidene]hydrazinyl)-4,5-dihydro-1,3-thiazol-4-yl)acetate
(32)

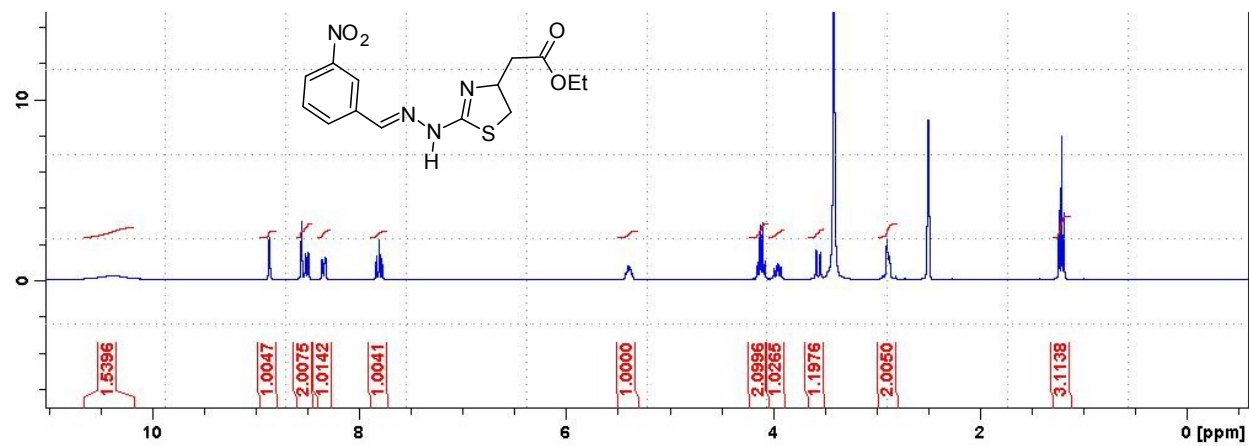
¹H NMR of 32



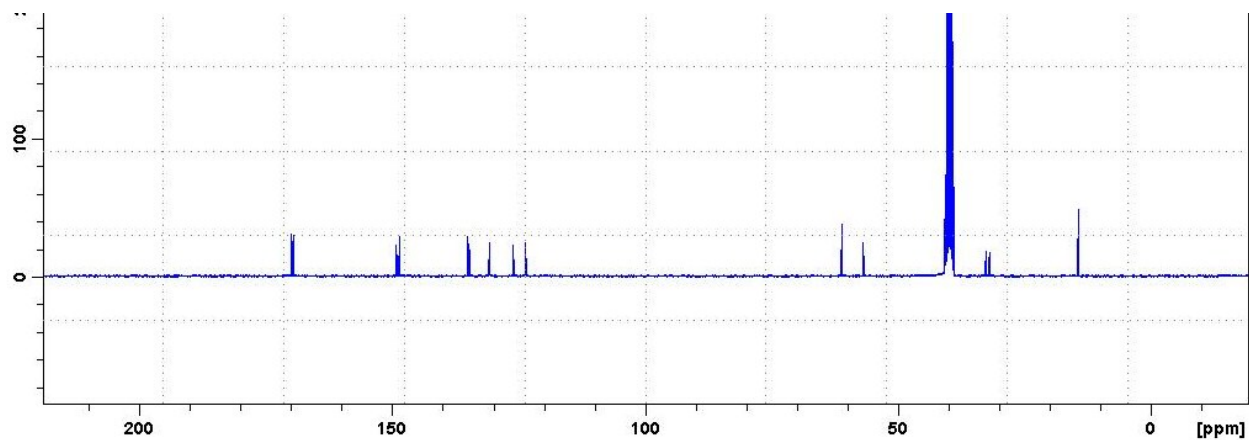
¹³C NMR of 32



Ethyl 2-[(2E)-2-[(3-nitrophenyl)methylidene]hydrazinyl]-4,5-dihydro-1,3-thiazol-4-yl)acetate (33)
¹H NMR of 33

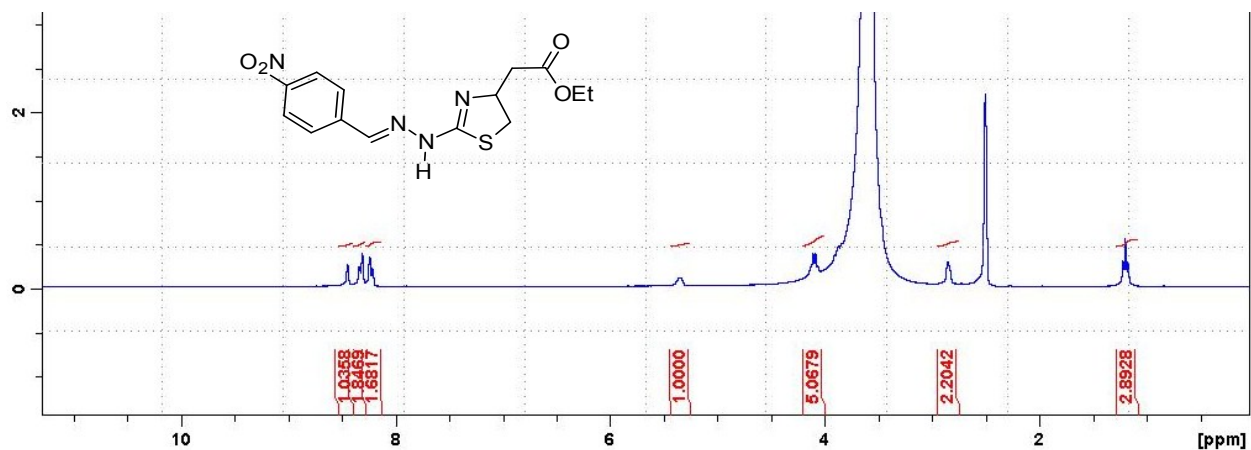


¹³C NMR of 33

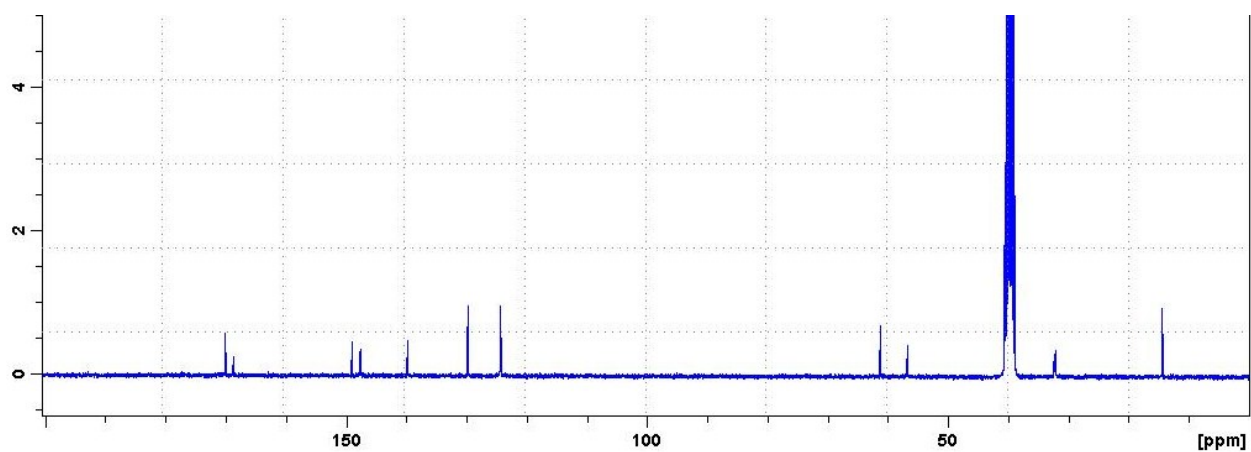


Ethyl (2-((2E)-2-[(4-nitrophenyl)methylidene]hydrazinyl)-4,5-dihydro-1,3-thiazol-4-yl)acetate (34)

¹H NMR of 34

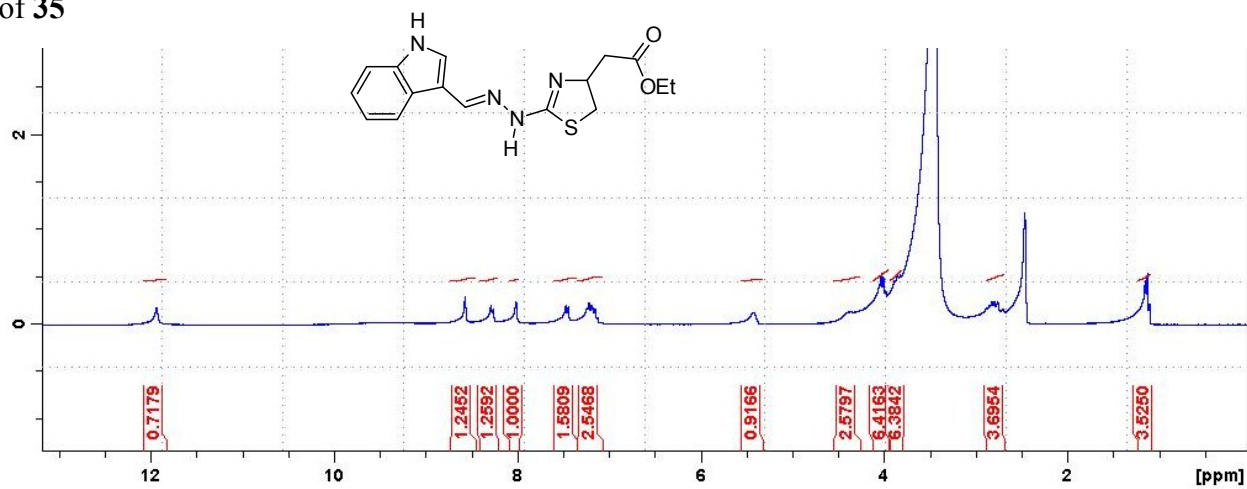


¹³C NMR of 34

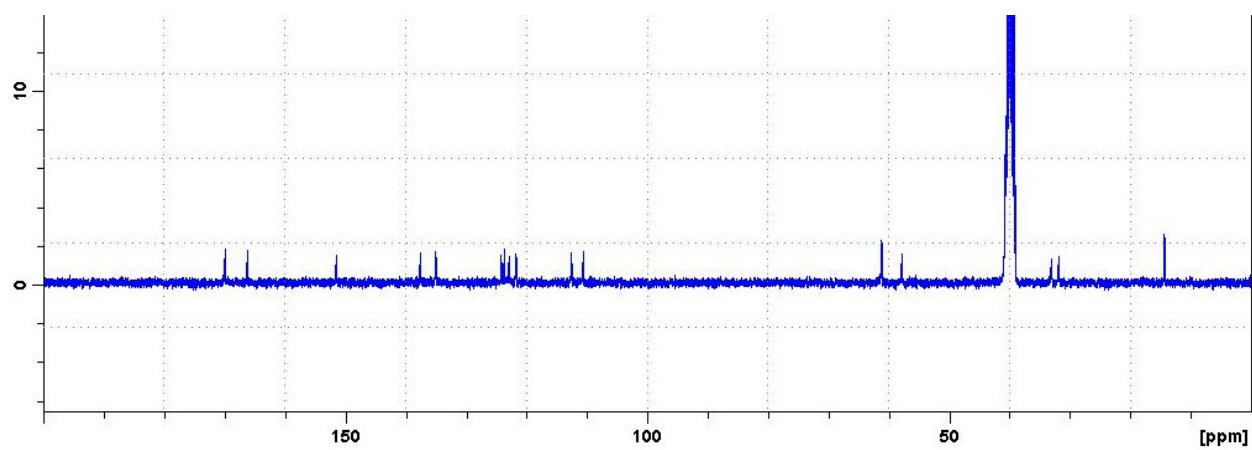


Ethyl (2-((2E)-2-[(3H-indol-3-yl)methylidene]hydrazinyl)-4,5-dihydro-1,3-thiazol-4-yl)acetate (35)

¹H NMR of 35

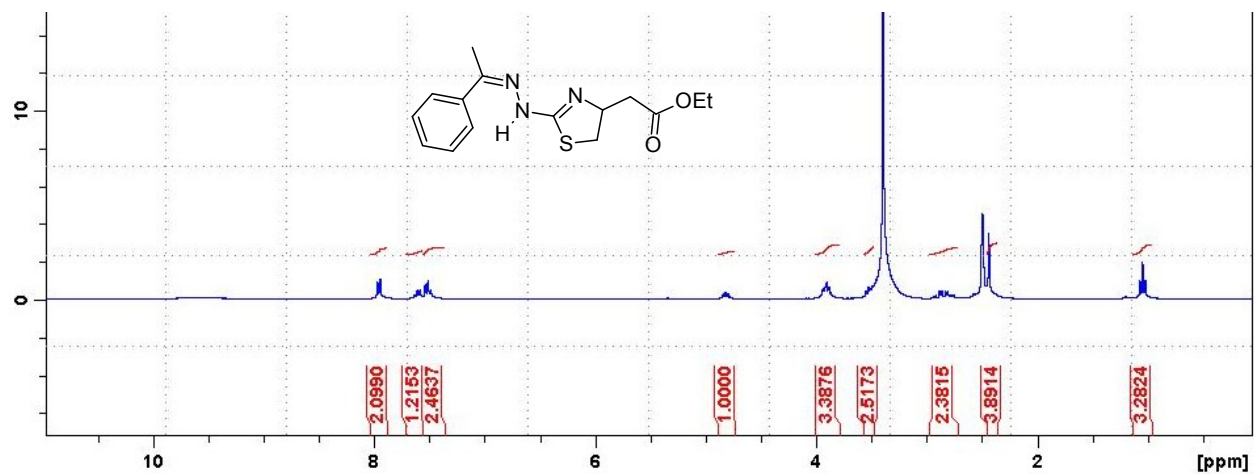


¹³C NMR of 35

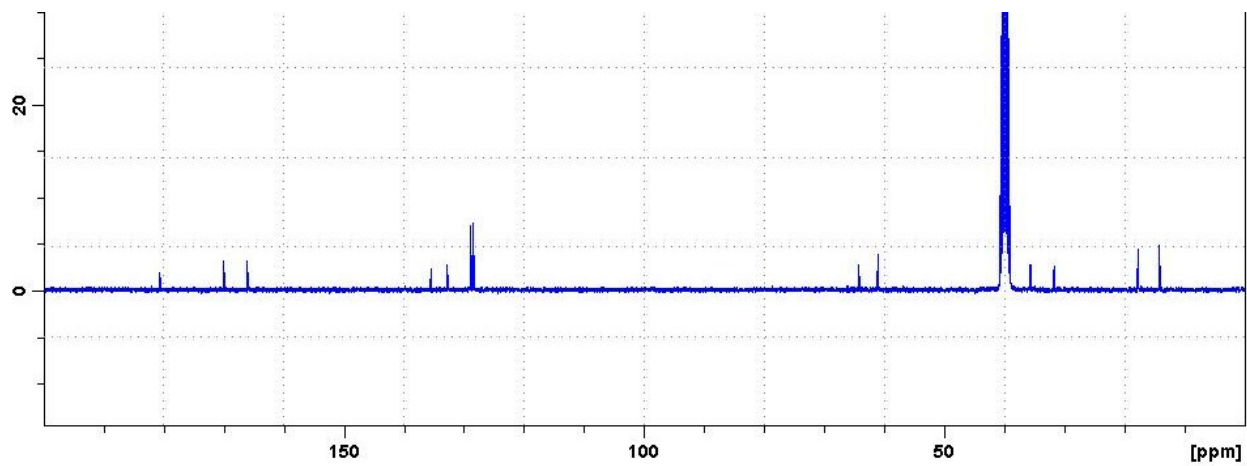


Ethyl {2-[(2Z)-2-(1-phenylethylidene)hydrazinyl]-4,5-dihydro-1,3-thiazol-4-yl}acetate (36)

¹H NMR of 36

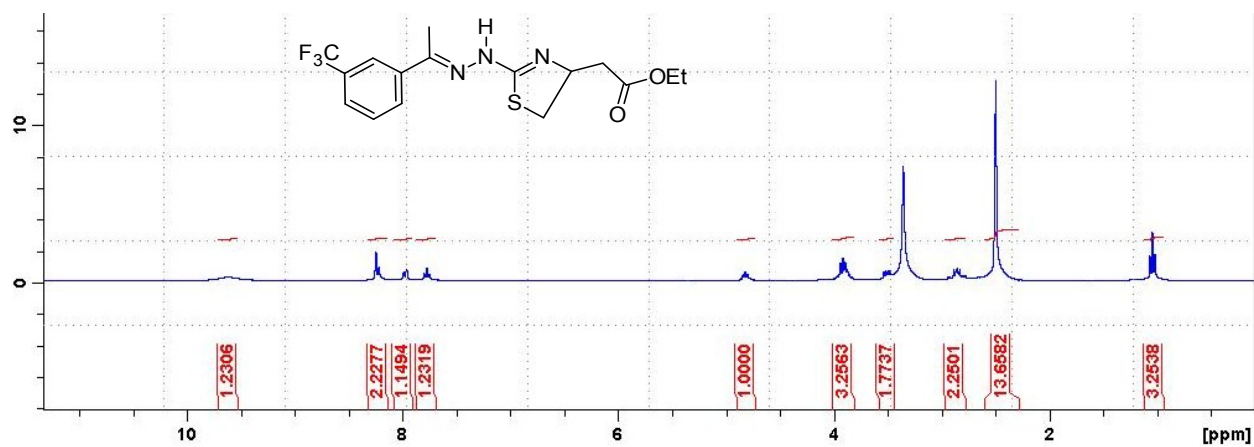


¹³C NMR of 36

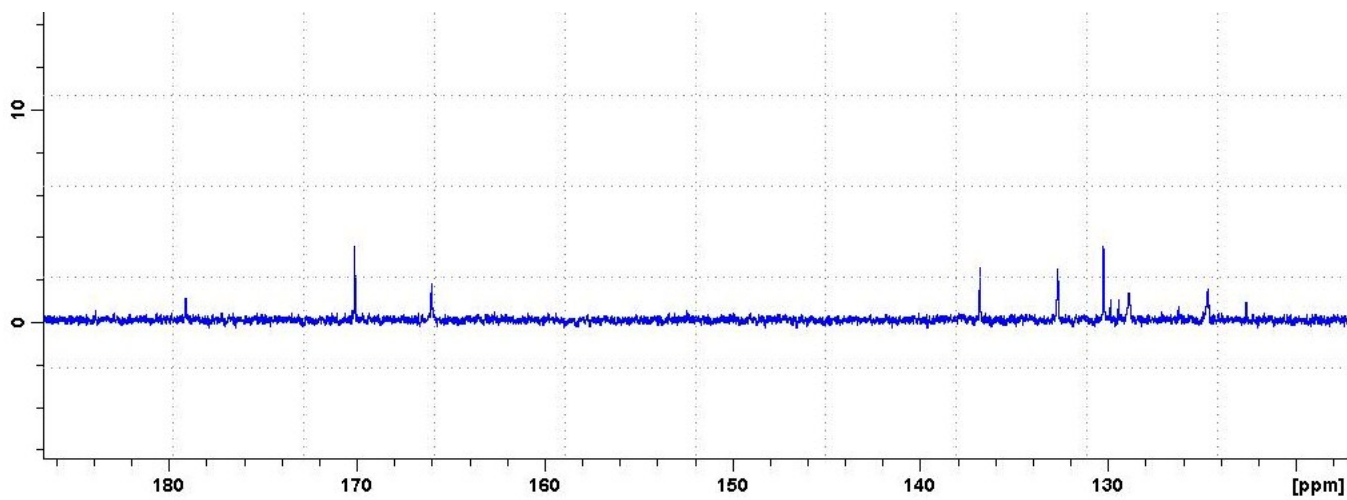
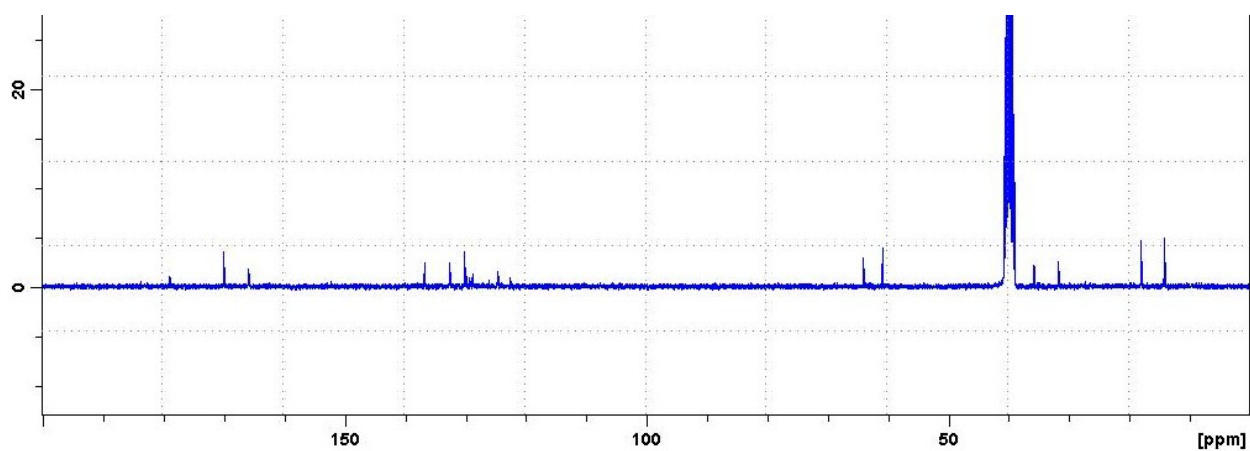


Ethyl {2-[(2E)-2-{2-[3-(trifluoromethyl)phenyl]propylidene}hydrazinyl]-4,5-dihydro-1,3-thiazol-4-yl}acetate (37)

¹H NMR of 37

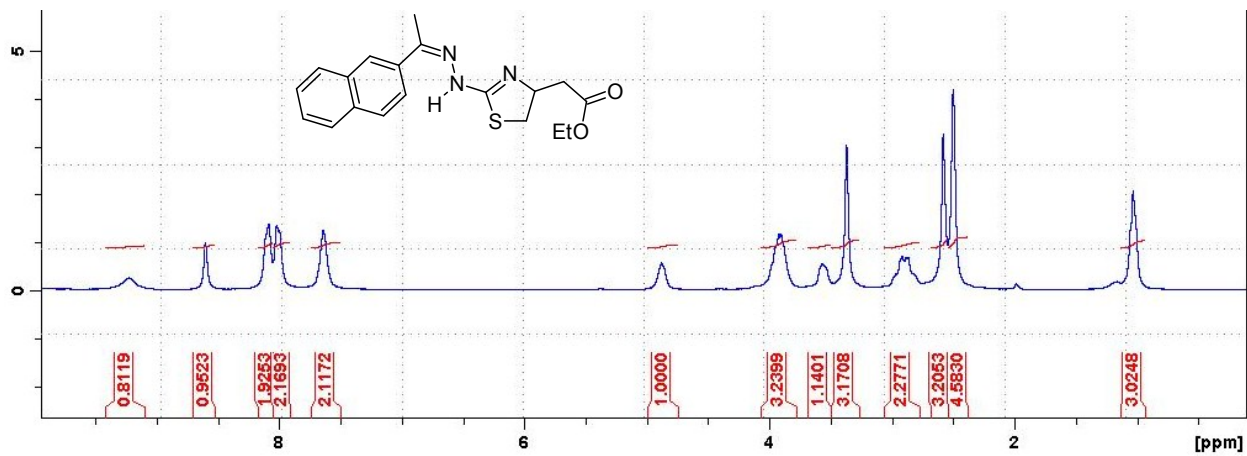


¹³C NMR of 37

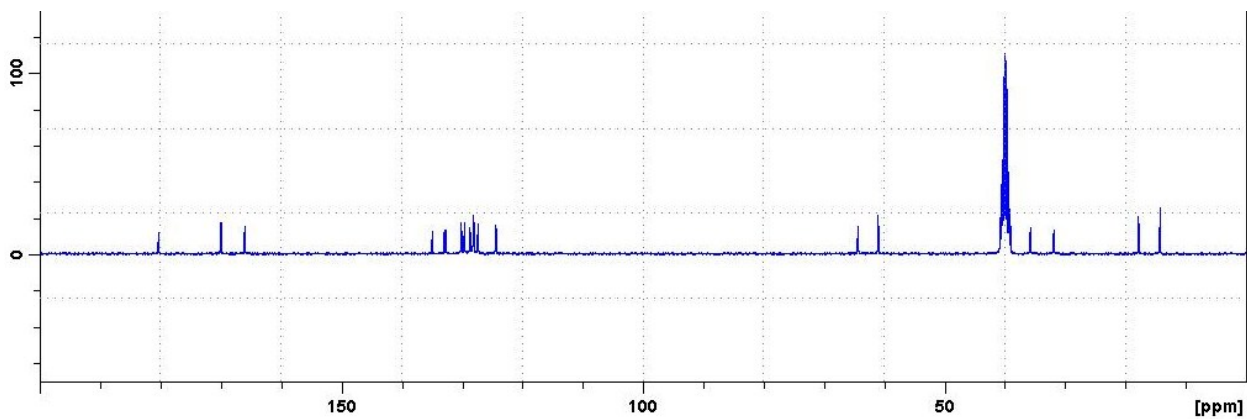


Ethyl (2-((2E)-2-[2-(naphthalen-2-yl)propylidene]hydrazinyl)-4,5-dihydro-1,3-thiazol-4-yl)acetate (38)

¹H NMR of 38

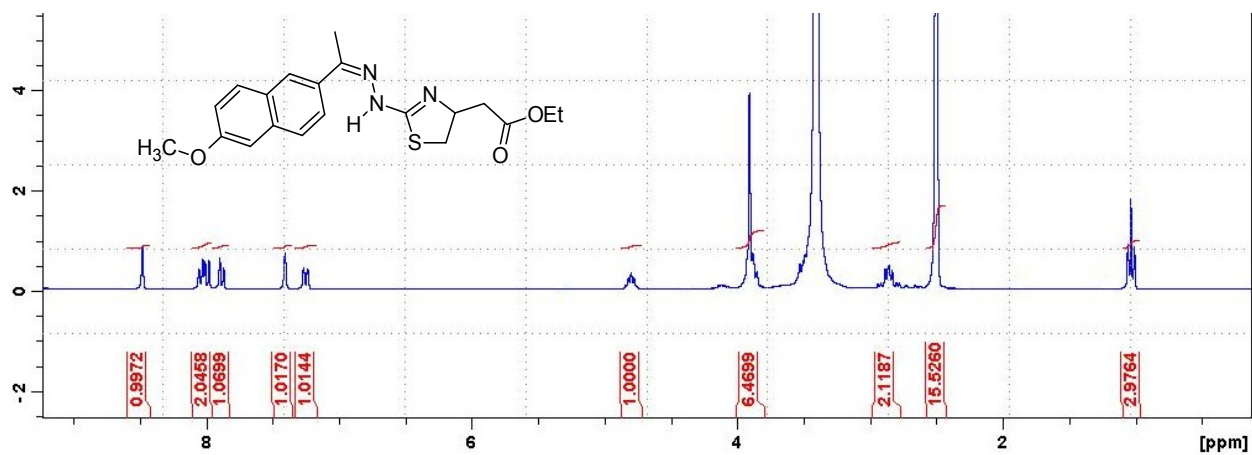


¹³C NMR of 38

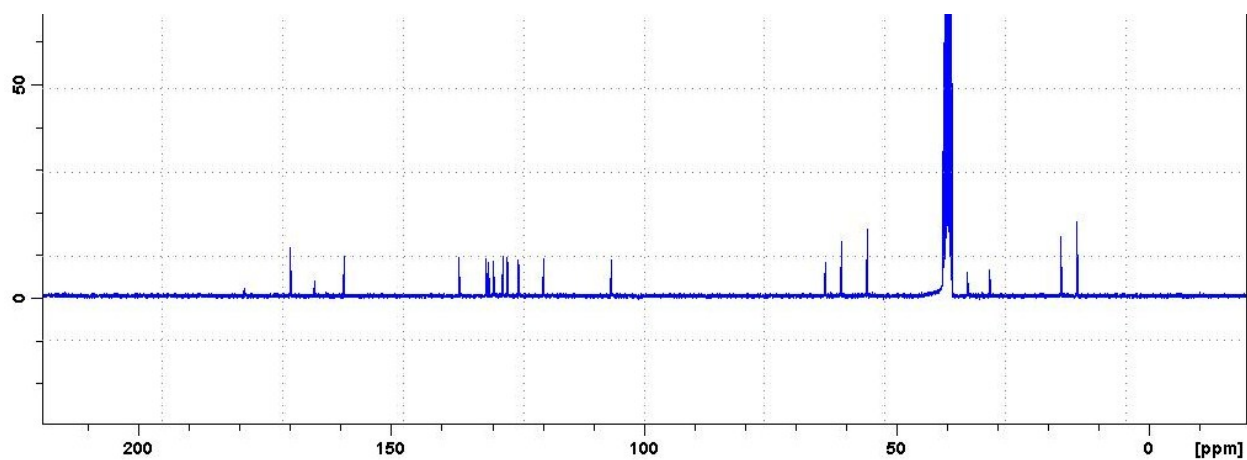


Ethyl (2-((2Z)-2-[1-(6-methoxynaphthalen-2-yl)ethylidene]hydrazinyl)-4,5-dihydro-1,3-thiazol-4-yl)acetate (39)

¹H NMR of 39

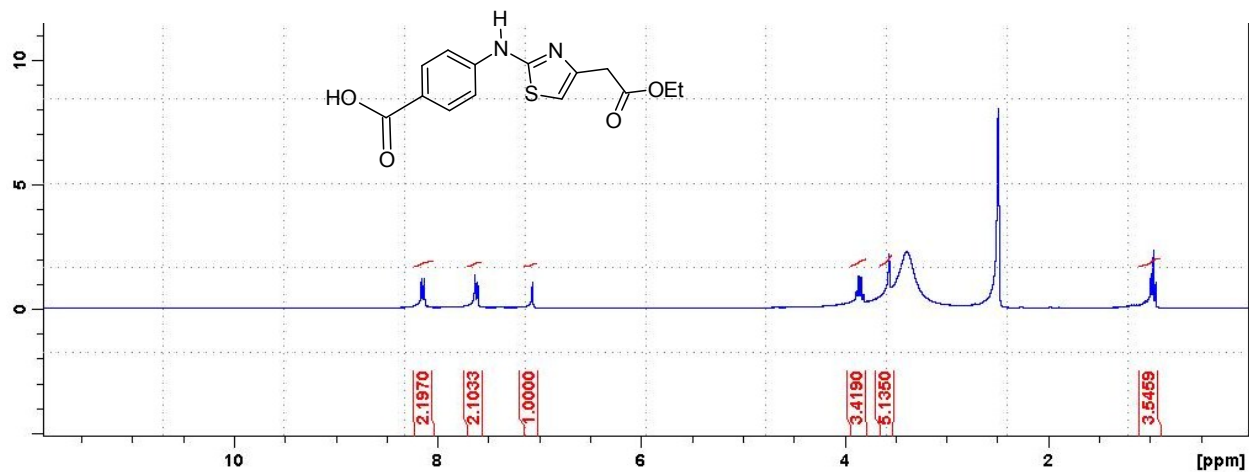


¹³C NMR of 39

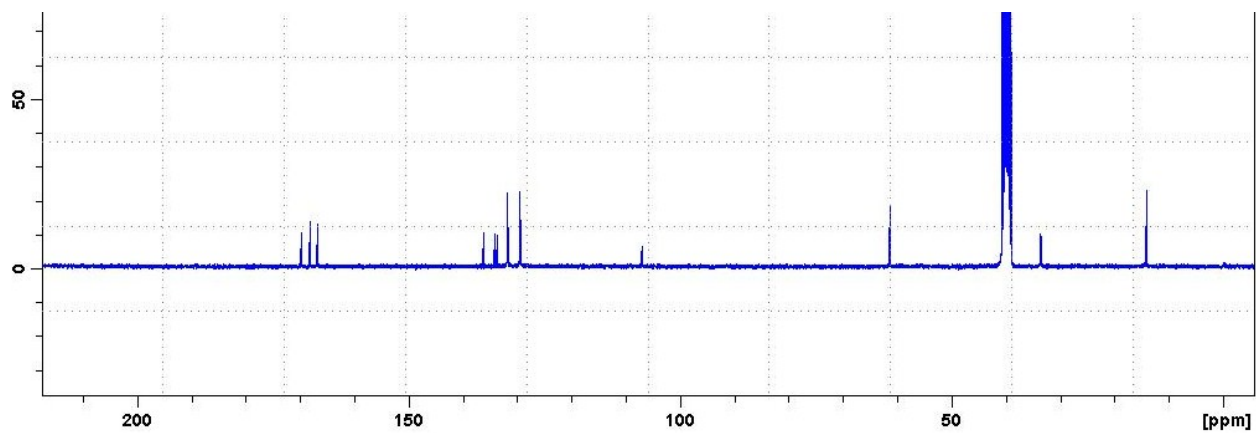


4-{{4-(2-Ethoxy-2-oxoethyl)-1,3-thiazol-2-yl}amino}benzoic acid (40)

¹H NMR of 40

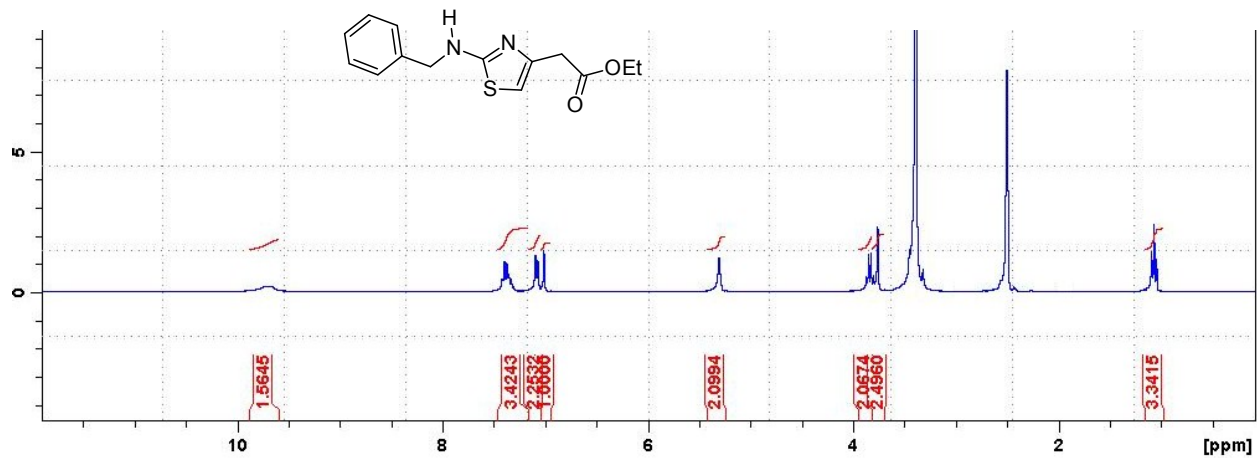


¹³C NMR of 40

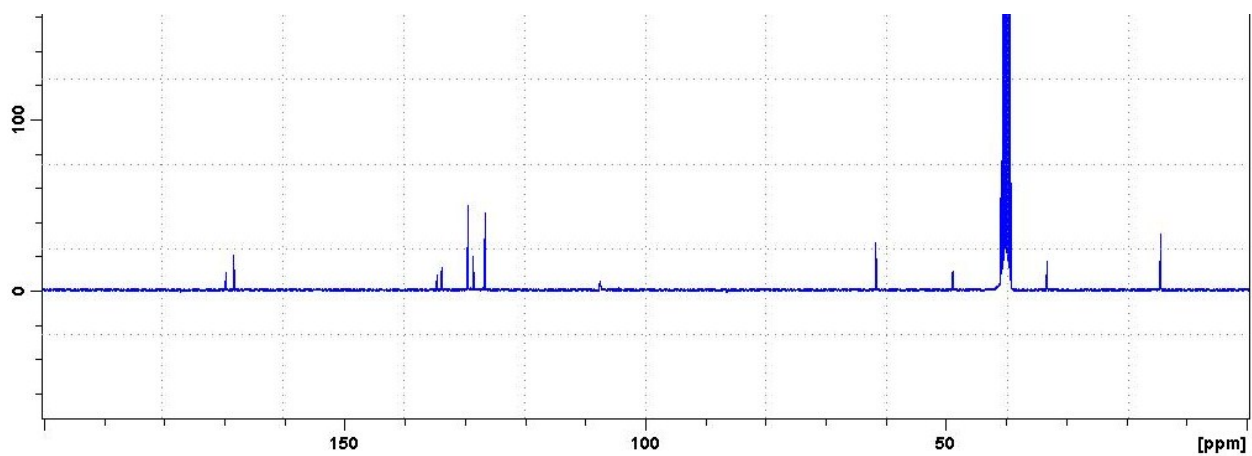


Ethyl [2-(benzylamino)-1,3-thiazol-4-yl]acetate (41)

¹H NMR of 41

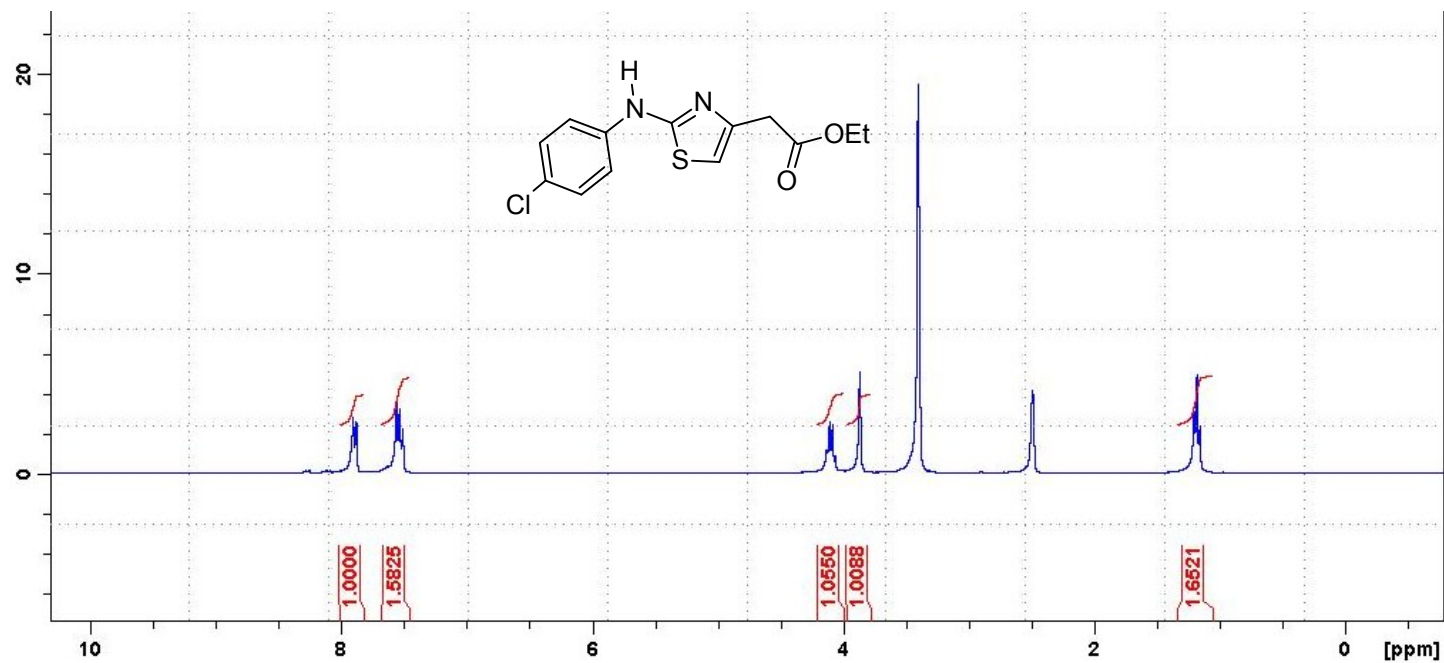


¹³C NMR of 41

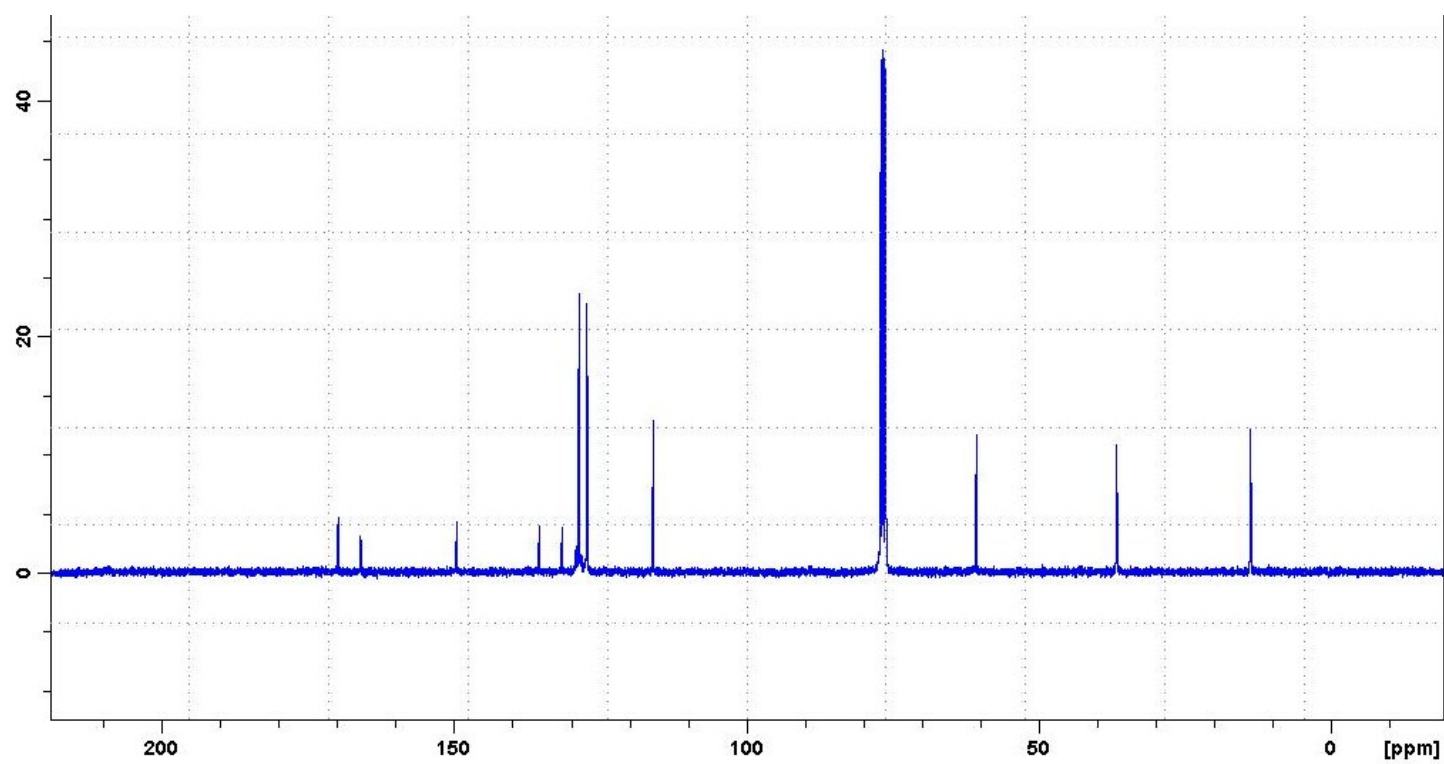


Ethyl {2-[(4-chlorophenyl)amino]-1,3-thiazol-4-yl}acetate (42)

¹H NMR of 42

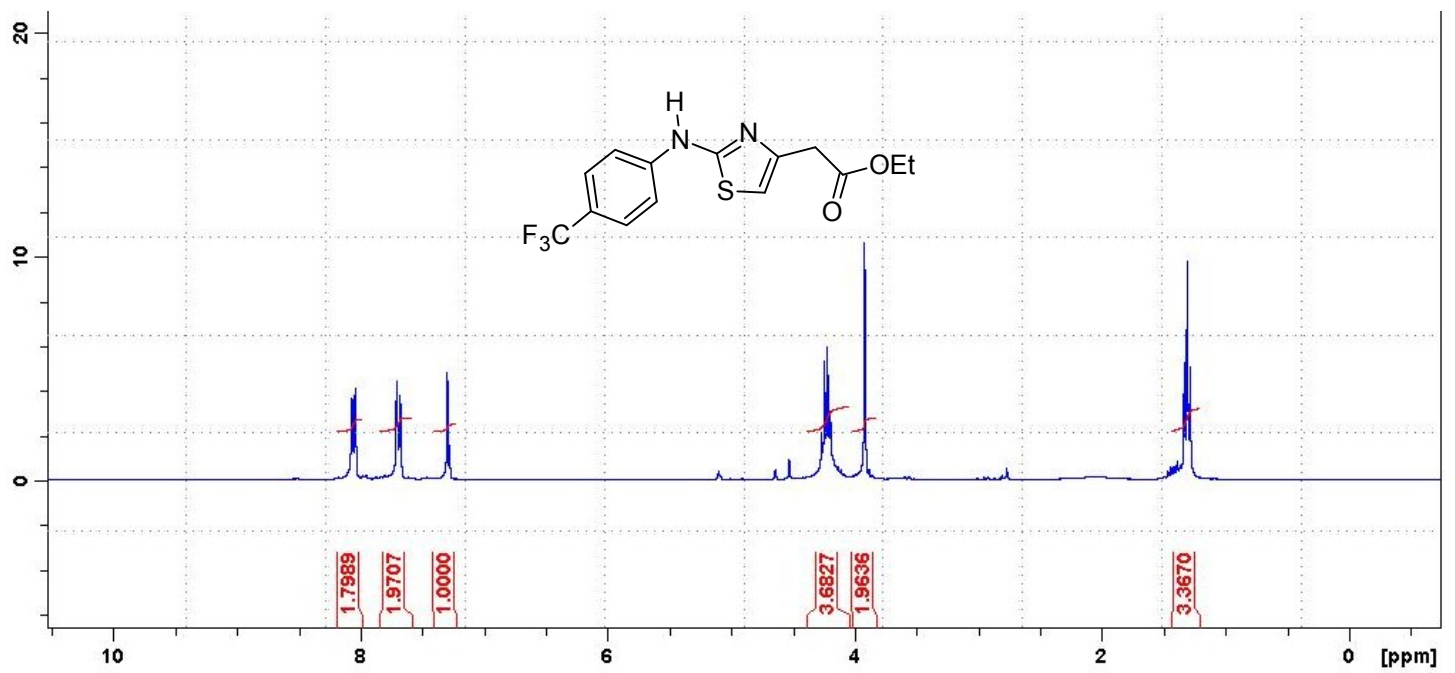


¹³C NMR of 42



Ethyl (2-{{4-(trifluoromethyl)phenyl}amino}-1,3-thiazol-4-yl)acetate (43)

¹H NMR of 43



¹³C NMR of 43

