Supporting Information

for

A facile, rapid, one-pot regio/steroselective synthesis of 2-iminothiazolidin-4-ones under solvent/scavenger-free conditions

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Experimental procedures and product characterization for compounds 4a–j

Experimental section

All chemicals, reagents and solvents were of commercial high-purity grade purchased from Avra Synthesis Pvt. Ltd. and Merck Ltd. India. Silica gel (60–120 mesh) was used for column chromatographic isolation and purification of the products. Melting points were measured in open capillary tubes and are uncorrected. Elemental analyses were performed on a Perkin Elmer 2400 Series II Elemental CHNS analyzer. The ^{1}H NMR, ^{13}C NMR, DEPT, H,H-COSY and C,H-COSY, HMBC were recorded on a Bruker (Avance) 300 MHz NMR instrument using TMS as an internal standard and $CDCl_3$ as a solvent. Chemical shifts are given in parts per million (δ-scale) and the coupling constants are given in hertz.

General procedure for the synthesis of 2-iminothiazolidin-4-ones (4a–j)

A mixture of 1-isothiocyanato-2-phenylcyclohex-2-ene (**1**, 0.5 g, 2.3 mmol) and aromatic amine (**2**, 2.3 mmol) was heated for 5–10 minutes at 100 °C under solvent-free conditions to afford the thiourea derivative as an off-white solid. To the solid, chloroacetic acid (**3**, 6.9 mmol) was added, and the mixture was further heated for 10–15 minutes. After completion of the reaction as monitored by TLC, crushed ice was added to the reaction mixture, and the resulting solid was filtered, washed with water, and purified by filtration through a pad of silica gel using a 7:3 petroleum ether–ethylacetate mixture to afford the pure product **4**.

(*Z*)-3-Ethyl-2-(2-phenylcyclohex-2-enylimino)thiazolidin-4-one (4a)

Yield: 0.55 g (79%). White solid, mp 118–119 °C. ^{1}H NMR (300 MHz, $CDCl_3$) δ (ppm): 7.23–7.48 (m, 5H, ArH), 6.12 (br s, 1H, C=CH), 4.34 (br s, 1H, CHN), 3.78 (s, 2H), 3.56 (m, 2H, CH_2N), 2.26–2.34 (m, 2H, Alicyclic protons), 1.95–1.98 (m, 1H, Alicyclic protons), 1.76–1.80 (m, 2H, Alicyclic protons), 1.66–1.68 (m, 1H, Alicyclic protons), 0.88 (t, J = 7.2 Hz, 3H). ^{13}C NMR (75 MHz, $CDCl_3$) δ (ppm): 171.40, 150.45, 141.61, 139.47, 127.92,

127.75, 126.46, 126.23, 58.50, 37.98, 32.63, 30.27, 25.96, 19.23, 11.99. IR (KBr) ν_{max} 3028, 1712, 1628, 1483 cm^{-1}. Anal. calcd for: C, 67.97; H, 6.71; N, 9.32. Found: C, 67.83; H, 6.70; N, 9.30.

(*Z*)-3-Butyl-2-(2-phenylcyclohex-2-enylimino)thiazolidin-4-one (4b)

Yield: 0.64 g (84%). White solid, mp 150–151 °C. ^{1}H NMR (300 MHz, $CDCl_3$) δ (ppm): 7.13–7.29 (m, 5H, ArH), 6.09 (br s, 1H, C=CH), 4.50 (br s, 1H, CHN), 3.76 (s, 2H), 3.53 (m, 2H), 2.15–2.18 (m, 2H, Alicyclic protons), 1.95–2.01 (m, 1H, Alicyclic protons), 1.88–1.91 (m, 2H, Alicyclic protons), 1.67–1.77 (m, 1H, Alicyclic protons), 1.19 (m, 2H), 1.01 (m, 2H), 0.71(t, *J* = 6.9 Hz, 3H). ^{13}C NMR (75 MHz, $CDCl_3$) δ (ppm): 171.43, 150.53, 141.61, 139.57, 127.56, 127.58, 126.39, 126.17, 58.42, 42.62, 32.48, 30.12, 28.78, 25.90, 19.64, 19.31, 13.60. IR (KBr) ν_{max} 2986, 1705, 1630, 1463 cm^{-1}. Anal. calcd for: C, 69.47; H, 7.36; N, 8.53. Found: C, 69.55; H, 7.39; N, 8.56.

(*Z*)-3-Benzyl-2-(2-phenylcyclohex-2-enylimino)thiazolidin-4-one (4c)

Yield: 0.69 g (83%). White solid, mp 132–133 °C. ^{1}H NMR (300 MHz, $CDCl_3$) δ (ppm): 7.24–7.31 (m, 5H, ArH), 7.10–7.14 (m, 5H, ArH), 6.12 (br s, 1H, C=CH), 4.39 (br s, 1H, CHN), 4.85 (d, *J* = 14.1 Hz, 1H, benzylic), 4.60 (d, *J* = 14.1 Hz, 1H, benzylic), 3.73 (s, 2H), 2.12–2.27 (m, 2H, Alicyclic protons), 1.89–1.93 (m, 1H, Alicyclic protons), 1.73–1.77 (m, 2H, Alicyclic protons), 1.68–1.71 (m, 1H, Alicyclic protons). ^{13}C NMR (75 MHz, $CDCl_3$) δ (ppm): 171.23, 150.48, 141.75, 139.48, 136.18, 128.86, 128.13, 128.06, 127.91, 127.34, 126.58, 126.35, 58.19, 46.01, 32.44, 30.48, 26.01, 19.01. IR (KBr) ν_{max} 2925, 1712, 1628, 1427 cm^{-1}. Anal. calcd for: C, 72.89; H, 6.12; N, 7.73. Found: C, 72.95; H, 6.11; N, 7.70.

(*Z*)-3-Cyclohexyl-2-(2-phenylcyclohex-2-enylimino)thiazolidin-4-one (4d)

Yield: 0.69 g (84%). White solid, mp 139–140 °C. ^{1}H NMR (300 MHz, $CDCl_3$) δ (ppm): 7.21–7.26 (m, 5H, ArH), 6.10 (br s, 1H, C=CH), 4.32 (br s, 1H, CHN), 3.82 (s, 2H), 2.48 (m, 1H, CHN), 2.18–2.28 (m, 4H, Alicyclic protons), 1.96–1.98 (m, 4H, Alicyclic protons), 1.72–

1.76 (m, 4H, Alicyclic protons), 1.56–1.69 (m, 5H, Alicyclic protons), 0.81–086 (m, 1H, Alicyclic protons), 0.66–0.68 (m, 1H, Alicyclic protons). ^{13}C NMR (75 MHz, $CDCl_3$) δ (ppm): 171.86, 151.20, 141.91, 139.71, 128.70, 127.97, 127.81, 126.48, 126.37, 126.21, 29.19, 32.45, 29.99, 25.98, 25.80, 19.55, 6.78, 6.49. IR (KBr) ν_{max} 2979, 1710, 1634, 1481 cm^{-1}. Anal. calcd for: C, 71.15; H, 7.39; N, 7.90. Found: C, 71.26; H, 7.36; N, 7.94.

(*Z*)-3-Phenyl-2-(2-phenylcyclohex-2-enylimino)thiazolidin-4-one (4e)

Yield: 0.64 g (80%). White solid, mp 142–143 °C. ^{1}H NMR (300 MHz, $CDCl_3$) δ (ppm): 7.18–7.33 (m, 10H, ArH), 6.75 (br s, 1H, C=CH), 4.39 (br s, 1H, CHN), 3.95 (dd, *J* = 13.4, 5.4 Hz, 2H), 2.17–2.18 (m, 2H, Alicyclic protons), 1.93–2.00 (m, 1H, Alicyclic protons), 1.78–1.85 (m, 2H, Alicyclic protons), 1.61–1.66 (m, 1H, Alicyclic protons). ^{13}C NMR (75 MHz, $CDCl_3$) δ (ppm): 171.07, 150.86, 142.19, 139.85, 134.98, 128.70, 128.12, 127.93, 127.70, 127.56, 126.68, 126.41, 59.33, 32.68, 29.49, 25.75, 19.81. IR (KBr) ν_{max} 2931, 1727, 1639, 1516 cm^{-1}. Anal. calcd for: C, 72.38; H, 5.79; N, 8.04. Found: C, 72.49; H, 5.77; N, 8.06.

(*Z*)-2-(2-Phenylcyclohex-2-enylimino)-3-*p*-tolylthiazolidin-4-one (4f)

Yield: 0.69 g (82%). White solid, mp 148–149 °C. ^{1}H NMR (300 MHz, $CDCl_3$) δ (ppm): 7.18–7.33 (m, 5H, ArH), 7.01 (d, *J* = 7.8 Hz, 2H), 6.61 (d, *J* = 7.2 Hz, 2H), 5.95 (br s, 1H, C=CH), 4.39 (br s, 1H, CHN), 3.93 (dd, *J* = 13.4, 5.4 Hz, 2H), 2.28 (s, 3H, CH_3), 2.16–2.17 (m, 2H, Alicyclic protons), 1.94–1.96 (m, 1H, Alicyclic protons), 1.78–1.80 (m, 2H, Alicyclic protons), 1.62–1.66 (m, 1H, Alicyclic protons). ^{13}C NMR (75 MHz, $CDCl_3$) δ (ppm): 171.12, 150.91, 142.22, 139.92, 137.96, 132.46, 129.41, 127.89, 127.51, 127.41, 126.72, 126.38, 59.38, 32.62, 29.59, 25.79, 21.13, 19.83. IR (KBr) ν_{max} 2946, 1726, 1632, 1512 cm^{-1}. Anal. calcd for: C, 72.89; H, 6.12; N, 7.73. Found: C, 73.02; H, 6.11; N, 7.76.

(*Z*)-3-(4-Fluorophenyl)-2-(2-phenylcyclohex-2-enylimino)thiazolidin-4-one (4g)

Yield: 0.66 g (80%). White solid, mp 161–162 °C. ^{1}H NMR (300 MHz, $CDCl_3$) δ (ppm): 7.19–7.33 (m, 5H, ArH), 6.85–6.91 (m, 2H), 6.65–6.70 (m, 2H), 5.95 (br s, 1H, C=CH), 4.39 (br s, 1H, CHN), 3.93 (dd, *J* = 13.4, 5.4 Hz, 2H), 2.17–2.19 (m, 2H, Alicyclic protons), 1.83–1.99 (m, 1H, Alicyclic protons), 1.72–1.74 (m, 2H, Alicyclic protons), 1.56–1.68 (m, 1H, Alicyclic protons). ^{13}C NMR (75 MHz, $CDCl_3$) δ (ppm): 170.99, 163.52, 160.24, 150.86, 142.21, 139.83, 130.74, 130.70, 129.53, 129.41, 127.98, 127.64, 126.66, 126.44, 115.85, 115.55, 59.29, 32.62, 29.40, 25.74, 19.89. IR (KBr) ν_{max} 2924, 1720, 1621, 1498 cm^{-1}. Anal. calcd for: C, 68.83; H, 5.23; N, 7.64. Found: C, 68.90; H, 5.21; N, 7.61.

(*Z*)-3-(4-Chlorophenyl)-2-(2-phenylcyclohex-2-enylimino)thiazolidin-4-one (4h)

Yield: 0.73 g (83%). White solid, mp 156–157 °C. ^{1}H NMR (300 MHz, $CDCl_3$) δ (ppm): 7.24–7.34 (m, 5H, ArH), 7.18 (d, *J* = 7.2 Hz, 2H), 6.63 (d, *J* = 8.7 Hz, 2H), 5.96 (br s, 1H, C=CH), 4.39 (br s, 1H, CHN), 3.94 (dd, *J* = 13.4, 5.4 Hz, 2H), 2.17–2.18 (m, 2H, Alicyclic protons), 1.93–2.00 (m, 1H, Alicyclic protons), 1.78–1.85 (m, 2H, Alicyclic protons), 1.61–1.66 (m, 1H, Alicyclic protons). ^{13}C NMR (75 MHz, $CDCl_3$) δ (ppm): 170.70, 150.47, 142.22, 139.82, 133.86, 133.40, 129.02, 128.88, 127.97, 127.62, 126.68, 126.45, 59.30, 32.63, 29.48, 25.74, 19.82. IR (KBr) ν_{max} 2919, 1730, 1620, 1490 cm^{-1}. Anal. calcd for: C, 65.87; H, 5.00; N, 7.32. Found: C, 66.01; H, 5.03; N, 7.35.

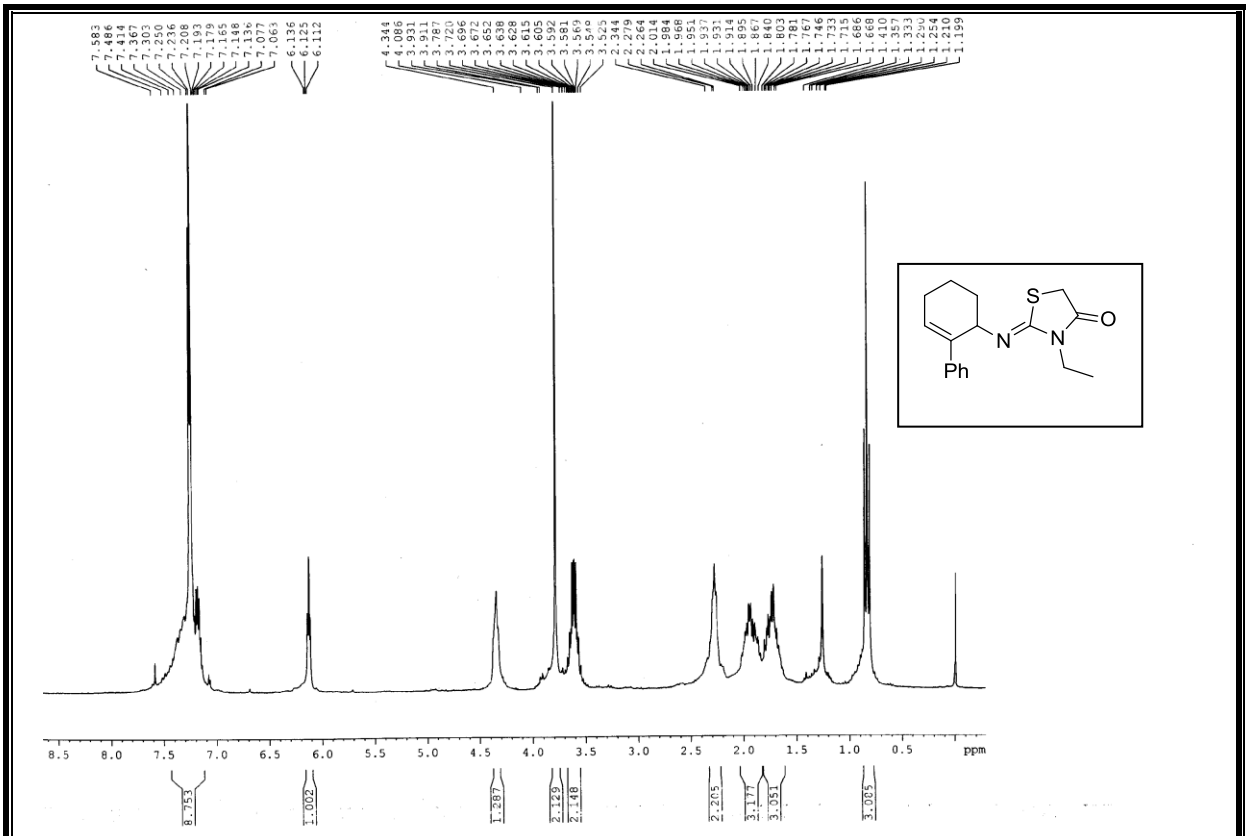
(*Z*)-3-(4-Methoxyphenyl)-2-(2-phenylcyclohex-2-enylimino)thiazolidin-4-one (4i)

Yield: 0.72 g (82%). White solid, mp 181–183 °C. ^{1}H NMR (300 MHz, $CDCl_3$) δ (ppm 7.18–7.31 (m, 5H, ArH), 6.74 (d, *J* = 7.2 Hz, 2H), 6.63 (d, *J* = 9 Hz, 2H), 5.95 (br s, 1H, C=CH), 4.39 (br s, 1H, CHN), 3.92 (dd, *J* = 13.4, 5.4 Hz, 2H), 3.74 (s, 3H, OCH_3), 2.15–2.17 (m, 2H, Alicyclic protons), 1.92–2.00 (m, 1H, Alicyclic protons), 1.72–1.83 (m, 2H, Alicyclic protons), 1.58–1.66 (m, 1H, Alicyclic protons). ^{13}C NMR (75 MHz, $CDCl_3$) δ (ppm): 171.32, 159.04, 151.23, 142.20, 139.89, 128.73, 127.94, 127.58, 126.68, 126.41, 114.09, 59.33,

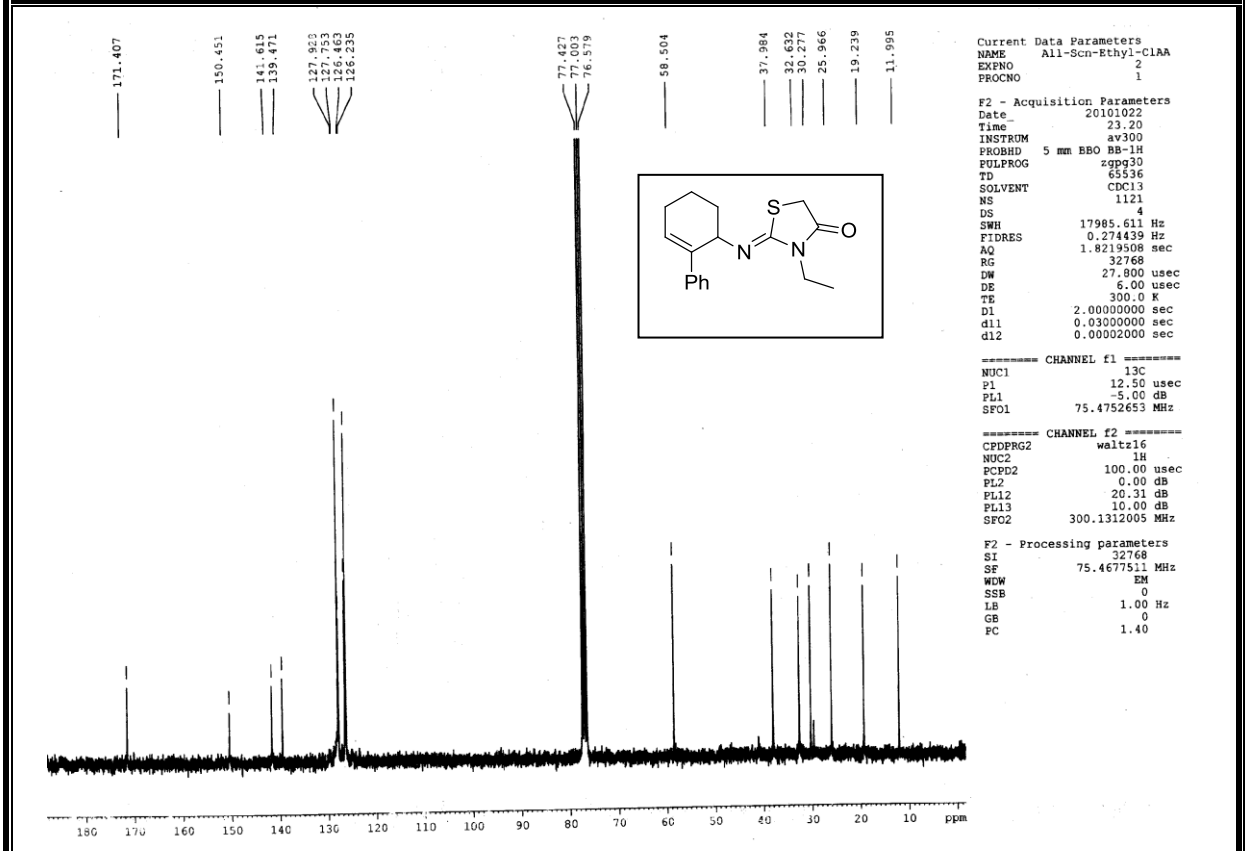
55.33, 32.61, 29.46, 25.78, 19.91. IR (KBr) ν_{max} 2952, 1730, 1639, 1519 cm^{-1}. Anal. calcd for: C, 69.81; H, 5.86; N, 7.40. Found: C, 69.77; H, 5.85; N, 7.43.

(*Z*)-3-(4-Bromophenyl)-2-(2-phenylcyclohex-2-enylimino)thiazolidin-4-one (4j)

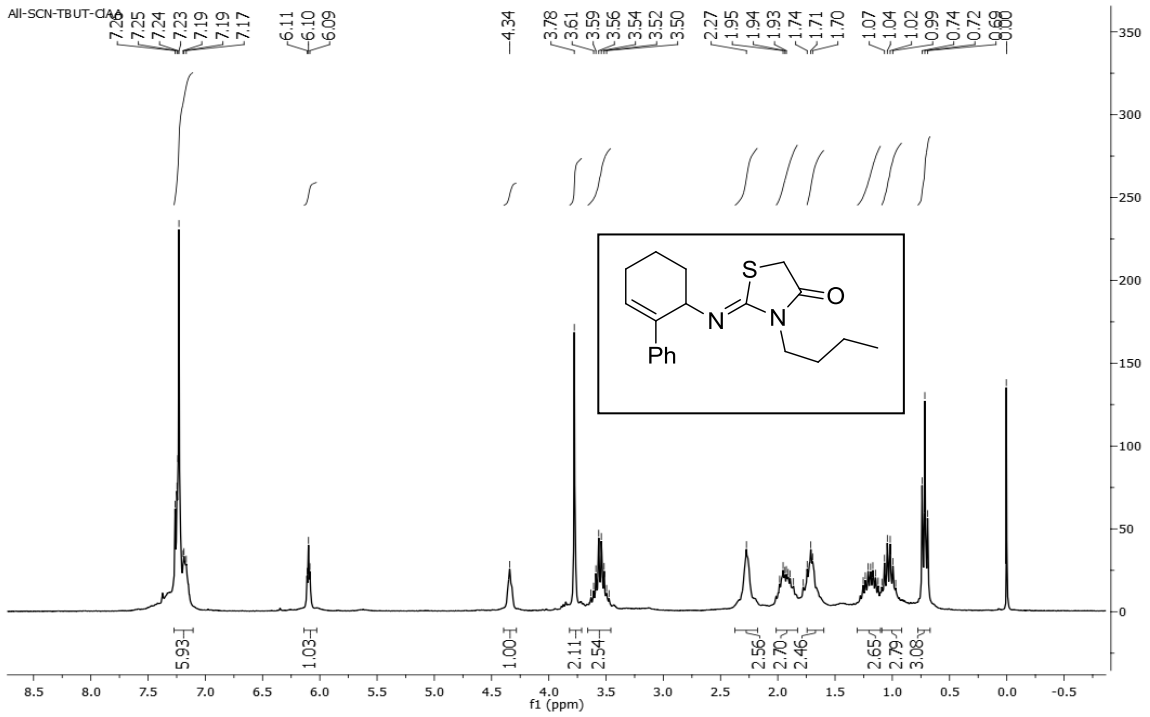
Yield: 0.79 g (81%). White solid, mp 172–173 °C. ^{1}H NMR (300 MHz, $CDCl_3$) δ (ppm): 7.24–7.46 (m, 5H, ArH), 7.21 (d, *J* = 7.5 Hz, 2H), 6.56 (d, *J* = 8.7 Hz, 2H), 5.97 (br s, 1H, C=CH), 4.39 (br s, 1H, CHN), 3.96 (dd, *J* = 13.4, 5.4 Hz, 2H), 2.17–2.18 (m, 2H, Alicyclic protons), 1.93–2.00 (m, 1H, Alicyclic protons), 1.78–1.85 (m, 2H, Alicyclic protons), 1.61–1.66 (m, 1H, Alicyclic protons). ^{13}C NMR (75 MHz, $CDCl_3$) δ (ppm): 170.58, 150.35, 142.14, 139.74, 133.86, 131.79, 129.28, 127.91, 127.58, 126.61, 126.39, 121.94, 59.24, 32.58, 29.40, 25.67, 19.75. IR (KBr) ν_{max} 2917, 1719, 1626, 1473 cm^{-1}. Anal. calcd for: C, 59.02; H, 4.48; N, 6.56. Found: C, 59.11; H, 4.48; N, 6.52.



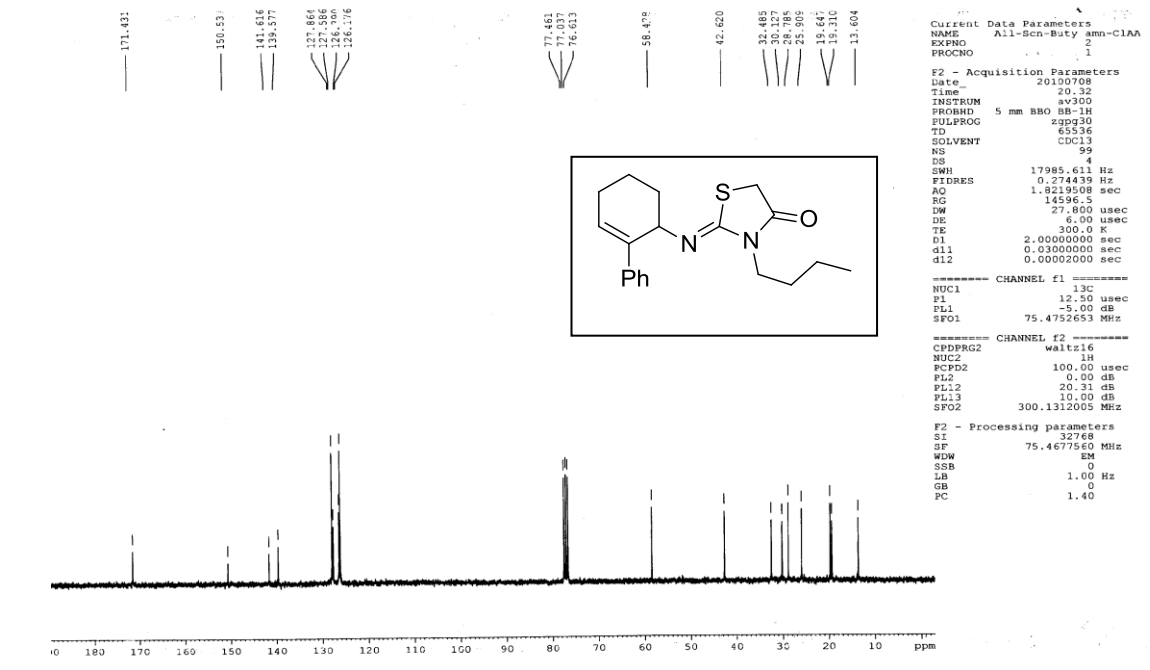
(*Z*)-3-Ethyl-2-(2-phenylcyclohex-2-enylimino)thiazolidin-4-one (4a)



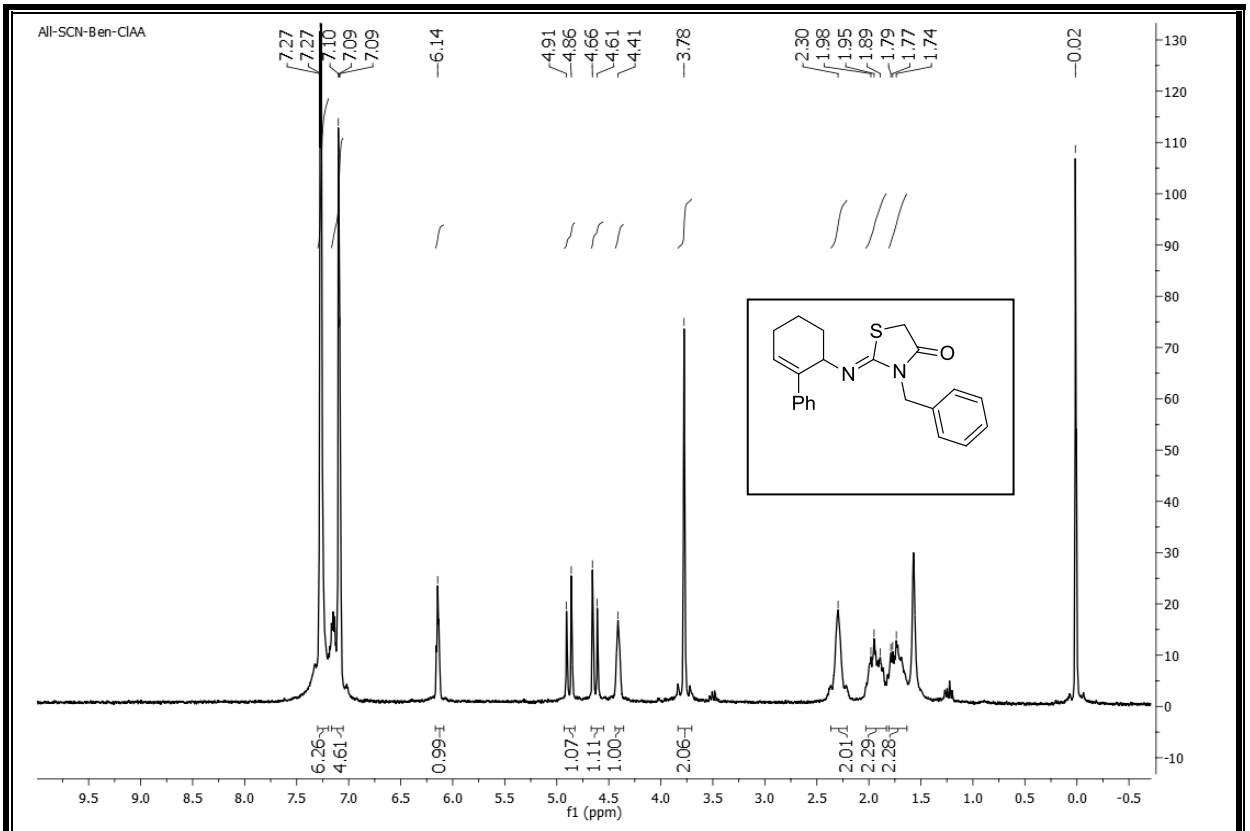
(*Z*)-3-Ethyl-2-(2-phenylcyclohex-2-enylimino)thiazolidin-4-one (4a)



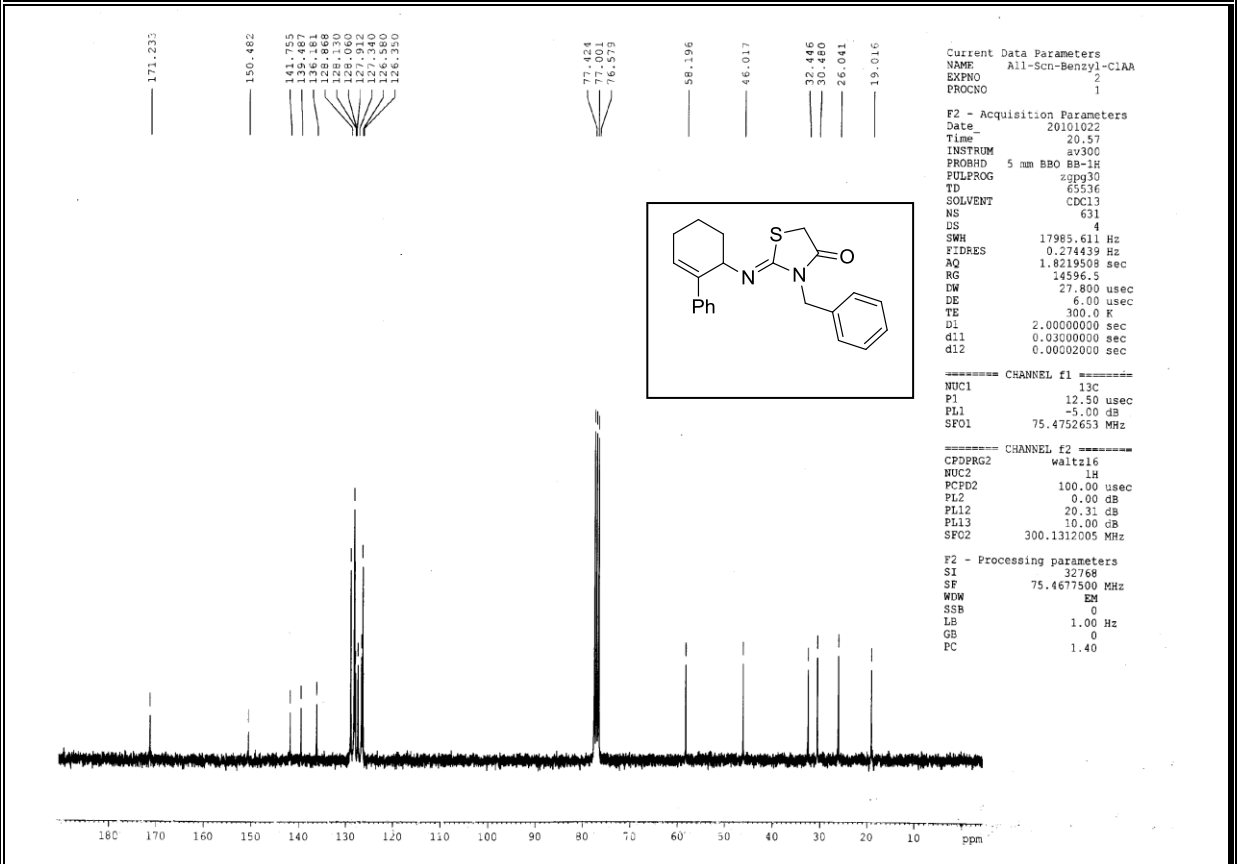
(*Z*)-3-Butyl-2-(2-phenylcyclohex-2-enylimino)thiazolidin-4-one (4b)



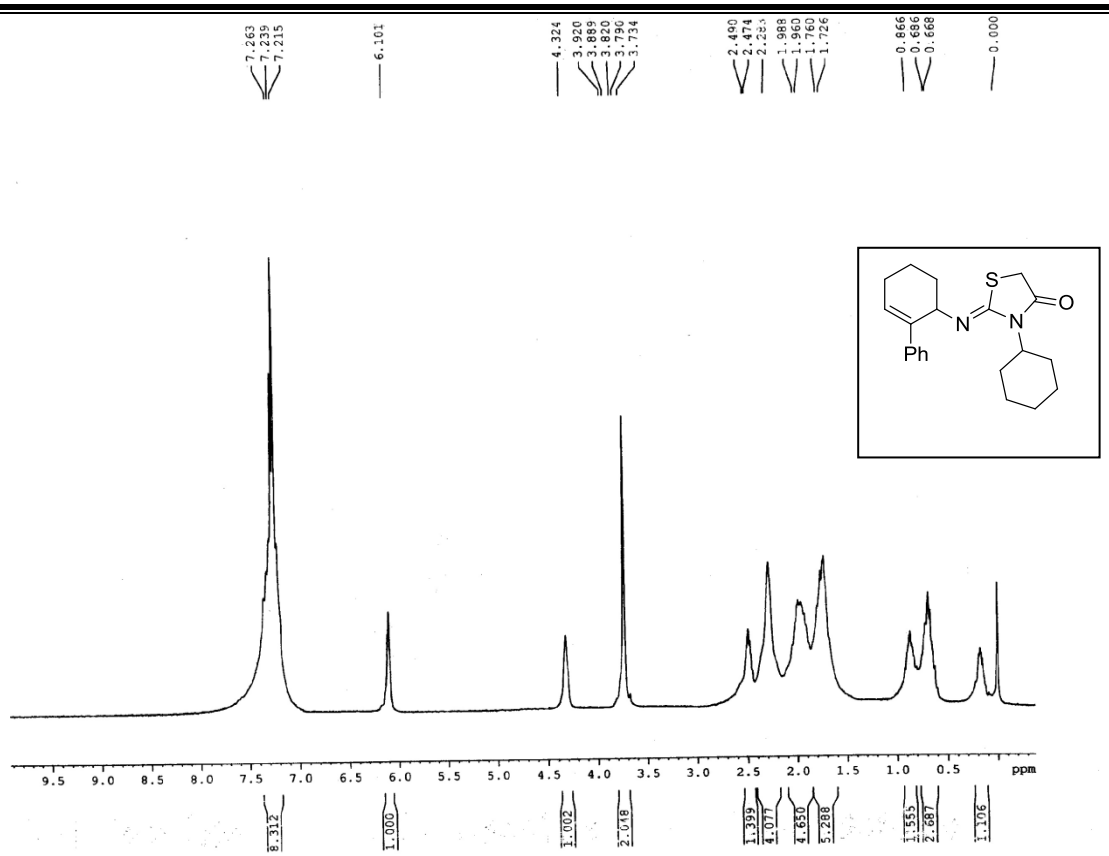
(*Z*)-3-Butyl-2-(2-phenylcyclohex-2-enylimino)thiazolidin-4-one (4b)



(*Z*)-3-Benzyl-2-(2-phenylcyclohex-2-enylimino)thiazolidin-4-one (4c)



(*Z*)-3-Benzyl-2-(2-phenylcyclohex-2-enylimino)thiazolidin-4-one (4c)



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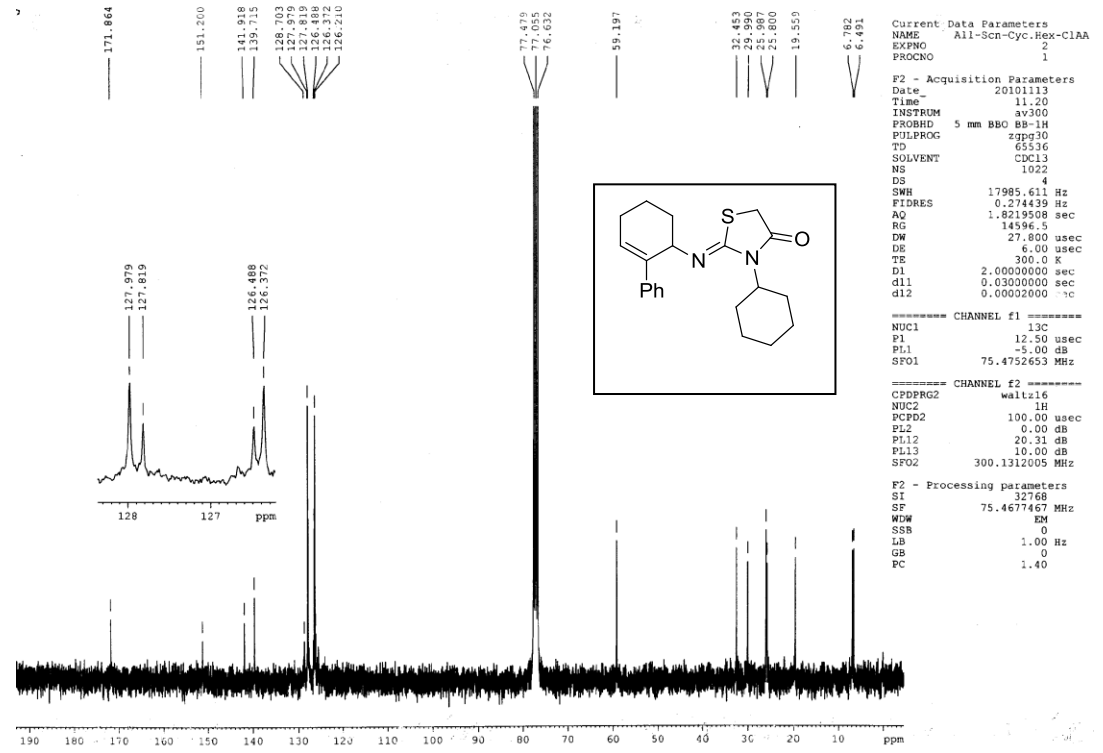

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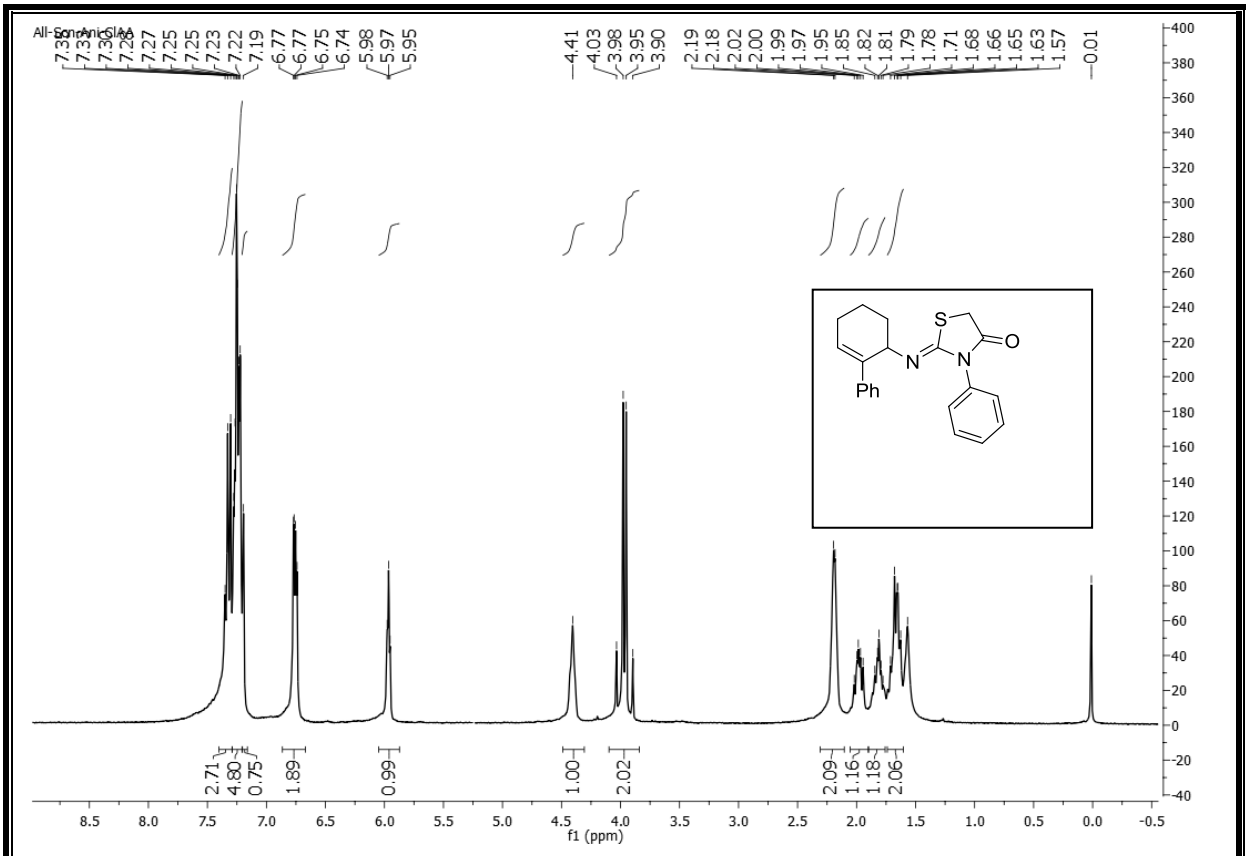
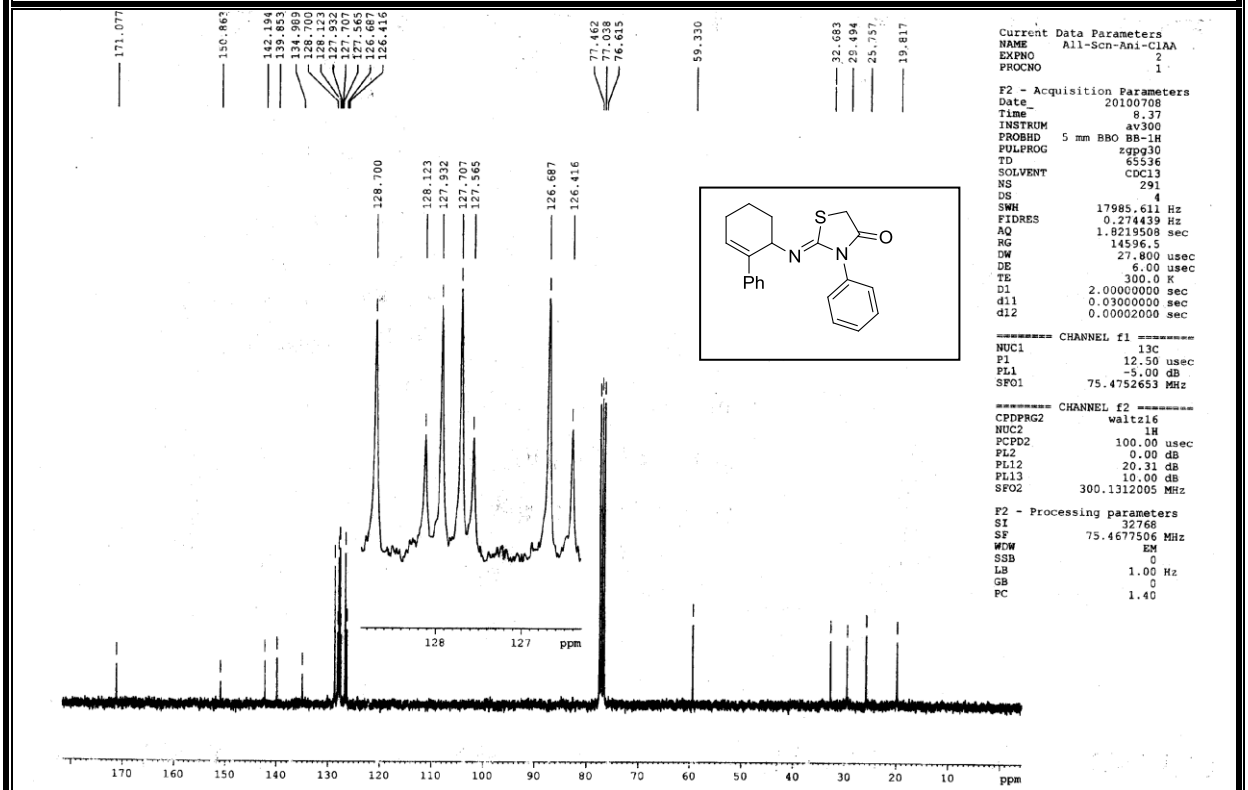
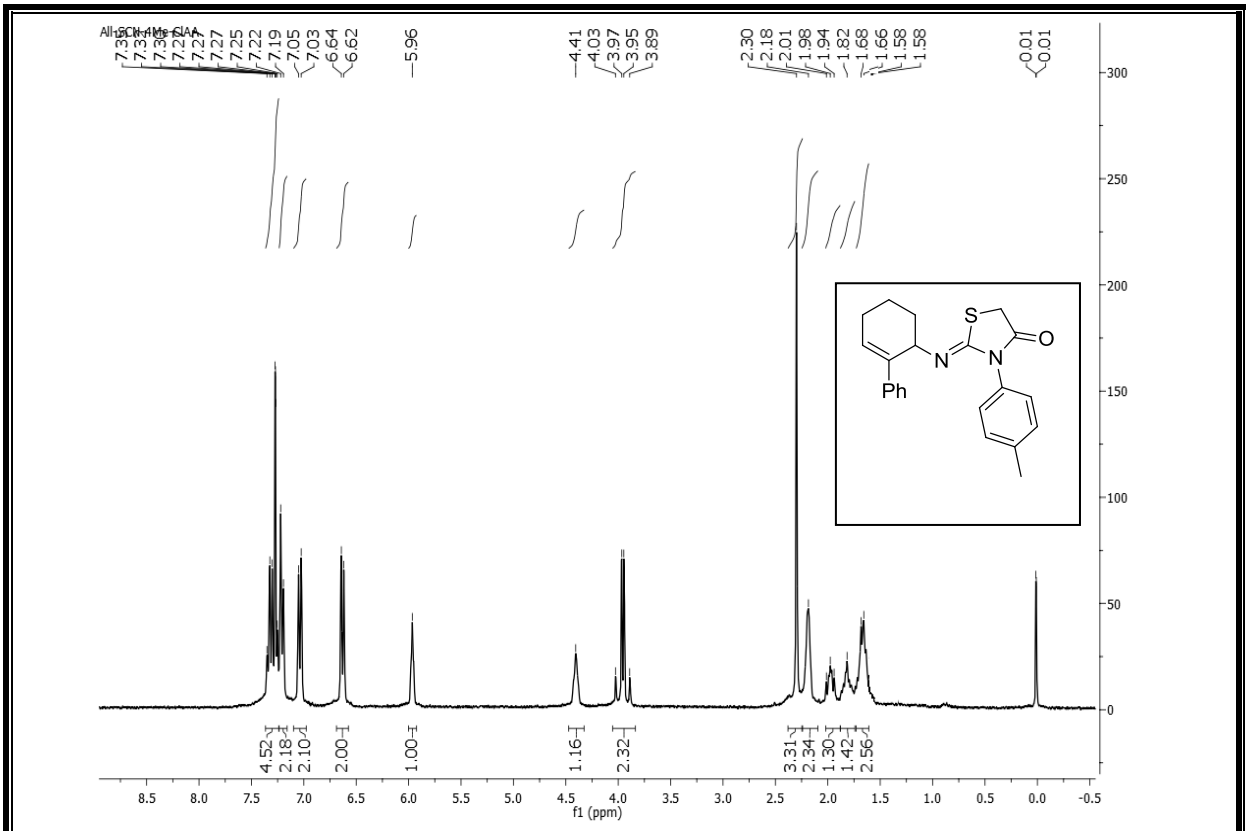


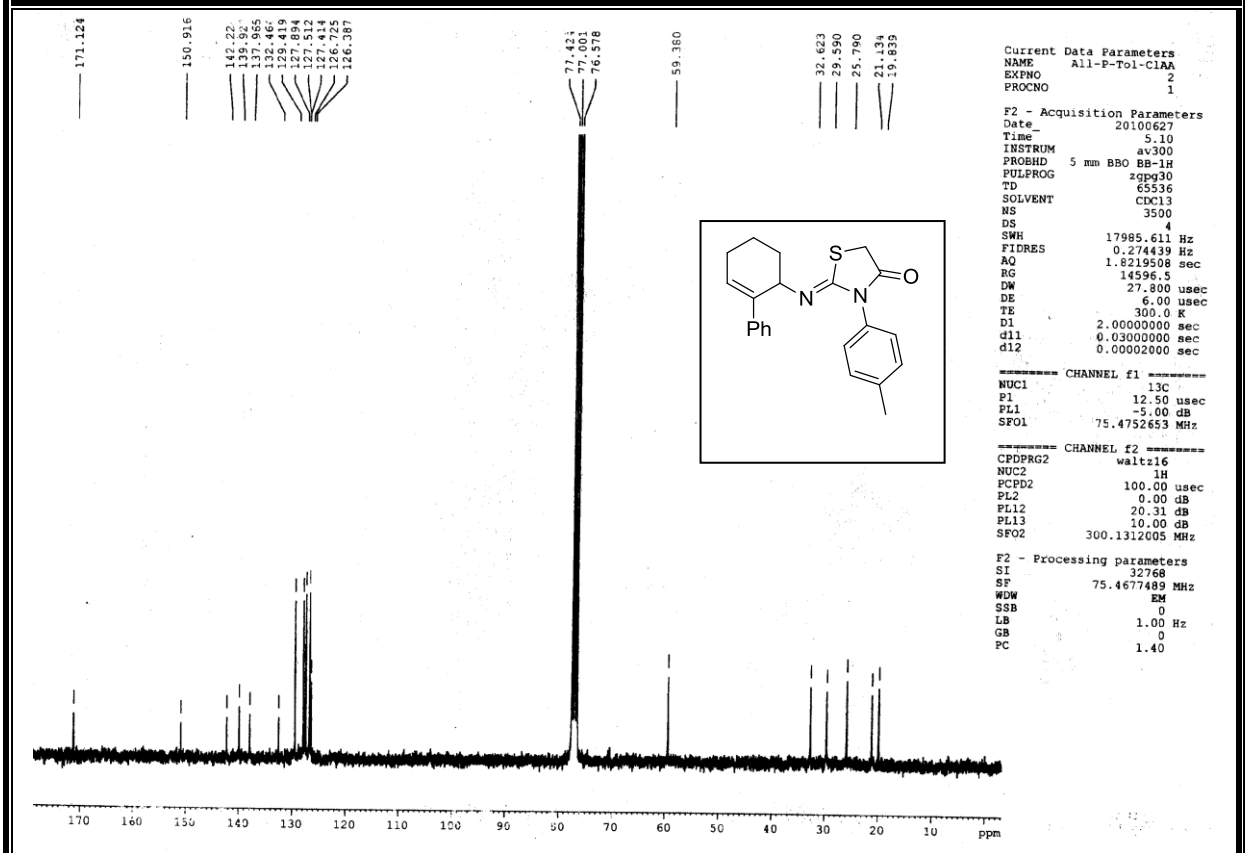
(*Z*)-3-Phenyl-2-(2-phenylcyclohex-2-enylimino)thiazolidin-4-one (4e)



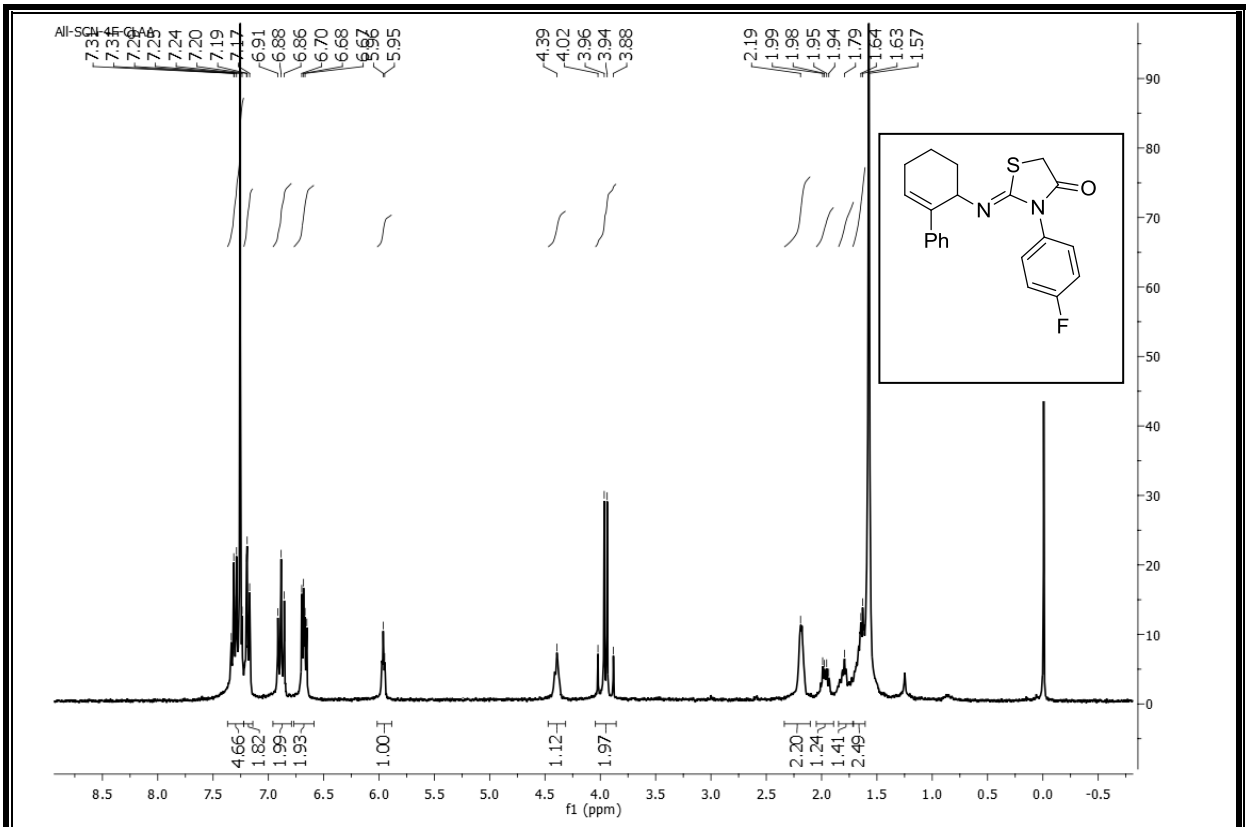
(*Z*)-3-Phenyl-2-(2-phenylcyclohex-2-enylimino)thiazolidin-4-one (4e)



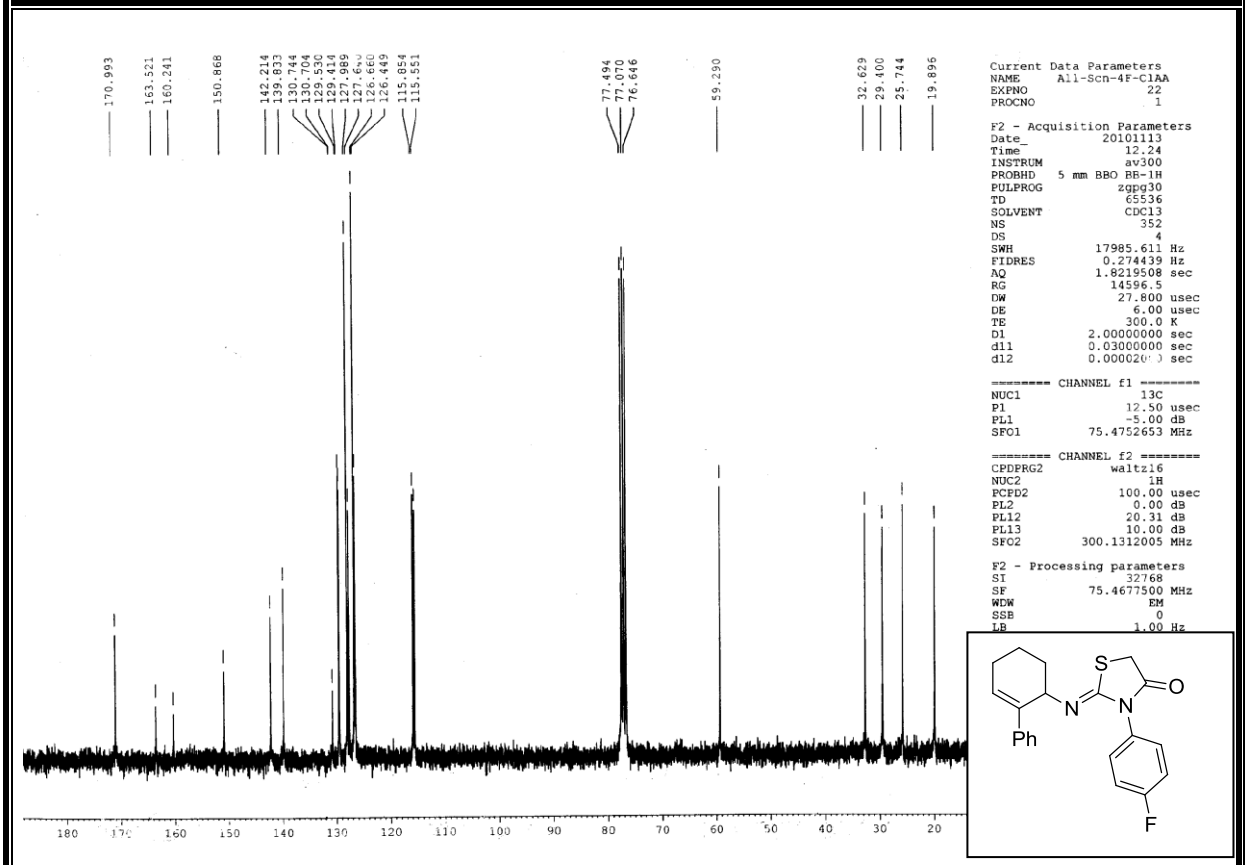
(*Z*)-2-(2-Phenylcyclohex-2-enylimino)-3-*p*-tolylthiazolidin-4-one (4f)



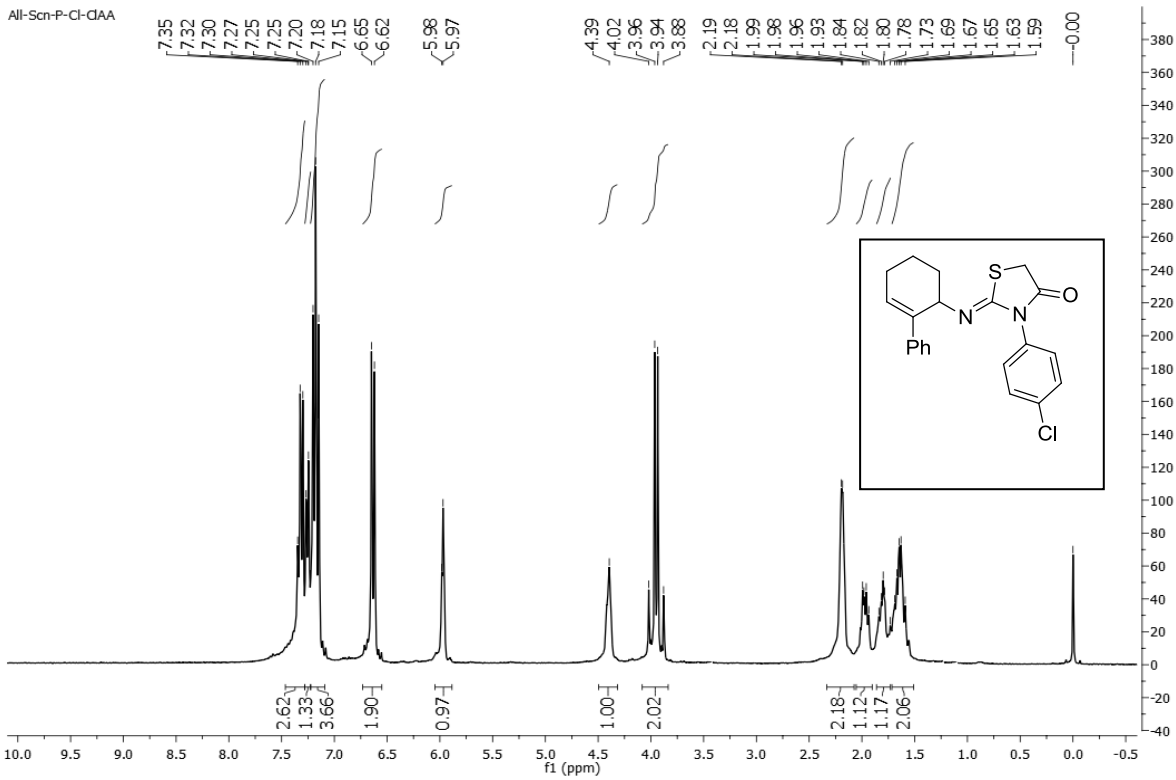
(*Z*)-2-(2-Phenylcyclohex-2-enylimino)-3-*p*-tolylthiazolidin-4-one (4f)



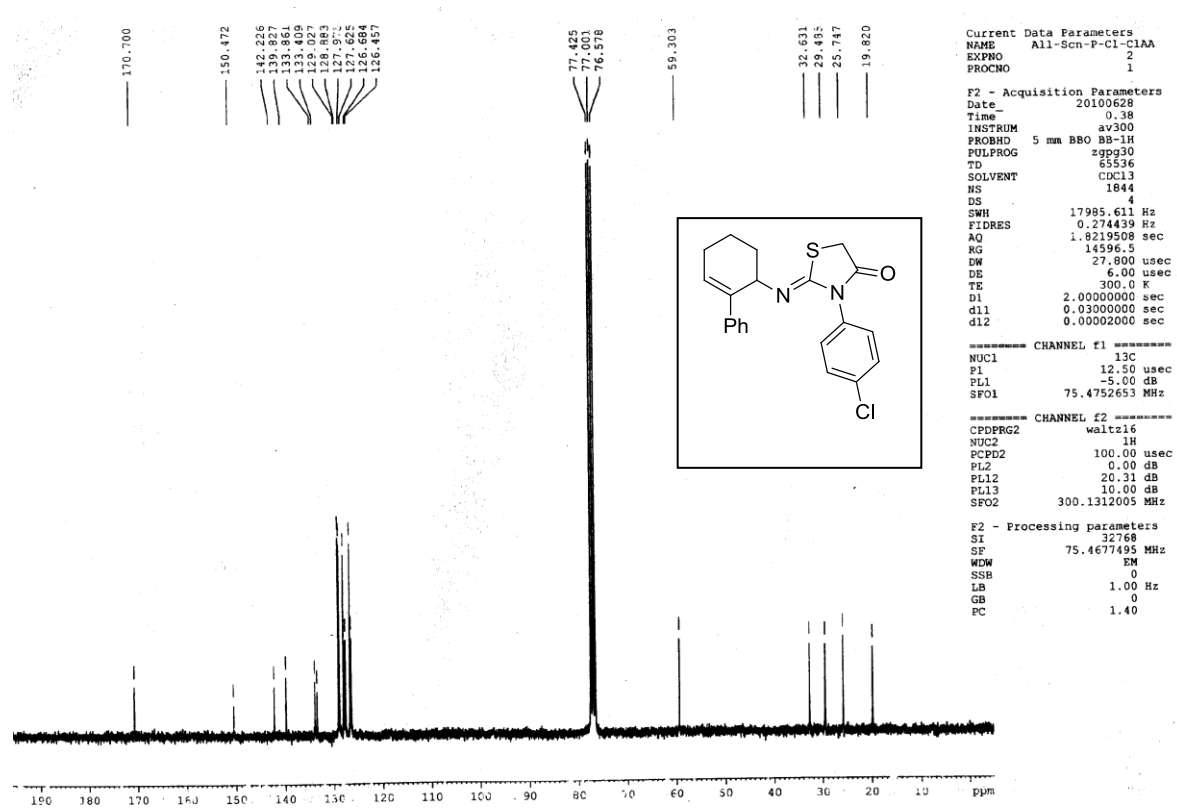
(*Z*)-3-(4-Fluorophenyl)-2-(2-phenylcyclohex-2-enylimino)thiazolidin-4-one (4g)



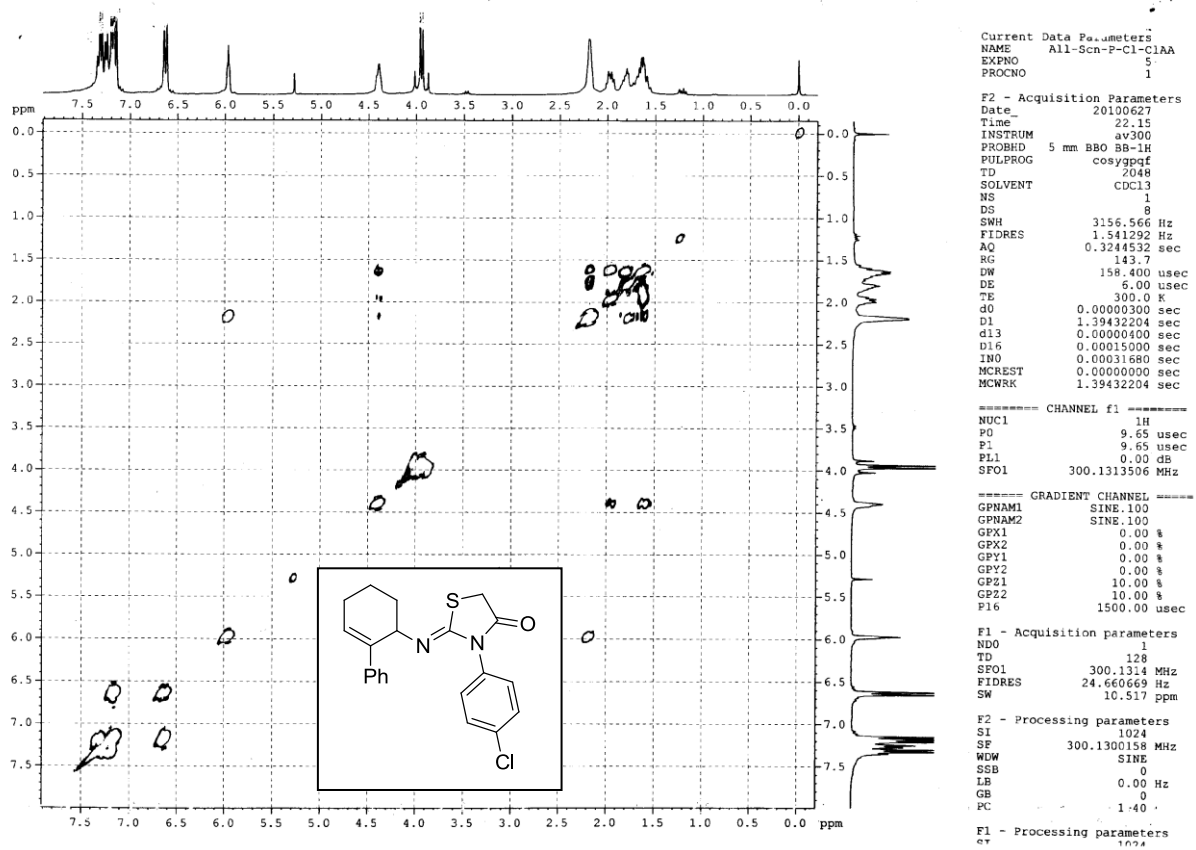
(*Z*)-3-(4-Fluorophenyl)-2-(2-phenylcyclohex-2-enylimino)thiazolidin-4-one (4g)



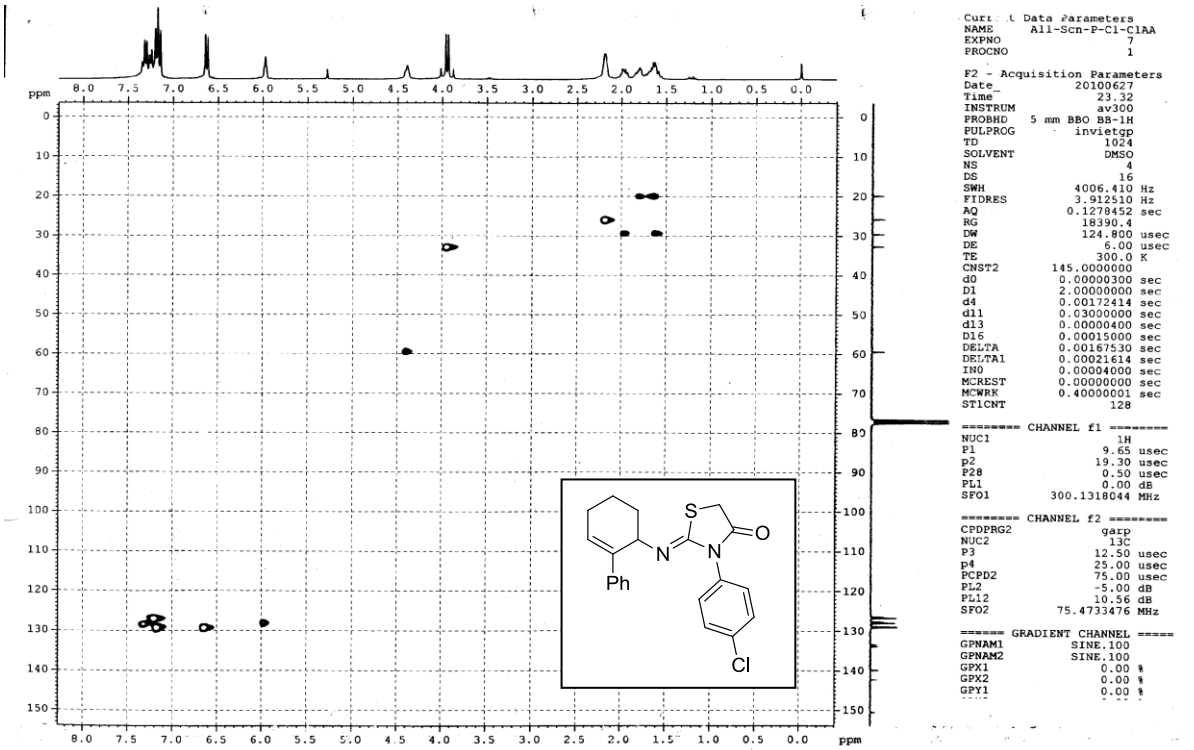
(*Z*)-3-(4-Chlorophenyl)-2-(2-phenylcyclohex-2-enylimino)thiazolidin-4-one (4h)



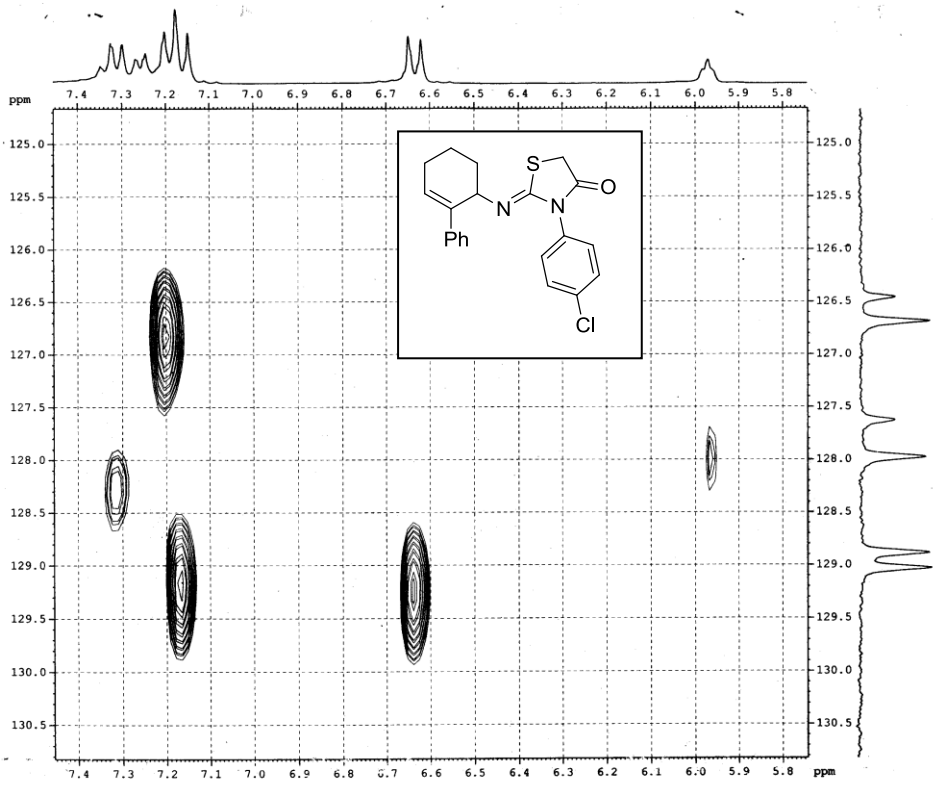
(*Z*)-3-(4-Chlorophenyl)-2-(2-phenylcyclohex-2-enylimino)thiazolidin-4-one (4h)



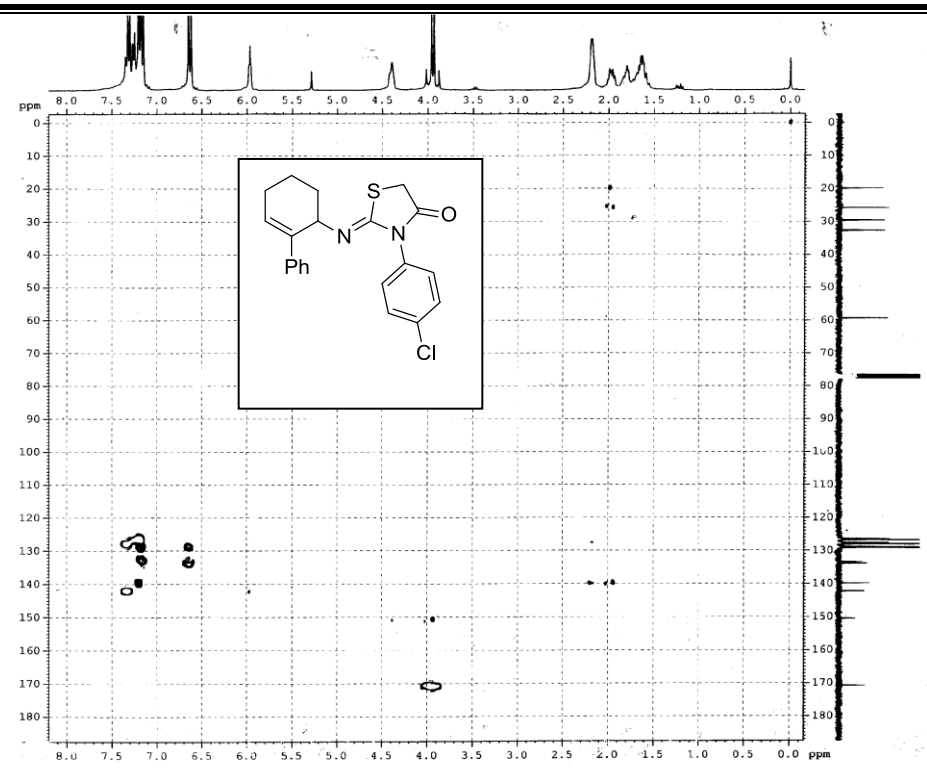
(*Z*)-3-(4-Chlorophenyl)-2-(2-phenylcyclohex-2-enylimino)thiazolidin-4-one (4h)



(*Z*)-3-(4-Chlorophenyl)-2-(2-phenylcyclohex-2-enylimino)thiazolidin-4-one (4h)



(*Z*)-3-(4-Chlorophenyl)-2-(2-phenylcyclohex-2-enylimino)thiazolidin-4-one (4h)

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FIDRES              3.281460 Hz
AQ                  0.1524212 sec
RG                       16384
DW                  148.800 usec
DE                    6.00 usec
TE                    300.0 K
CNST2              145.0000000
d0                  0.00000300 sec
D1                  1.47521901 sec
d2                  0.00344828 sec
D6                  0.06500000 sec
d13                 0.00000400 sec
D16                 0.00015000 sec
IN0                 0.00002990 sec
MCREST              0.00000000 sec
MCWRK               1.47521901 sec

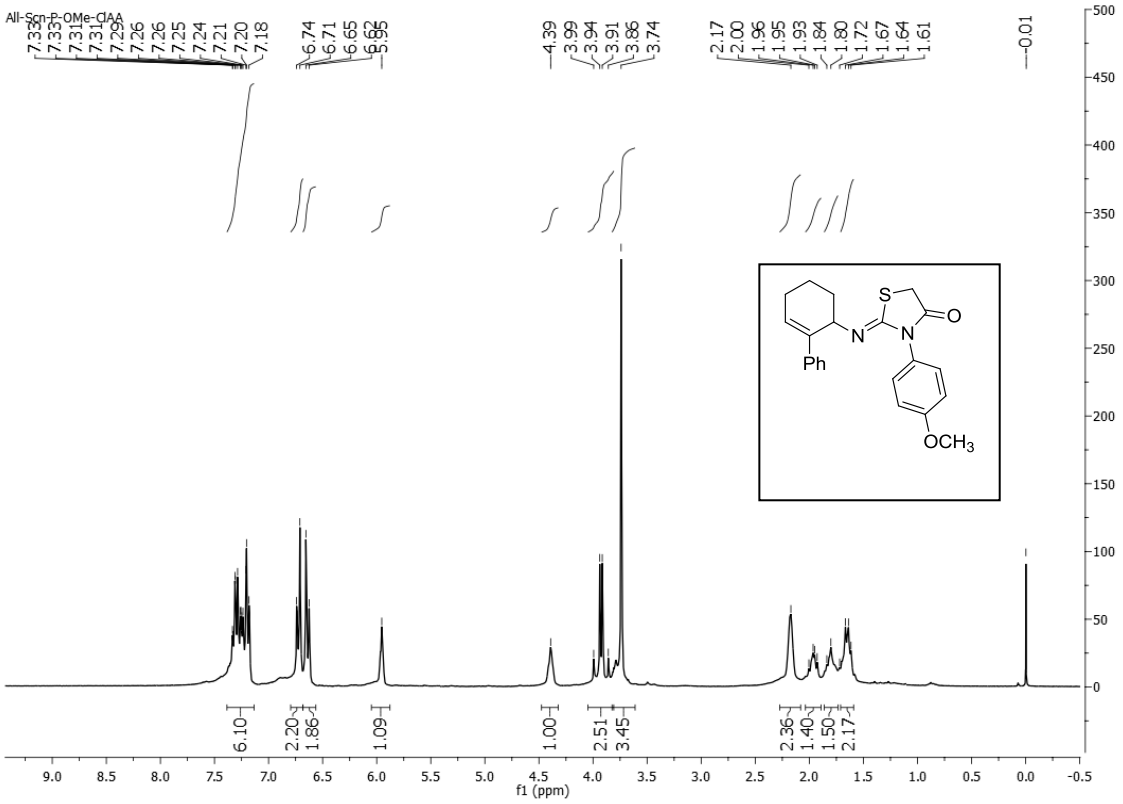
======== CHANNEL f1 ========
NUC1                       1H
P1                       9.65 usec
p2                      19.30 usec
PL1                      0.00 dB
SFO1           300.1314236 MHz

======== CHANNEL f2 ========
NUC2                      13C
P3                      12.50 usec
PL2                     -5.00 dB
SFO2            75.4752239 MHz

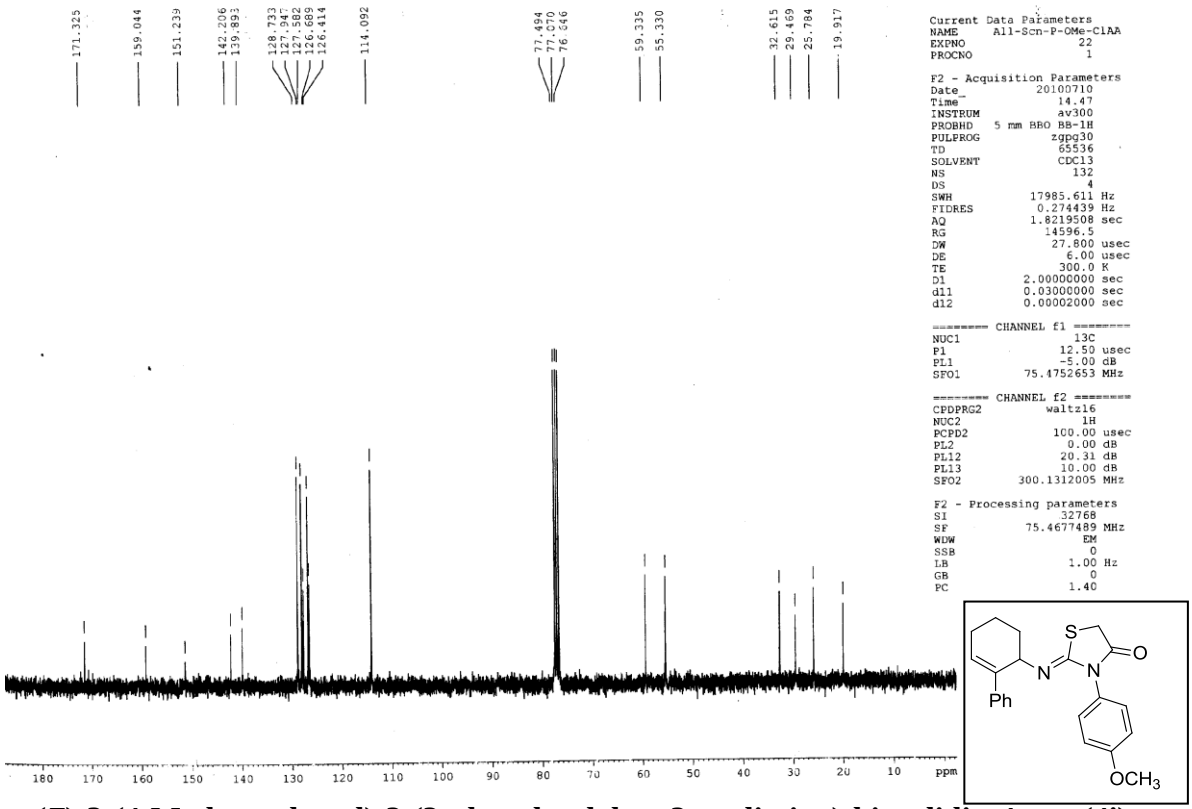
====== GRADIENT CHANNEL =====
GPNAM1              SINE.100
GPNAM2              SINE.100
GPNAM3              SINE.100
GPX1                    0.00 %
GPX2                    0.00 %
GPX3                    0.00 %
GPY1                    0.00 %
GPY2                    0.00 %
GPY3                    0.00 %
GPZ1                   50.00 %
GPZ2                   30.00 %
GPZ3                   40.10 %
P16                 1500.00 usec

F1 - Acquisition parameters
NDO                        2
TD                       128
SFO1            75.47522 MHz
```

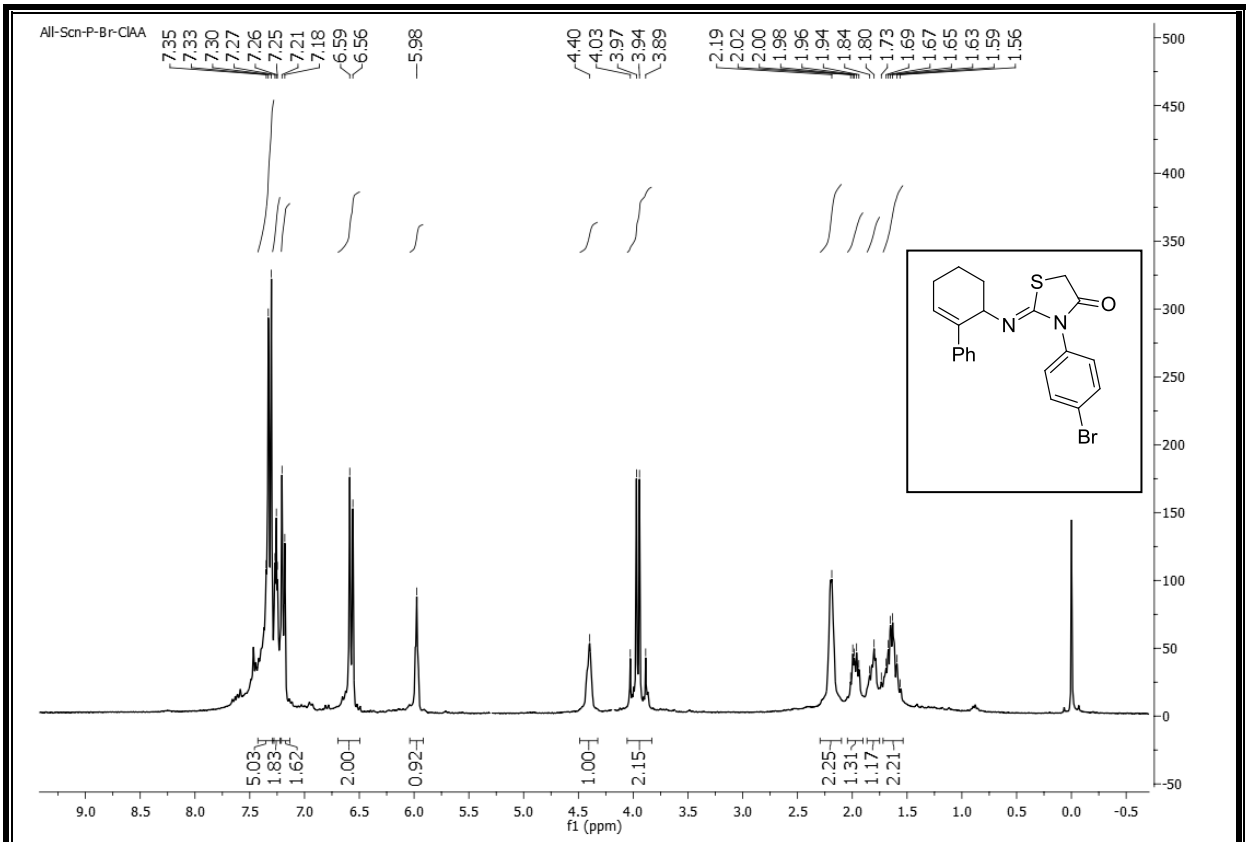
(*Z*)-3-(4-Chlorophenyl)-2-(2-phenylcyclohex-2-enylimino)thiazolidin-4-one (4h)



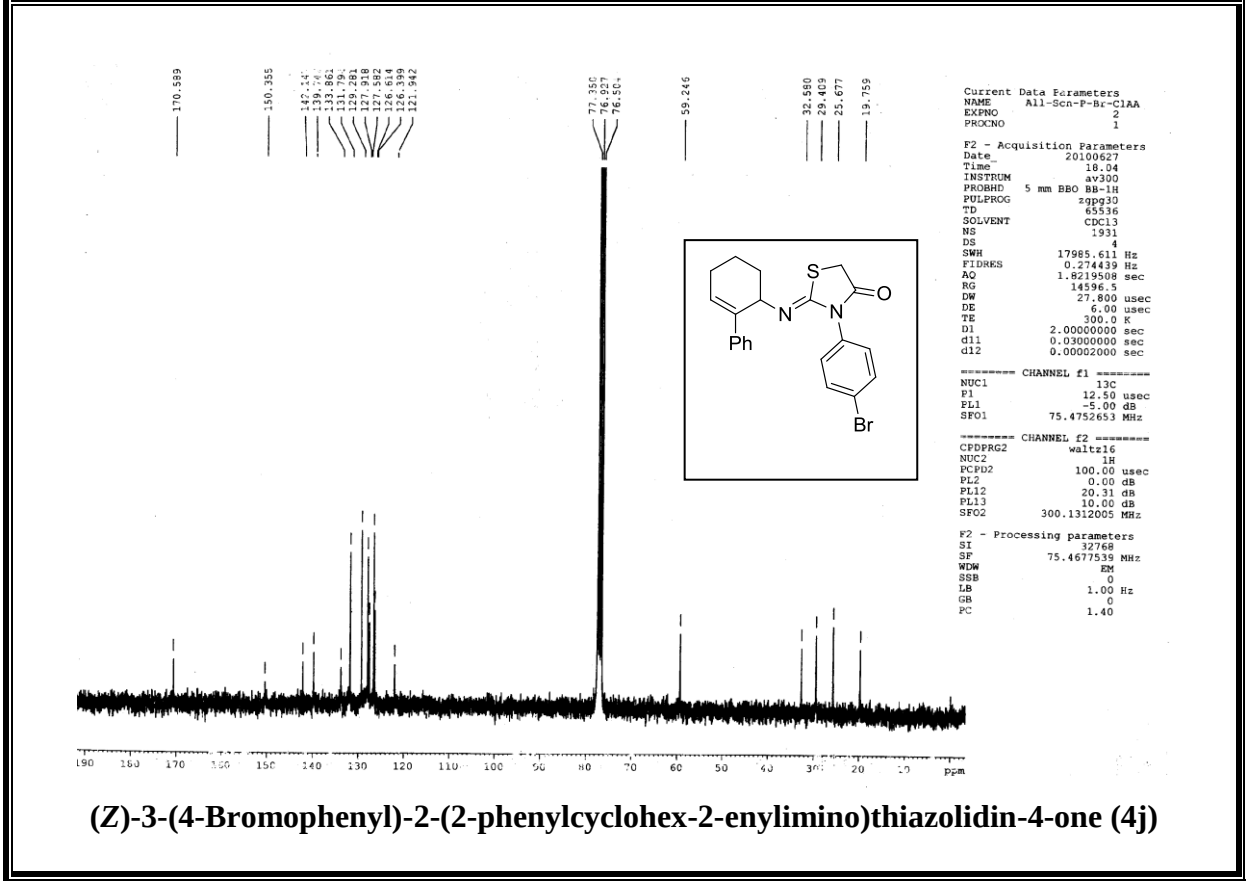
(*Z*)-3-(4-Methoxyphenyl)-2-(2-phenylcyclohex-2-enylimino)thiazolidin-4-one (4i)



(*Z*)-3-(4-Methoxyphenyl)-2-(2-phenylcyclohex-2-enylimino)thiazolidin-4-one (4i)



(*Z*)-3-(4-Bromophenyl)-2-(2-phenylcyclohex-2-enylimino)thiazolidin-4-one (4j)



(*Z*)-3-(4-Bromophenyl)-2-(2-phenylcyclohex-2-enylimino)thiazolidin-4-one (4j)