Electronic Supplementary Material (ESI) for RSC Advances.

Synthesis of ß-Hydroxy-1,4-disubstituted-1,2,3-triazoles catalysed by Copper ferrite nano particles in tap water using Click Chemistry

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General Information:

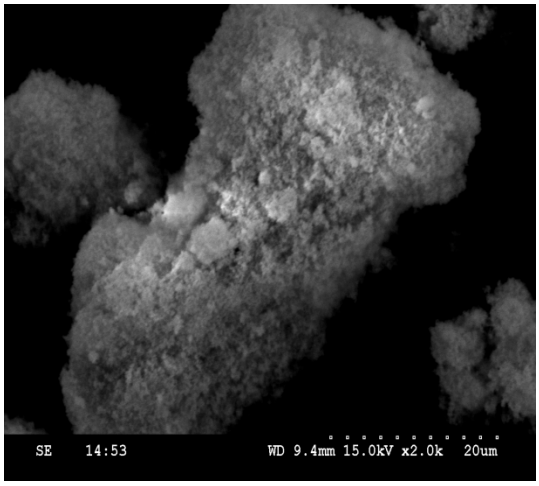
Analytical thin layer chromatography (TLC) was carried out using silica gel 60 F_{254} pre-coated plates. Visualization was accomplished with UV lamp or I_2 stain. All products were characterized by their NMR and MS spectra. ^1H and ^{13}C NMR were recorded on 300 and 75 MHz in $CDCl_3$ using TMS as the internal standard, Chemical shifts were reported in parts per million (ppm, δ) downfield from tetramethylsilane.

***General Procedure for the Synthesis of 1,4-Disubstituted 1, 2, 3-triazoles*:**

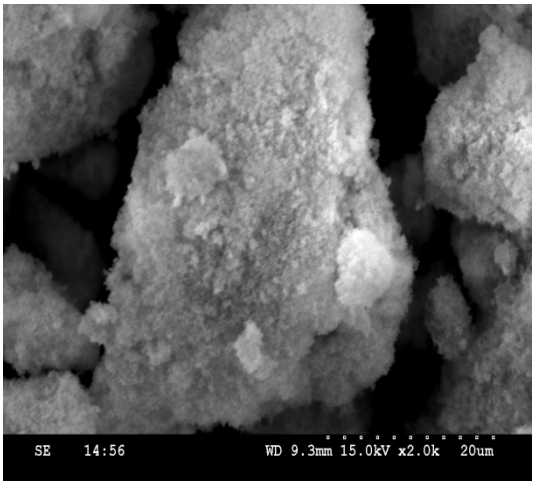
Styrene Oxide (1 mmol), phenyl acetylene (1 mmol) and NaN_3 (72 mg, 1.1 mmol) were placed in a 25 ml round-bottomed flask in H_2O (10 mL). Sequentially $CuFe_2O_4$ (5 mol%) (Purchase from Aldrich CAS No. 12018-79-0) was added. The reaction mixture was warmed to 60 ^0C and monitored by TLC until total conversion of the starting materials. After completion of the reaction, the reaction mixture was magnetically concentrated with the aid of a magnet to separate the catalyst. Catalyst was separated and washed several times with acetone, dried under vacuum. Water (30 mL) was added to the resulting reaction mixture followed by extraction with EtOAc (4x10 mL). The collected organic phases were dried with Na_2SO_4 and the solvent was removed under vacuum to give the corresponding triazole.

Characterization of the $CuFe_2O_4$Nano Catalyst:

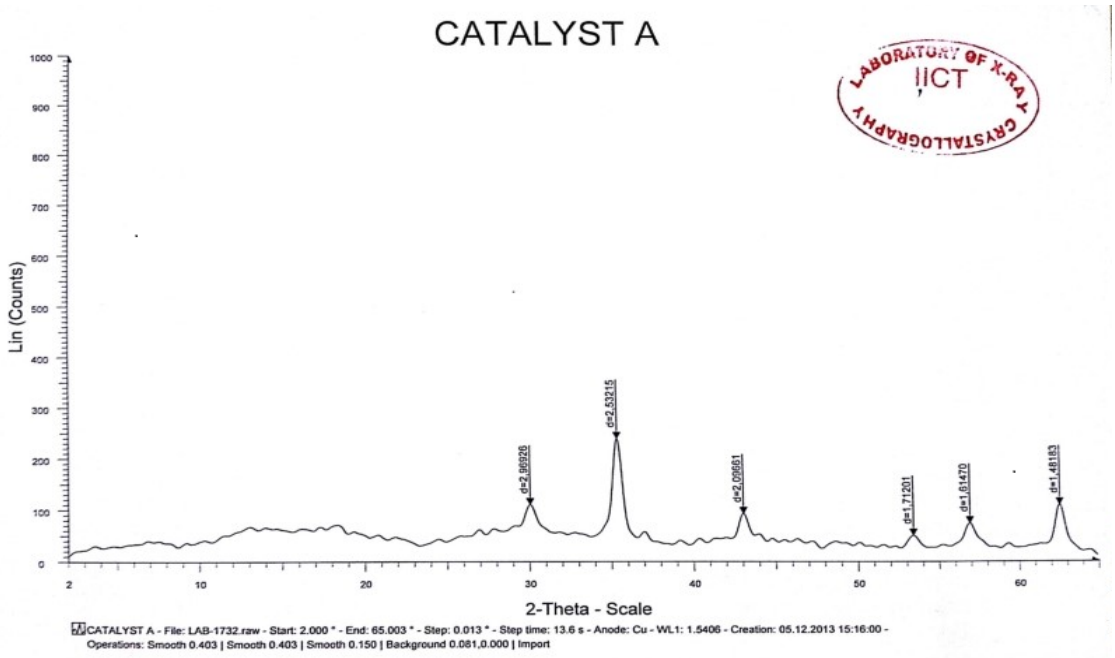
From SEM studies, it is revealed that the $CuFe_2O_4$ nanoparticles remained in the same state, even after four cycles.

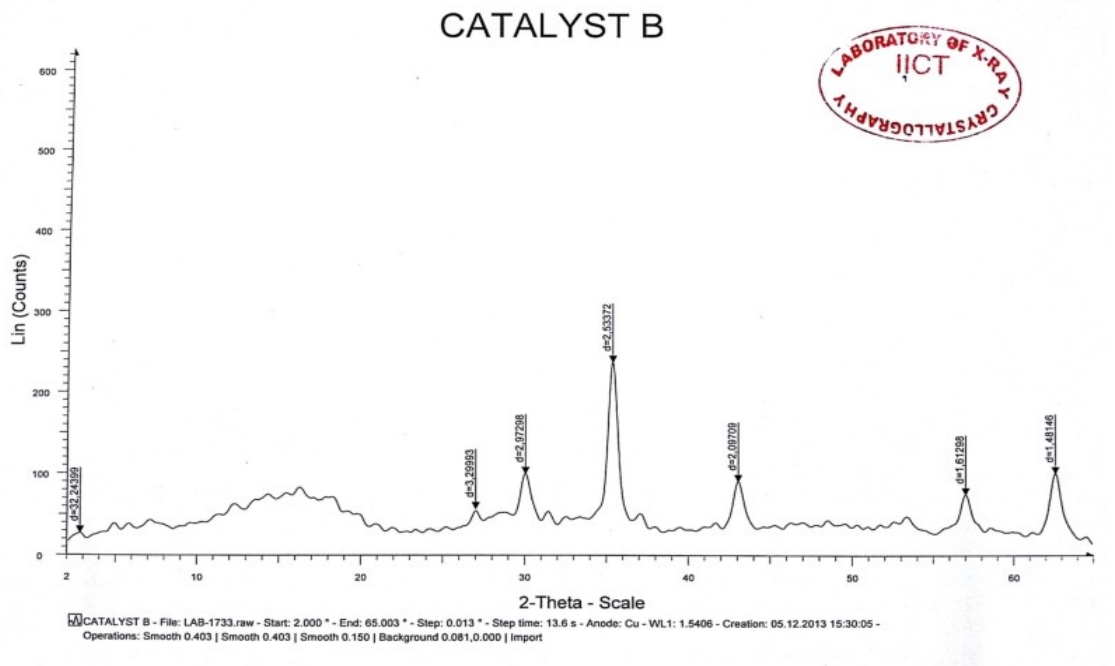


a. SEM-analysis of native $CuFe_2O_4$ catalyst



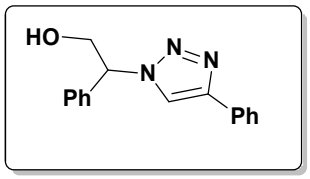
b. SEM-analysis of reused $CuFe_2O_4$ catalyst after 4 th cycle



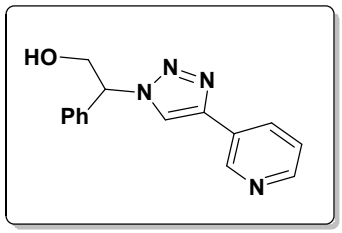


XRD spectra of $CuFe_2O_4$ catalyst (a) native and (b) after the 4th cycle.

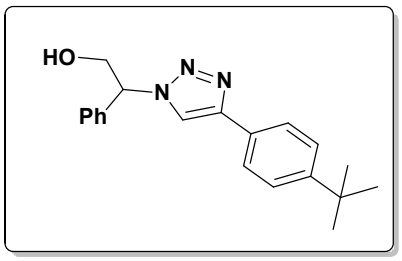
Supporting data



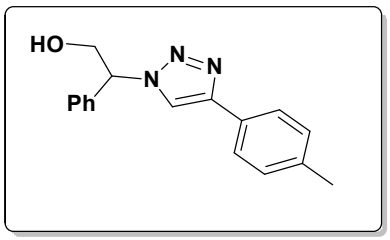
2-phenyl-2-(4-phenyl-1H-1,2,3-triazol-1-yl)ethanol (Table 1, entry 1) ^{1}H NMR (300 MHz, $CDCl_3$): δ 4.24 (1H, dd, *J* = 3.97, 11.93 Hz), 4.64 (1H, dd, *J* = 7.95, 12.93 Hz), 5.68 (1H, dd, *J* = 3.97, 7.95 Hz), 7.20-7.47 (8H, m), 7.70 (1H, s), 7.77 (2H, d, *J* = 7.95 Hz); ESI-MS: *m/z* 266 $(M+H)^+$. HRMS calctd. For 266.1287 found 266.1282. $C_{16}H_{16}ON_3$



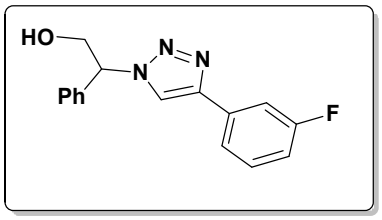
2-phenyl-2-(4-(pyridin-3-yl)-1H-1,2,3-triazol-1-yl)ethanol (Table 1, entry 2) ^{1}H NMR (300 MHz, $CDCl_3$): δ 4.15-4.32 (1H, m), 4.55-4.73 (1H, m), 5.60-5.80 (1H, m), 7.17-7.47 (6H, m), 7.78 (1H, t, *J* = 7.36 Hz) 8.03-8.38 (2H, m), 8.52 (1H, s); ^{13}C NMR (75 MHz, $CDCl_3$): δ 64.86, 67.33, 122.95, 127.19, 128.91, 129.05, 135.77, 137.11, 147.96, 148.99. ESI-MS: *m/z* 267 $(M+H)^+$. HRMS calctd. For 267.1240 found 267.1235. $C_{15}H_{15}ON_4$



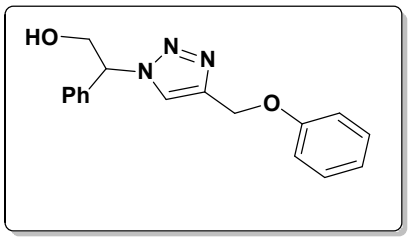
2-(4-(4-(tert-butyl)phenyl)-1H-1,2,3-triazol-1-yl)-2-phenylethanol (Table 1, entry 3) ^{1}H NMR (300 MHz, $CDCl_3$): δ 1.32 (9H, s), 4.20 (1H, dd, *J* = 3.77, 12.08 Hz), 4.61 (1H, dd, *J* = 8.30, 12.08 Hz), 5.66 (1H, dd, *J* = 3.77, 8.30 Hz), 7.13-7.47 (7H, m), 7.66 (3H, d, *J* = 6.79 Hz); ^{13}C NMR (75 MHz, $CDCl_3$): δ 31.22, 34.61, 65.01, 67.38, 120.28, 125.34, 125.67, 127.07, 127.29, 128.86, 129.05, 136.10, 147.59, 151.34. ESI-MS: *m/z* 322 $(M+H)^+$. HRMS calctd. For 322.1913 found 322.1908. $C_{20}H_{24}ON_3$



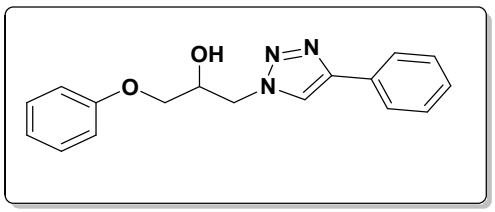
2-phenyl-2-(4-(p-tolyl)-1H-1,2,3-triazol-1-yl)ethanol (Table 1, entry 4) ^{1}H NMR (300 MHz, $CDCl_3$): δ 2.36 (3H, s), 3.52 (1H, s), 4.21 (1H, d, *J* = 11.33 Hz), 4.51-4.75 (1H, m), 5.59-5.73 (1H, m), 7.05-7.54 (8H, m), 7.65 (2H, t, *J* = 3.60 Hz); ESI-MS: *m/z* 280 $(M+H)^+$. HRMS calctd. For 280.1444 found 280.1439. $C_{17}H_{18}ON_3$



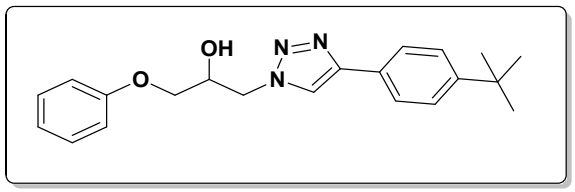
2-(4-(3-fluorophenyl)-1H-1,2,3-triazol-1-yl)-2-phenylethanol (Table 1, entry 5) ^{1}H NMR (300 MHz, $CDCl_3$): δ 3.30 (1H, dd, *J* = 5.28, 8.30 Hz), 4.10-4.34 (1H, m), 4.51-4.76 (1H, m), 5.67 (1H, dd, *J* = 3.77, 8.30 Hz), 6.90-7.10 (1H, m), 7.18-7.62 (8H, m), 7.71 (1H, s); ESI-MS: *m/z* 284 $(M+H)^+$. HRMS calctd. For 284.1194 found 284.1189. $C_{16}H_{15}ON_3F$



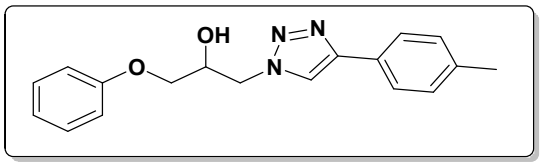
2-(4-(phenoxymethyl)-1H-1,2,3-triazol-1-yl)-2-phenylethanol (Table 1, entry 6) ^{1}H NMR (300 MHz, $CDCl_3$): δ 3.4 (1H, s), 4.04-4.29 (1H, m), 4.48-4.69 (1H, m), 5.17 (2H, s), 5.63 (1H, dd, *J* = 3.77, 8.20 Hz), 6.90-7.04 (3H, m), 7.12-7.46 (7H, m), 7.59 (1H, s); ^{13}C NMR (75 MHz, $CDCl_3$): δ 61.73, 64.79, 67.18, 114.64, 121.22, 123.58, 127.05, 128.35, 128.89, 129.03, 129.46, 135.80, 143.99, 158.04. ESI-MS: *m/z* 296 $(M+H)^+$. HRMS calctd. For 296.1393 found 296.1385. $C_{17}H_{18}O_2N_3$



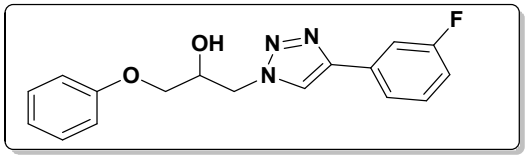
1-phenoxy-3-(4-phenyl-1H-1,2,3-triazol-1-yl)propan-2-ol (Table 1, entry 7) ^{1}H NMR (300 MHz, $CDCl_3$): δ 3.96-4.12 (2H, m), 4.43-4.62 (2H, m), 4.64-4.80 (1H, m), 6.78-7.06 (3H, m), 7.14-7.44 (5H, m), 7.54-7.73 (2H, m), 7.83 (1H, s); ^{13}C NMR (75 MHz, $CDCl_3$): δ 53.36, 68.70, 68.81, 114.44, 121.38, 121,42, 125.44, 128.10, 128.74, 129.74, 129.95, 147.27, 158.07. ESI-MS: *m/z* 296 $(M+H)^+$. HRMS calctd. For 296.1393 found 296.1389. $C_{17}H_{18}O_2N_3$



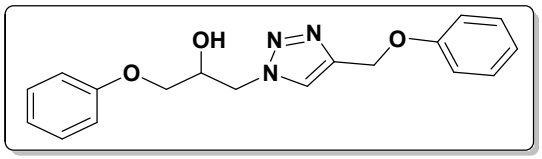
1-(4-(4-(tert-butyl)phenyl)-1H-1,2,3-triazol-1-yl)-3-phenoxypropan-2-ol (Table 1, entry 8) ^{1}H NMR (300 MHz, $CDCl_3$): δ 1.34 (9H, s), 3.55 (1H, s), 3.96-4.14 (2H, m), 4.47-4.62 (2H, m), 4.71 (1H, dd, *J* = 2.44, 13.27 Hz), 6.85-7.04 (3H, m), 7.21-7.49 (4H, m), 7.61-7.73 (2H, m), 7.84 (1H, s); ^{13}C NMR (75 MHz, $CDCl_3$): δ 31.25, 34.61, 53.29, 68.80, 114.47, 121.10, 125.66, 127.19, 129.58, 147.29, 151.21, 158.09. ESI-MS: *m/z* 352 $(M+H)^+$. HRMS calctd. For 352.2019 found 352.2012. $C_{21}H_{26}O_2N_3$



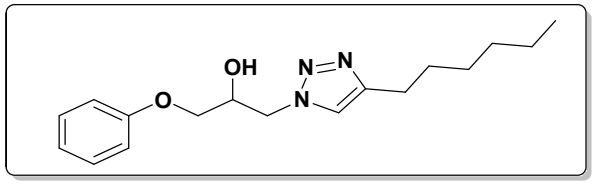
1-phenoxy-3-(4-(p-tolyl)-1H-1,2,3-triazol-1-yl)propan-2-ol (Table 1, entry 9) ^{1}H NMR (300 MHz, $CDCl_3$): δ 2.36 (3H, s), 4.02 (2H, dd, *J* = 2.26, 4.72 Hz), 4.44-4.61 (2H, m), 4.64-4.77 (1H, m), 6.78-7.05 (3H, m), 7.12-7.37 (4H, m), 7.60 (2H, d, *J* = 8.12 Hz), 7.81 (1H, s); ^{13}C NMR (75 MHz, $CDCl_3$): δ 21.18, 53.32, 68.61, 68.81, 114.41, 120.99, 121.11, 121.27, 125.35, 127.12, 129.35, 129.48, 137.91, 147.28, 158.08. ESI-MS: *m/z* 310 $(M+H)^+$, 332 (M+Na). HRMS calctd. For 310.1550 found 310.1546. $C_{18}H_{20}O_2N_3$



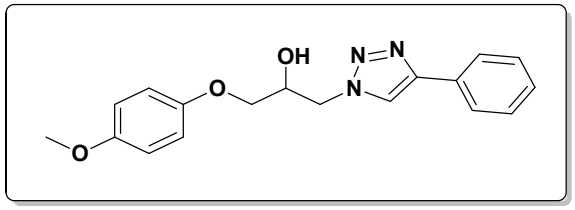
1-(4-(3-fluorophenyl)-1H-1,2,3-triazol-1-yl)-3-phenoxypropan-2-ol (Table 1, entry 10) ^{1}H NMR (300 MHz, $CDCl_3$): δ 3.96-4.13 (2H, m), 4.46-4.63 (2H, m), 4.65-4.80 (1H, m), 6.79-7.08 (4H, m), 7.17-7.55 (5H, m), 7.86-7.90 (1H, m); ^{13}C NMR (75 MHz, $CDCl_3$): δ 53.36, 63.58, 68.72, 112.20, 112.50, 114.42, 114.83, 115.11, 121.04, 121.47, 121.83, 130.30, 130.41, 146.25, 158.01, 161.36, 164.61. ESI-MS: *m/z* 314 $(M+H)^+$.



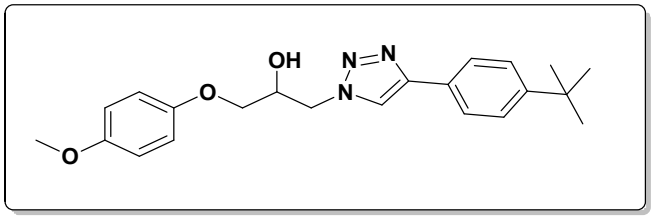
1-phenoxy-3-(4-(phenoxymethyl)-1H-1,2,3-triazol-1-yl)propan-2-ol (Table 1, entry 11) ^{1}H NMR (300 MHz, $CDCl_3$): δ 3.84-4.14 (2H, m), 4.38-4.76 (3H, m), 5.15 (2H, t, *J* = 19.87 Hz), 6.76-7.07 (6H, m), 7.18-7.40 (4H, m), 7.75 (1H, t, *J* = 19.98 Hz); ^{13}C NMR (75 MHz, $CDCl_3$): δ 53.00, 61.60, 68.63, 68.67, 114.42, 114.64, 121.20, 121.40, 124.42, 129.45, 129.50, 143.84, 157.95, 158.01. ESI-MS: *m/z* 326 $(M+H)^+$. HRMS calctd. For 326.1499 found 326.1494. $C_{18}H_{20}O_3N_3$



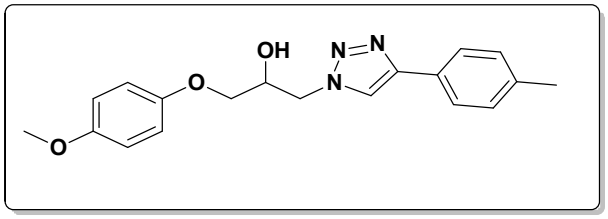
1-(4-hexyl-1H-1,2,3-triazol-1-yl)-3-phenoxypropan-2-ol (Table 1, entry 12) ^{1}H NMR (300 MHz, $CDCl_3$): δ 0.86 (3H, s), 1.27 (6H ,s), 1.60 (2H, s), 2.63 (2H, s), 3.95 (2H, s), 4.30-4.77 (3H, m), 6.71-7.04 (3H, m), 7.12-7.49 (3H, m); ^{13}C NMR (75 MHz, $CDCl_3$): δ 13.88, 22.34, 25.27, 28.71, 29.06, 31.33, 52.82, 68.33, 68.63, 114.25, 121.06, 122.36, 129.31, 147.77, 158.00. ESI-MS: *m/z* 304 $(M+H)^+$. HRMS calctd. For 304.2019 found 304.2013. $C_{17}H_{26}O_2N_3$



1-(4-methoxyphenoxy)-3-(4-phenyl-1H-1,2,3-triazol-1-yl)propan-2-ol (Table 1, entry 13) ^{1}H NMR (300 MHz, $CDCl_3$): δ 3.52 (1H, d, *J* = 4.72 Hz), 3.76 (3H, s), 3.91-4.10 (2H, m), 4.40-4.63 (2H, m), 4.70 (1H, dd, *J* = 2.83, 13.40 Hz), 6.85 (4H, s), 7.21-7.47 (3H, m), 7.76 (2H, d, *J* = 6.98 Hz), 7.87 (1H, s); ^{13}C NMR (75 MHz, $CDCl_3$): δ 53.01, 53.70, 68.98, 69.56, 114.74, 115.56, 121.27, 125.61, 128.17, 128.80, 130.23, 147.61, 152.18, 154.38. ESI-MS: *m/z* 326 $(M+H)^+$. HRMS calctd. For 326.1499 found 326.1492. $C_{18}H_{20}O_2N_3$

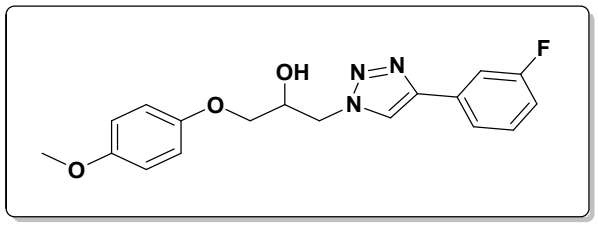


1-(4-(4-(tert-butyl)phenyl)-1H-1,2,3-triazol-1-yl)-3-(4-methoxyphenoxy)propan-2-ol (Table 1, entry 14) ^{1}H NMR (300 MHz, $CDCl_3$): δ 1.33 (9H, s), 3.76 (3H, s), 3.91-4.07 (2H, m), 4.43-4.59 (2H, m), 4.62-4.78 (1H, m), 6.83 (4H, dd, *J* = 5.85, 7.17 Hz), 7.41 (2H, d, *J* = 8.30 Hz), 7.62 (2H, d, *J* = 8.30 Hz), 7.82 (1H, s); ^{13}C NMR (75 MHz, $CDCl_3$): δ 31.25, 34.60, 53.26, 55.67, 68.86, 69.66, 114.69, 115.53, 121.07, 125.23, 125.64, 127.25, 147.35, 151.18, 152.28, 154.28. ESI-MS: *m/z* 382 $(M+H)^+$. HRMS calctd. For 382.2125 found 382.2123. $C_{22}H_{28}O_3N_3$

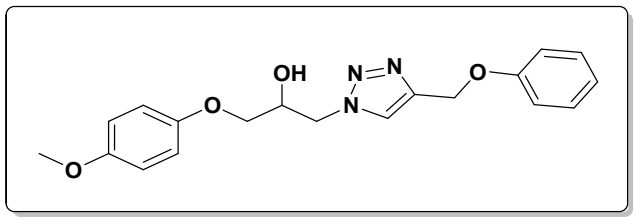


1-(4-methoxyphenoxy)-3-(4-(p-tolyl)-1H-1,2,3-triazol-1-yl)propan-2-ol (Table 1, entry 15) ^{1}H NMR (300 MHz, $CDCl_3$): δ 2.36 (3H, s), 3.76 (4H, s), 3.90-4.03 (2H, m), 4.42-4.61 (2H, m), 4.68 (1H, dd, *J* = 2.74, 13.58 Hz), 6.79-6.85 (4H, m), 7.19 (2H, d, *J* = 7.78 Hz), 7.61 (2H, d, *J* = 7.78 Hz), 7.82 (1H, s); ^{13}C NMR (75 MHz, $CDCl_3$): δ 21.22, 53.17, 55.66, 68.83, 69.64, 114.67, 115.52,

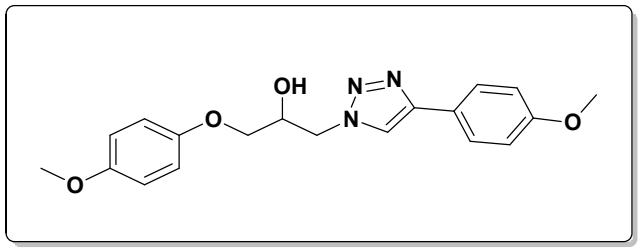
121.02, 125.45, 127.30, 129.41, 137.96, 147.47. ESI-MS: *m/z* 340 $(M+H)^+$, 362 (M+Na). HRMS calctd. For 340.1655 found 340.1653. $C_{22}H_{28}O_3N_3$



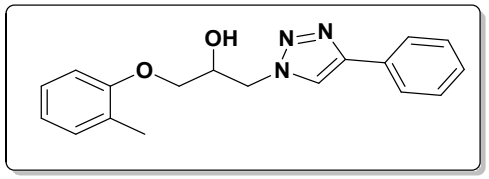
1-(4-(3-fluorophenyl)-1H-1,2,3-triazol-1-yl)-3-(4-methoxyphenoxy)propan-2-ol (Table 1, entry 16) ^{1}H NMR (300 MHz, $CDCl_3$): δ 3.76 (3H, s), 3.91-4.06 (2H, m), 4.42-4.60 (2H, m), 4.70 (1H, dd, *J* = 2.74, 13.42 Hz), 6.76-6.91 (4H, m), 6.94-7.01 (1H, m), 7.30-7.36 (1H, m), 7.42-7.44 (1H, m), 7.47-7.51 (1H, m), 7.88 (1H, s); ^{13}C NMR (75 MHz, $CDCl_3$): δ 53.32, 55.65, 68.81, 69.58, 112.21, 112.52, 114.67, 115.10, 115.47, 121.06, 121.79, 130.30, 132.11, 146.28, 152.17, 154.28, 161.37, 164.63. ESI-MS: *m/z* 344 $(M+H)^+$. HRMS calctd. For 344.1405 found 344.1400. $C_{18}H_{19}O_3N_3F$



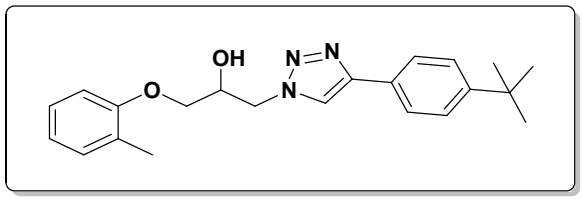
1-(4-methoxyphenoxy)-3-(4-(phenoxymethyl)-1H-1,2,3-triazol-1-yl)propan-2-ol (Table 1, entry 17) ^{1}H NMR (300 MHz, $CDCl_3$): δ 3.76 (3H, s), 3.83-4.02 (2H, m), 4.35-4.59 (2H, m), 4.67 (1H, dd, *J* = 3.58, 13.97 Hz), 5.20 (2H, s), 6.82 (4H, s), 6.91-7.02 (3H, m), 7.22-7.33 (2H, m), 7.76 (1H, s); ^{13}C NMR (75 MHz, $CDCl_3$): δ 52.98, 55.50, 68.53, 69.47, 114.55, 115.39, 121.13, 124.48, 129.37, 143.59, 152.08, 154.06, 157.94. ESI-MS: *m/z* 356 $(M+H)^+$. HRMS calctd. For 356.1604 found 356.1602. $C_{19}H_{22}O_4N_3$



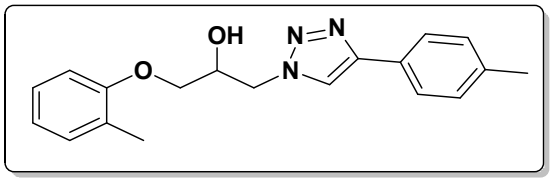
1-(4-methoxyphenoxy)-3-(4-(4-methoxyphenyl)-1H-1,2,3-triazol-1-yl)propan-2-ol (Table 1, entry 18) ^{1}H NMR (300 MHz, $CDCl_3$): δ 3.76 (3H, s), 3.91-4.04 (2H, m), 4.45-4.58 (2H, m), 4.63-4.75 (1H, m), 6.73-6.98 (6H, m), 7.60-7.67 (2H, m), 7.77 (1H, s); ESI-MS: *m/z* 356 $(M+H)^+$. HRMS calctd. For 356.1604 found 356.1599. $C_{19}H_{22}O_4N_3$



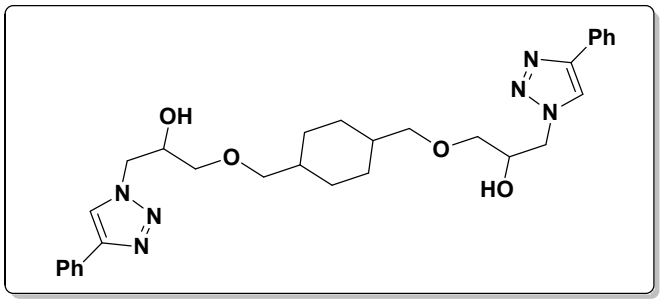
1-(4-phenyl-1H-1,2,3-triazol-1-yl)-3-(o-tolyloxy)propan-2-ol (Table 1, entry 19) ^{1}H NMR (300 MHz, $CDCl_3$): δ 2.25 (3H, s), 4.05 (2H, d, *J* = 5.49 Hz), 4.48-4.57 (2H, m), 4.72 (1H, dd, *J* = 1.83, 13.73 Hz), 6.80 (1H, d, *J* = 8.39 Hz), 6.89 (1H, t, *J* = 7.32 Hz), 7.14 (2H, t, *J* = 7.32 Hz), 7.27-7.36 (3H, m), 7.59-7.72 (2H, m), 7.83 (1H, s); ^{13}C NMR (75 MHz, $CDCl_3$): δ 16.23, 53.58, 68.75, 68.96, 111.04, 121.03, 121.42, 125.39, 126.55, 126.87, 128.06, 128.71, 129.91, 130.74, 147.17, 156.14. ESI-MS: *m/z* 310 $(M+H)^+$. HRMS calctd. For 310.1550 found 310.1543. $C_{18}H_{20}O_2N_3$



1-(4-(4-(tert-butyl)phenyl)-1H-1,2,3-triazol-1-yl)-3-(o-tolyloxy)propan-2-ol (Table 1, entry 20) ^{1}H NMR (300 MHz, $CDCl_3$): δ 1.33 (9H, s), 2.16 (3H, s), 4.04 (2H, d, *J* = 5.09 Hz), 4.44-4.62 (2H, m), 4.72 (1H, d, *J* = 10.95 Hz), 6.72-6.96 (2H, m), 7.04-7.21 (2H, m), 7.37 (2H, d, *J* = 8.30 Hz), 7.55-7.72 (2H, m), 7.82 (1H, s); ^{13}C NMR (75 MHz, $CDCl_3$): δ 16.25, 31.19, 34.54, 53.58, 68.75, 68.99, 111.04, 120.98, 121.14, 126.87, 130.73, 147.16, 151.09, 156.17. ESI-MS: *m/z* 366 $(M+H)^+$. HRMS calctd. For 366.2176 found 366.2169. $C_{22}H_{28}O_2N_3$

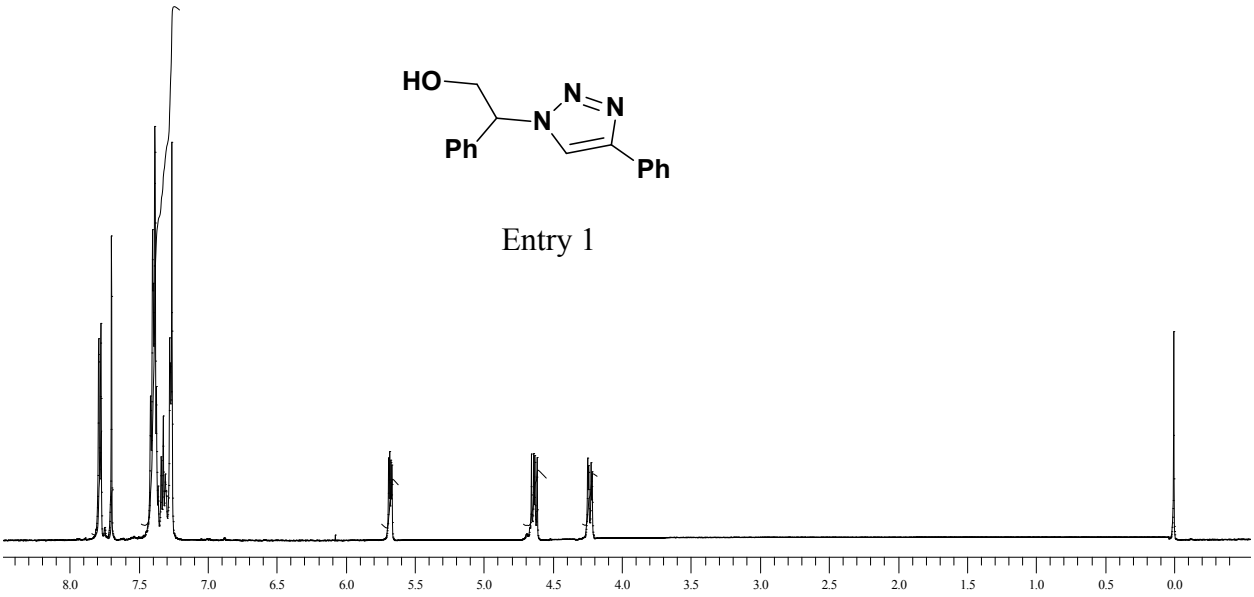


1-(4-(p-tolyl)-1H-1,2,3-triazol-1-yl)-3-(o-tolyloxy)propan-2-ol (Table 1, entry 21) ^{1}H NMR (300 MHz, $CDCl_3$): δ 2.25 (3H, s), 2.36, (3H, s), 4.02 (2H, d, *J* = 5.18 Hz), 4.44-4.62 (2H, m), 4.65-4.80 (1H, m), 6.80 (1H, d, *J* = 8.24 Hz), 6.90 (1H, t, *J* = 7.47 Hz), 7.09-7.24 (4H, m), 7.51-7.67 (2H, m), 7.73-7.87 (1H, m); ^{13}C NMR (75 MHz, $CDCl_3$): δ 16.23, 21.22, 53.32, 68.93, 111.18, 121.00, 121.15, 125.48, 126.60. 126.93, 127.32, 129.41, 130.80, 137.98, 147.53, 156.14 ESI-MS: *m/z* 324 $(M+H)^+$. HRMS calctd. For 324.1706 found 324.1701. $C_{19}H_{22}O_2N_3$



3,3'-((cyclohexane-1,4-diylbis(methylene))bis(oxy))bis(1-(4-phenyl-1H-1,2,3-triazol-1-yl)propan-2-ol) (Table 1, entry 22) ^{1}H NMR (300 MHz, $CDCl_3$): δ 0.75-1.06 (4H, m), 1.78 (4H, m), 1.99-2.12 (2H, m), 3.09-3.95 (12H, m), 4.10 (1H, dd, *J* = 6.86, 14.03 Hz), 4.25 (1H, s), 4.35-4.45 (1H, m), 4.59 (1H, d, *J* = 14.03 Hz), 7.17-7.52 (6H, m), 7.64-8.00 (6H, m); ESI-MS: *m/z* 547 $(M+H)^+$. HRMS calctd. For 547.3027 found 547.3016. $C_{30}H_{39}O_4N_6$

Copies of ^{1}H &^{13}C NMR spectra:



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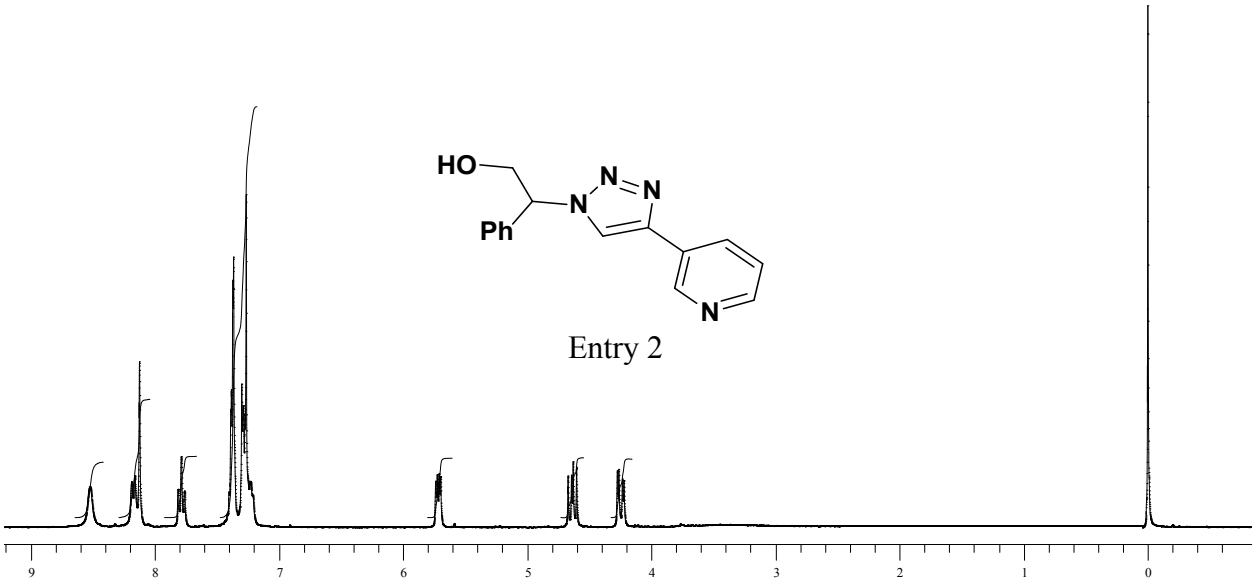

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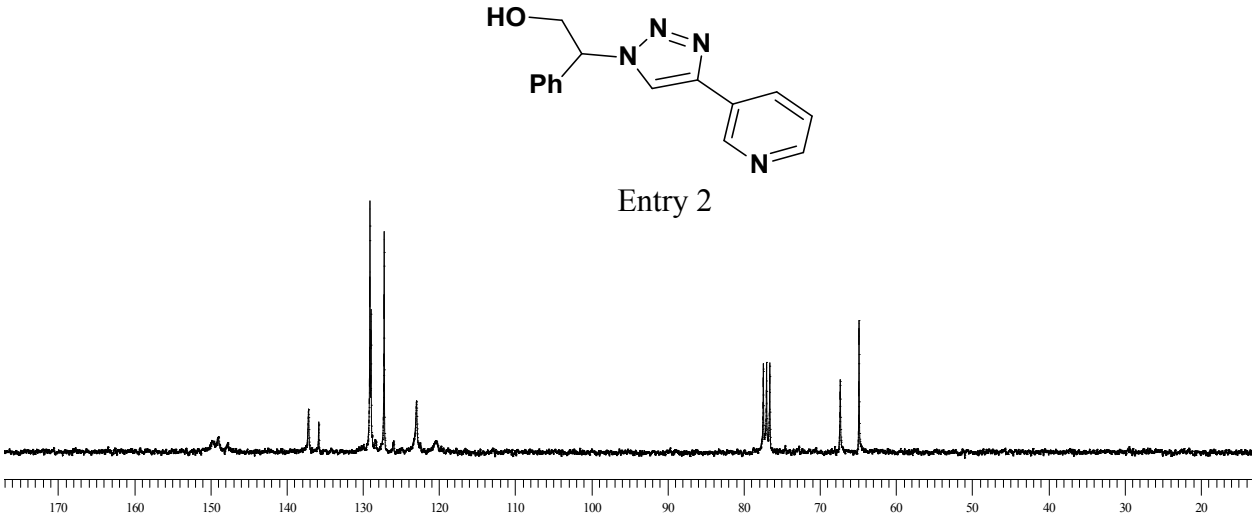

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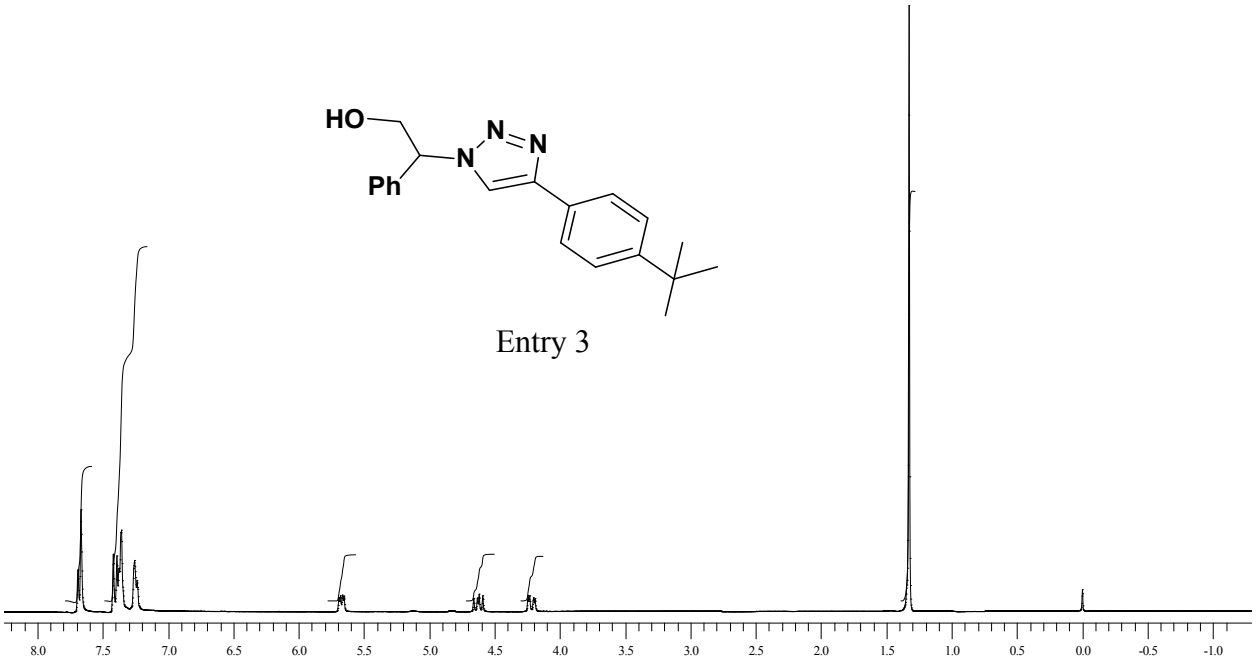

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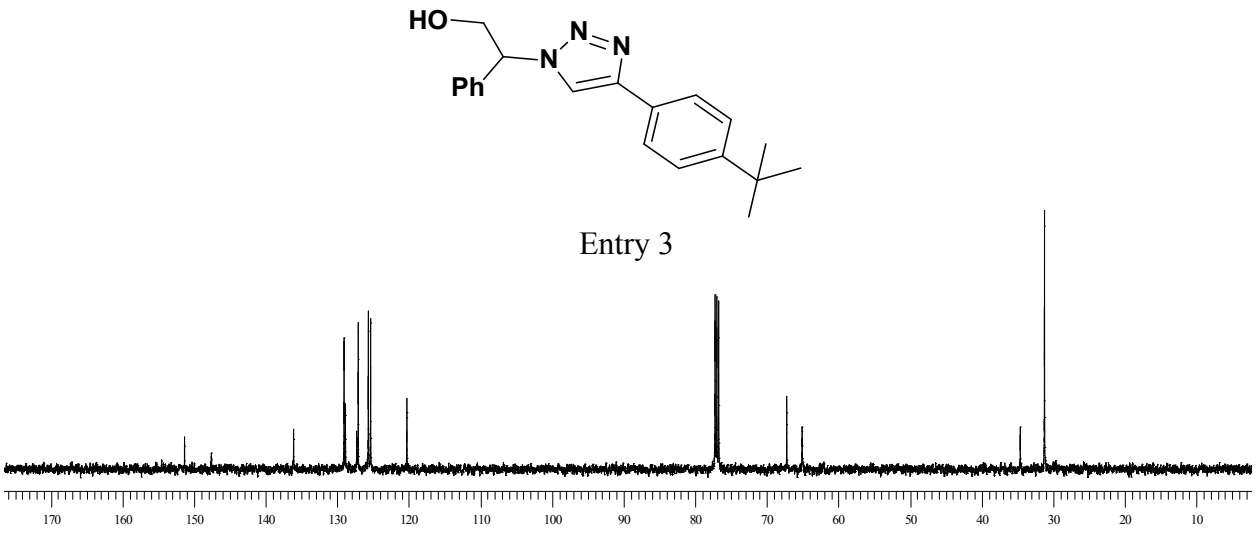

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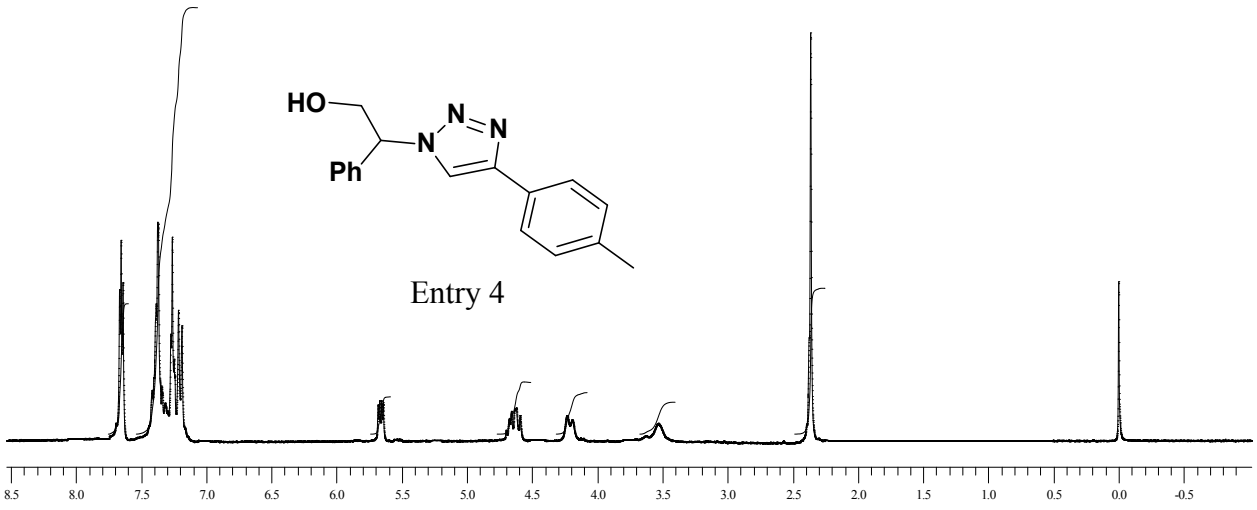

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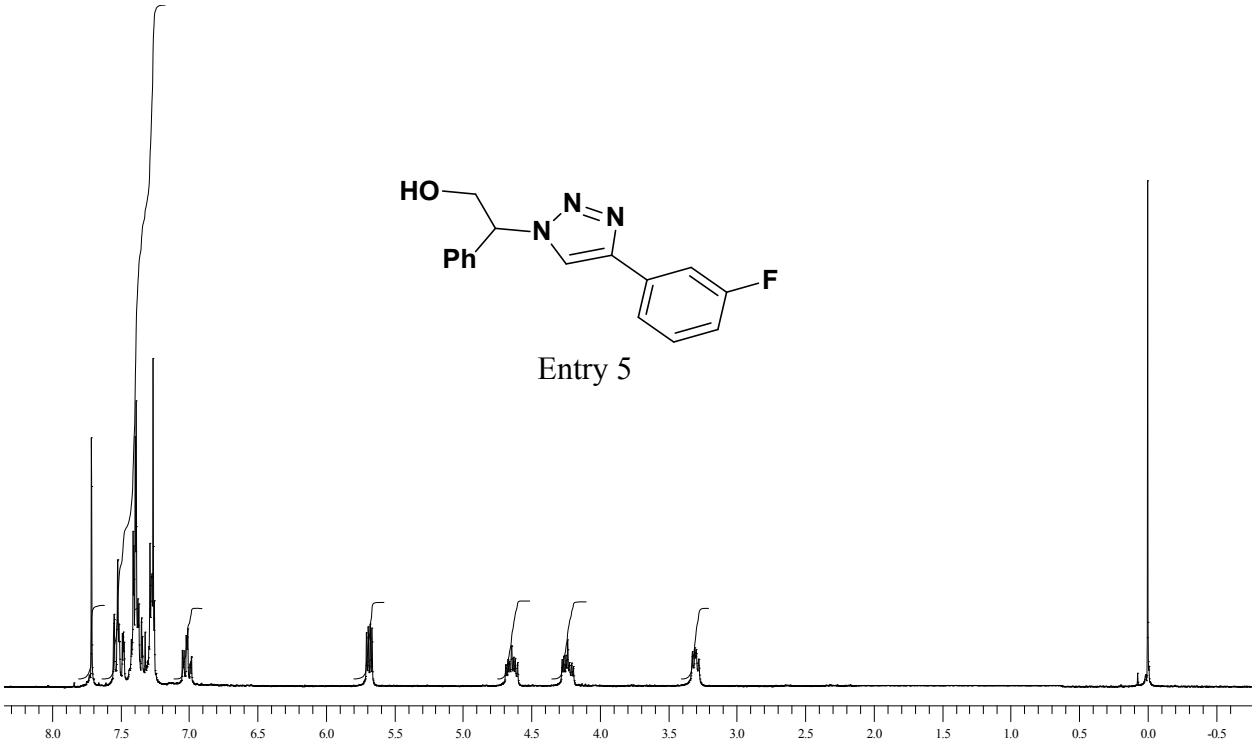

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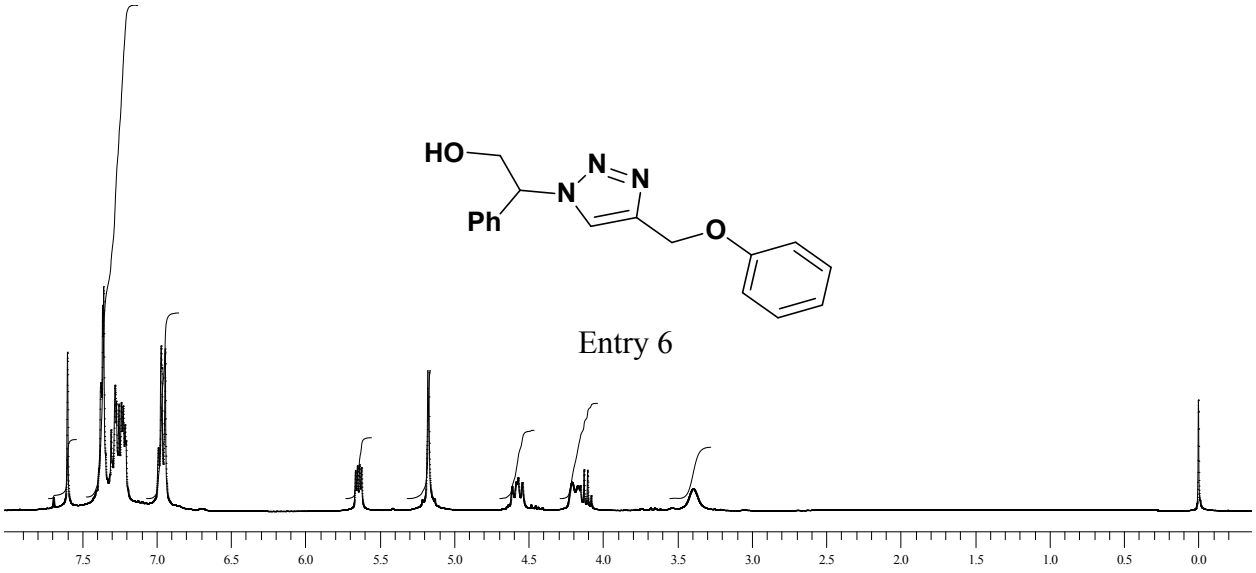

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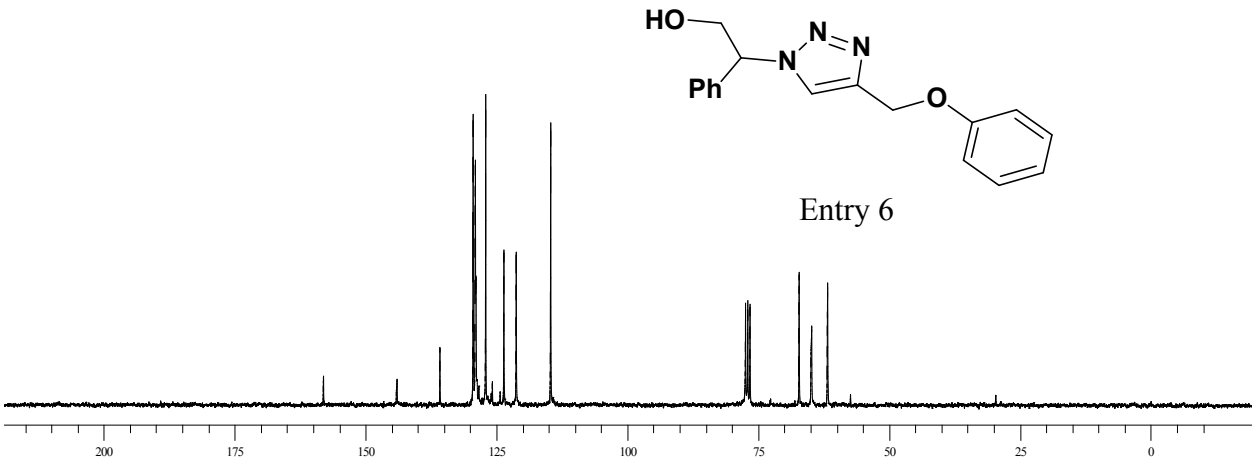

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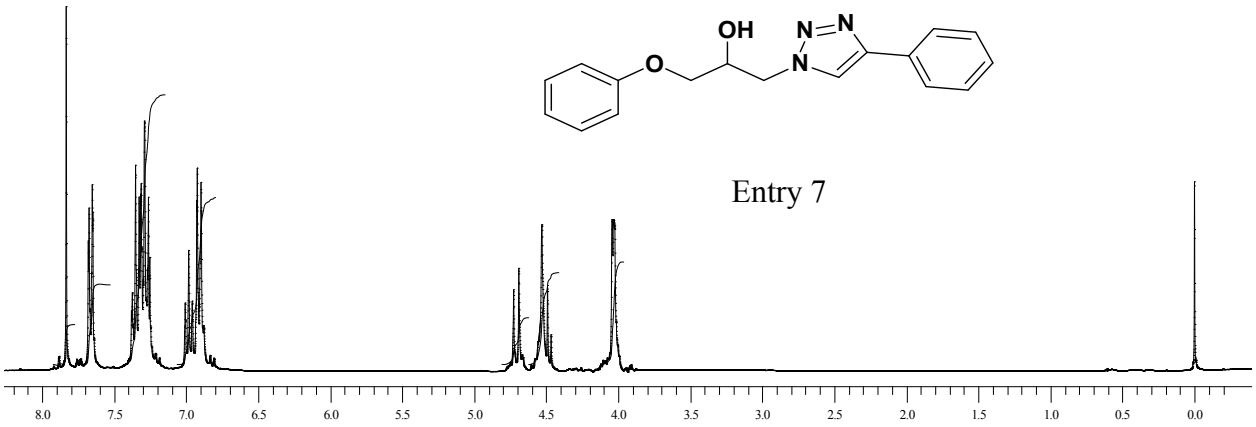
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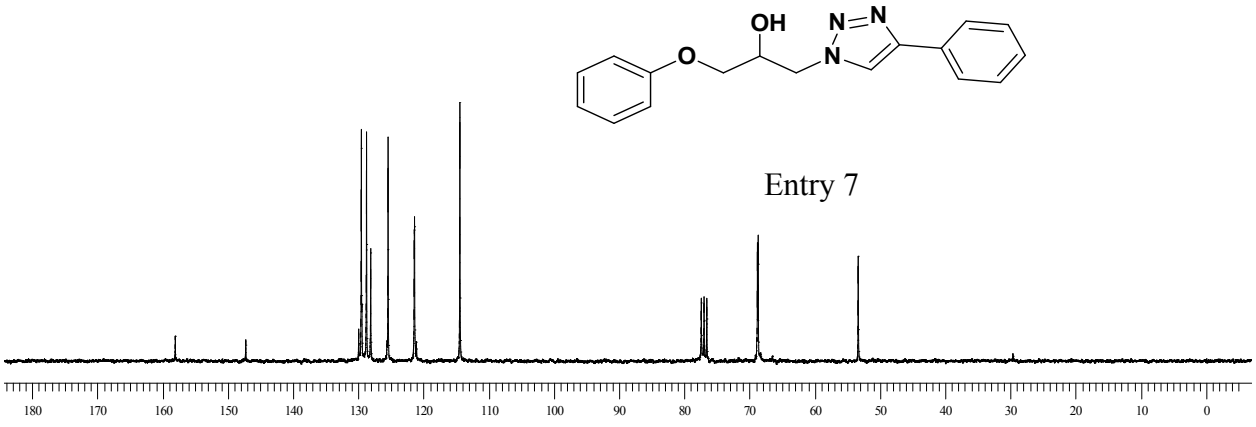
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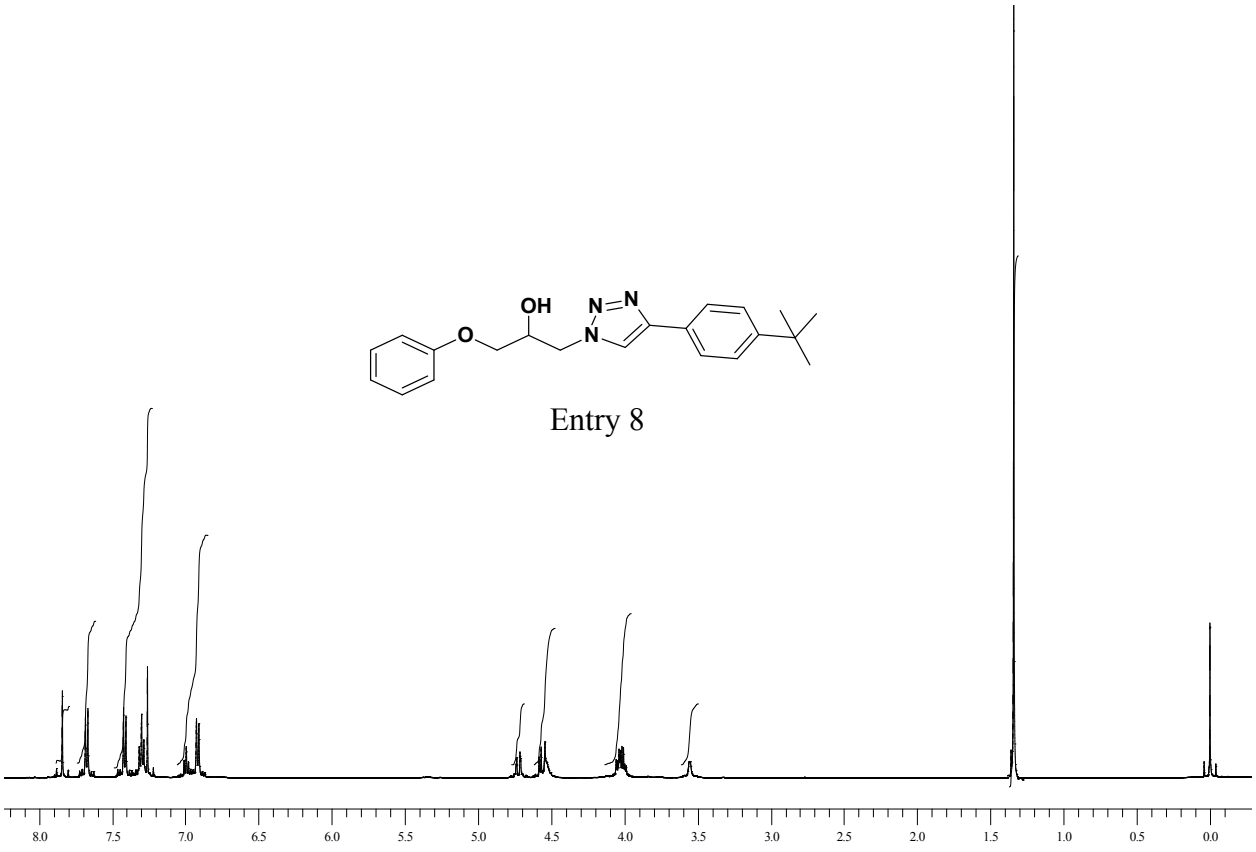

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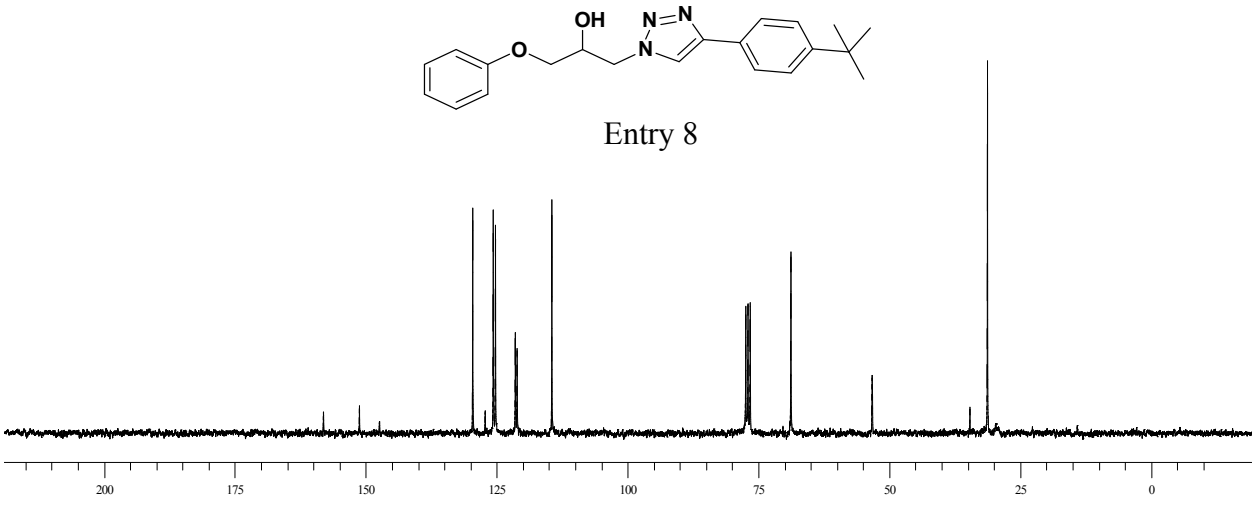

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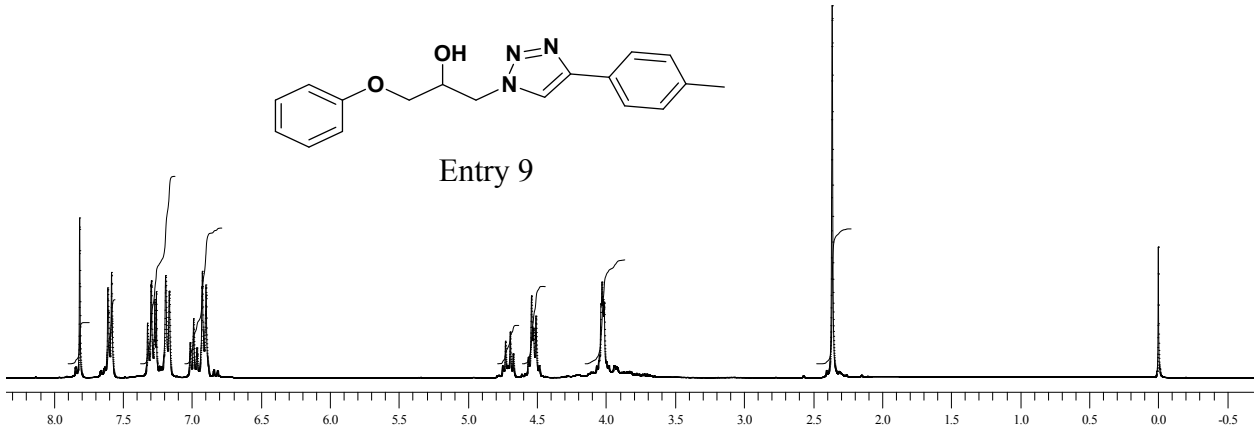

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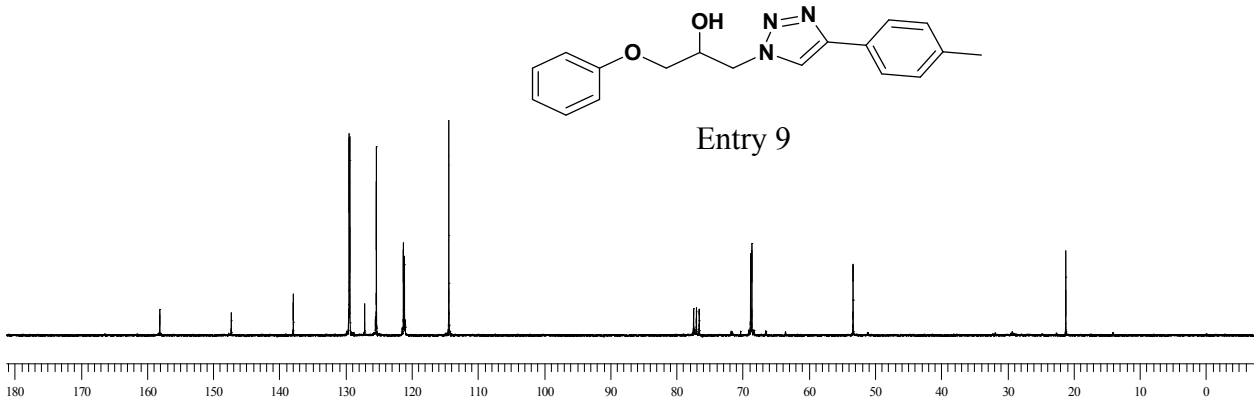

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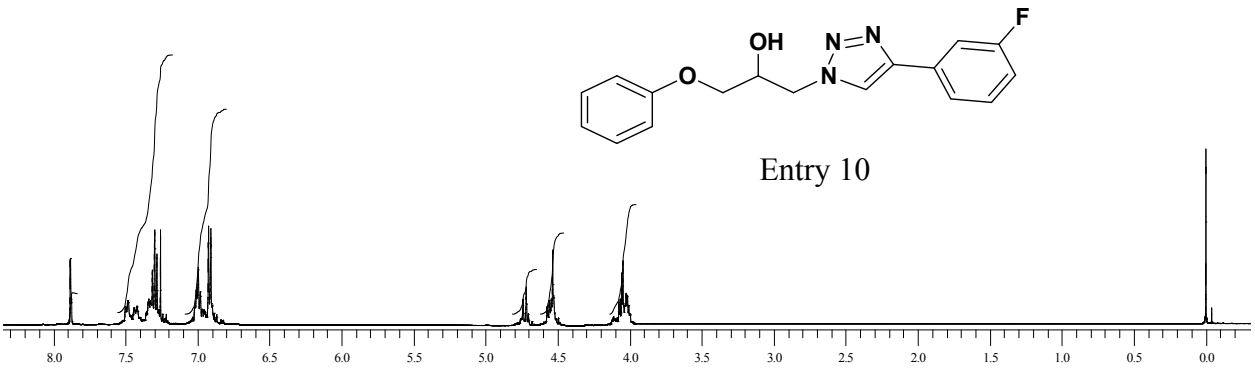

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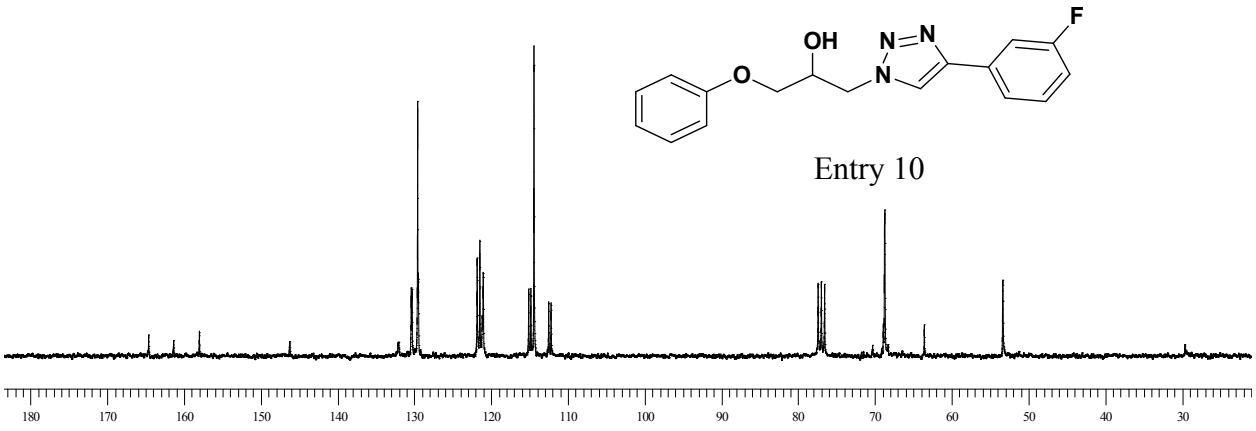

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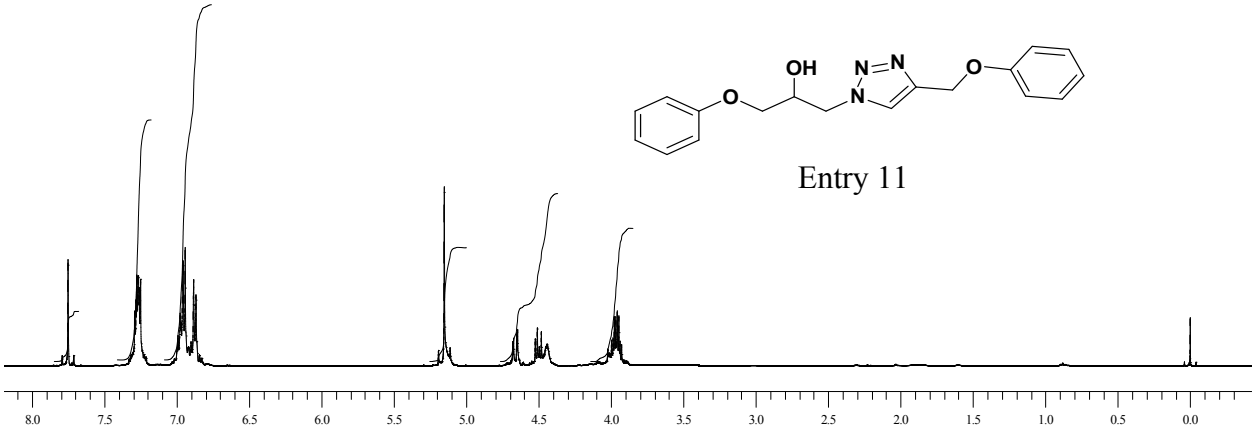

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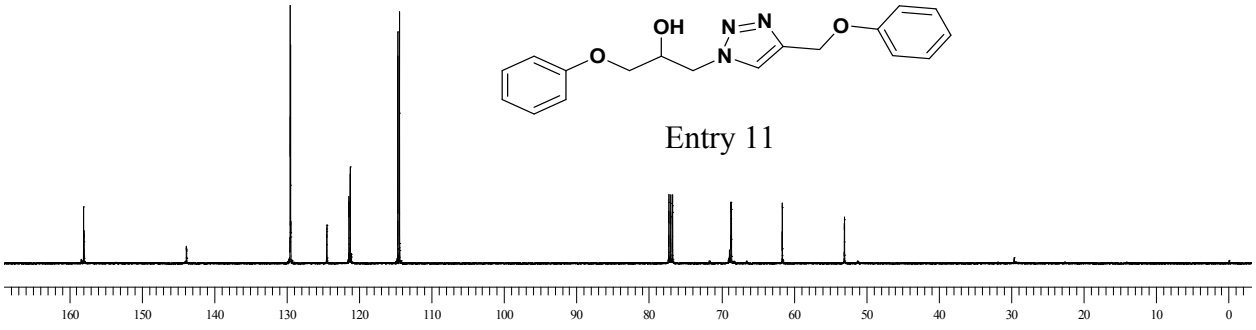

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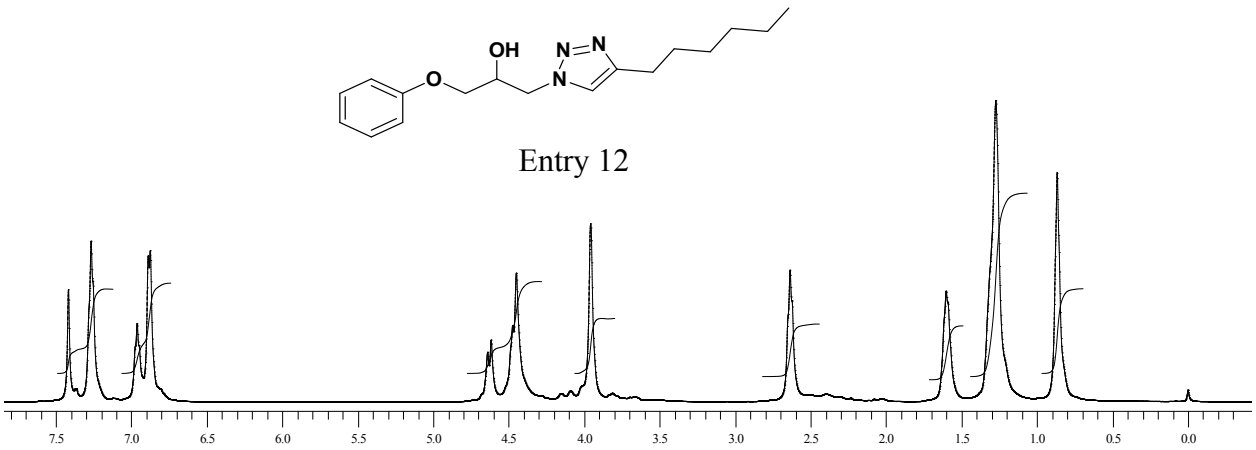

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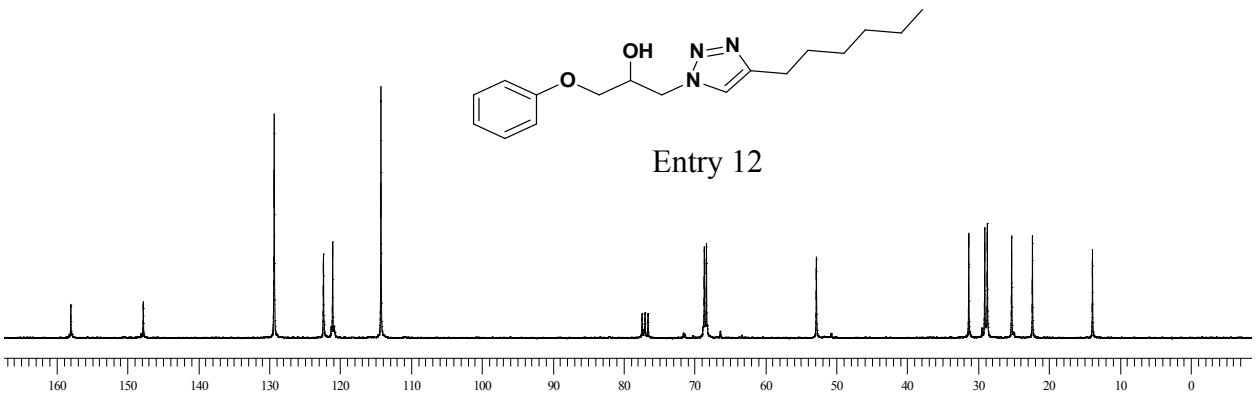

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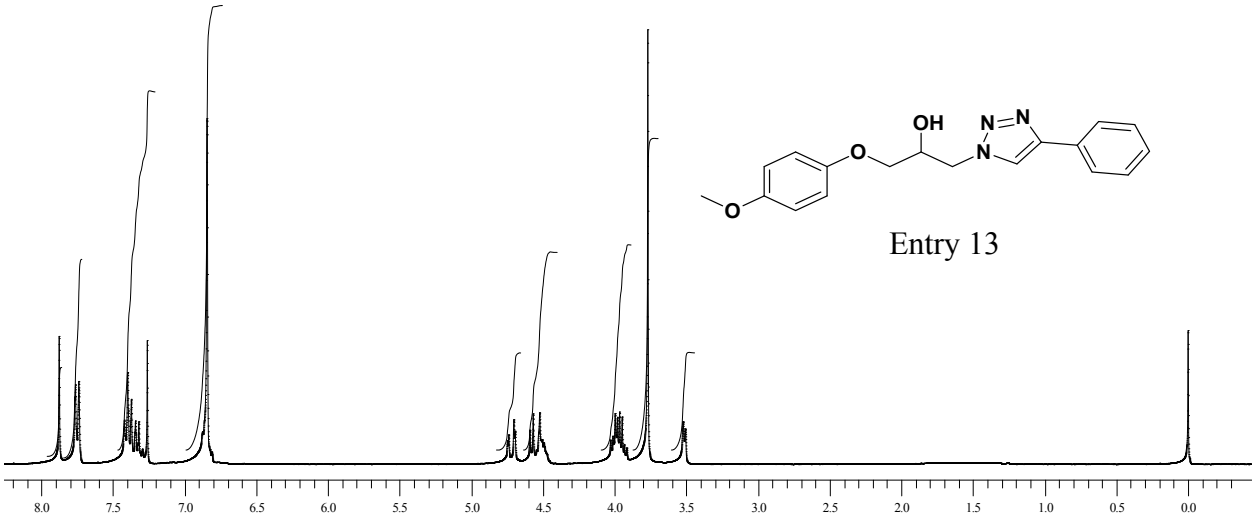

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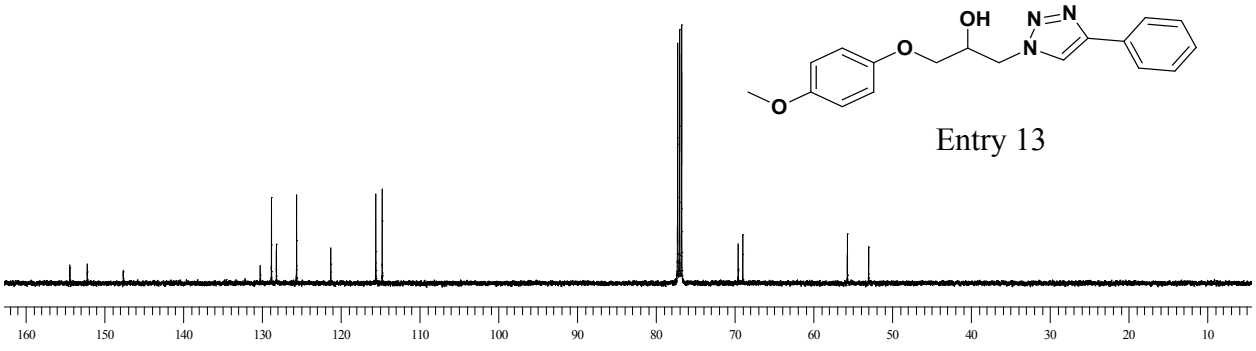

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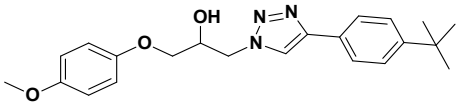

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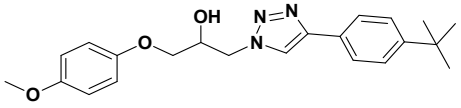

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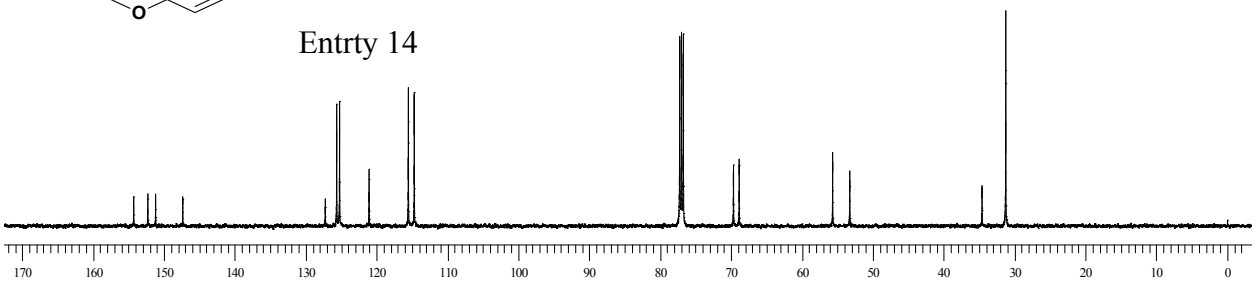

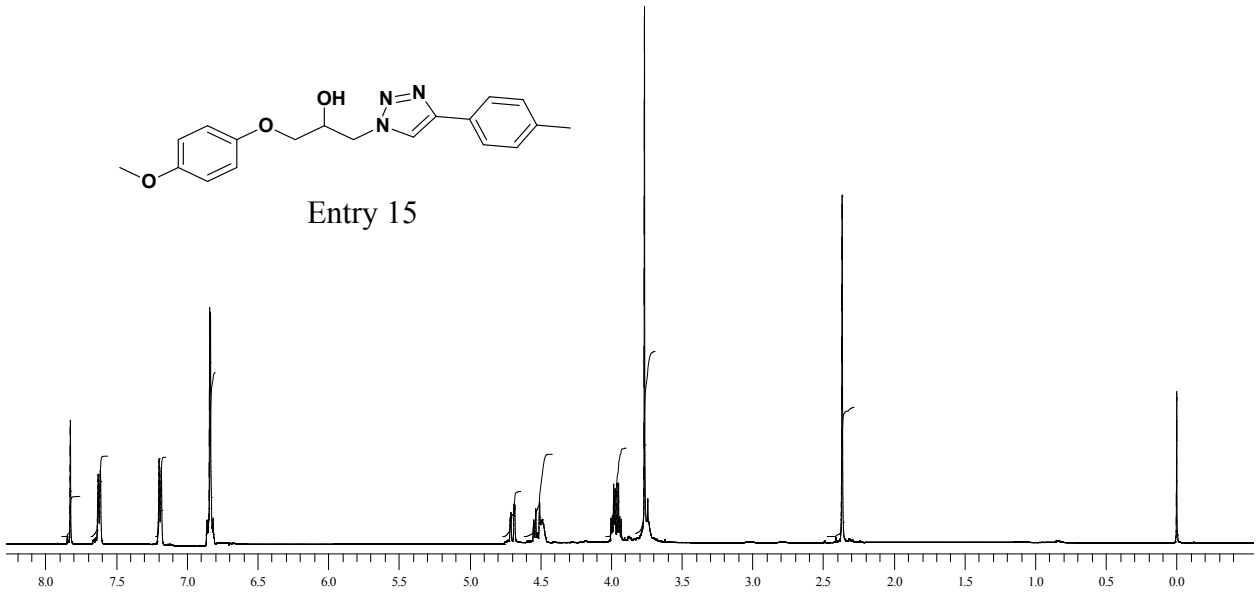

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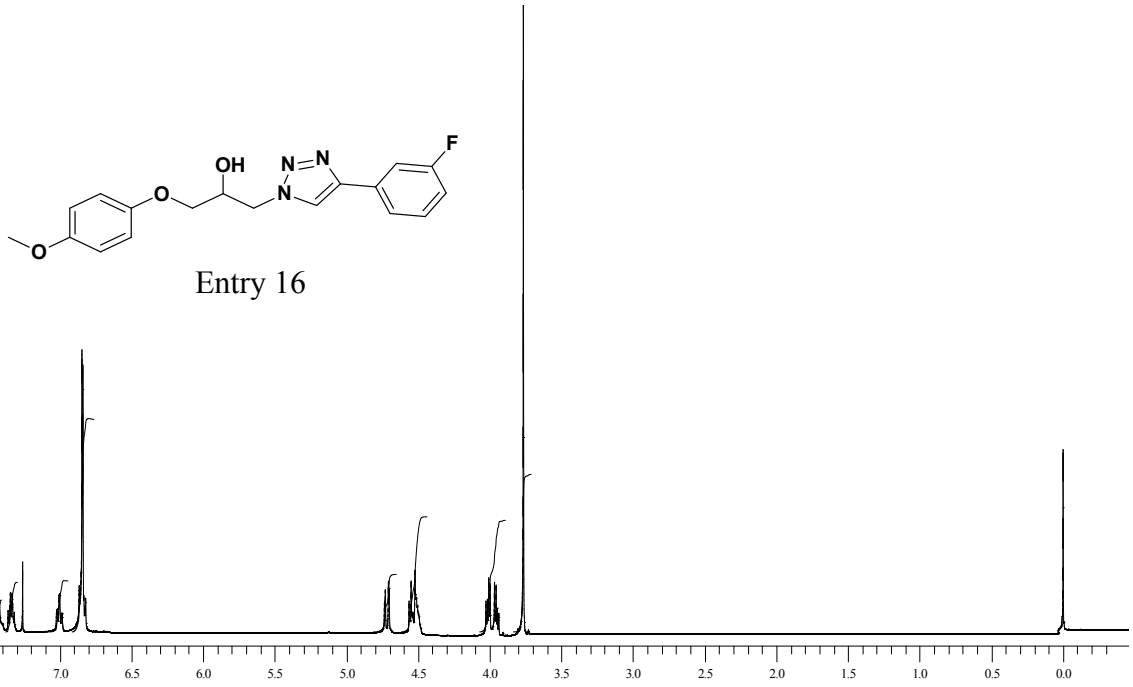

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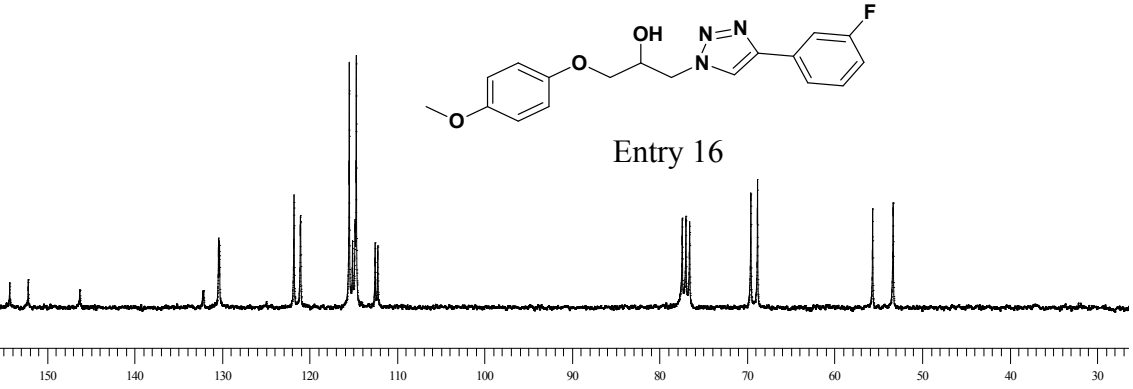

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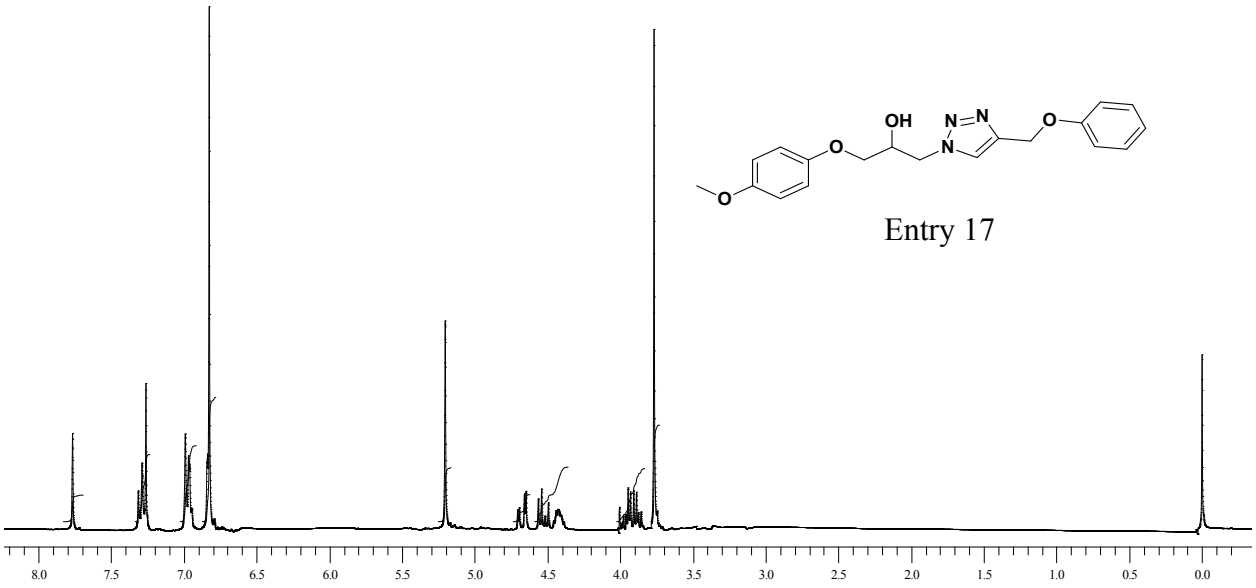

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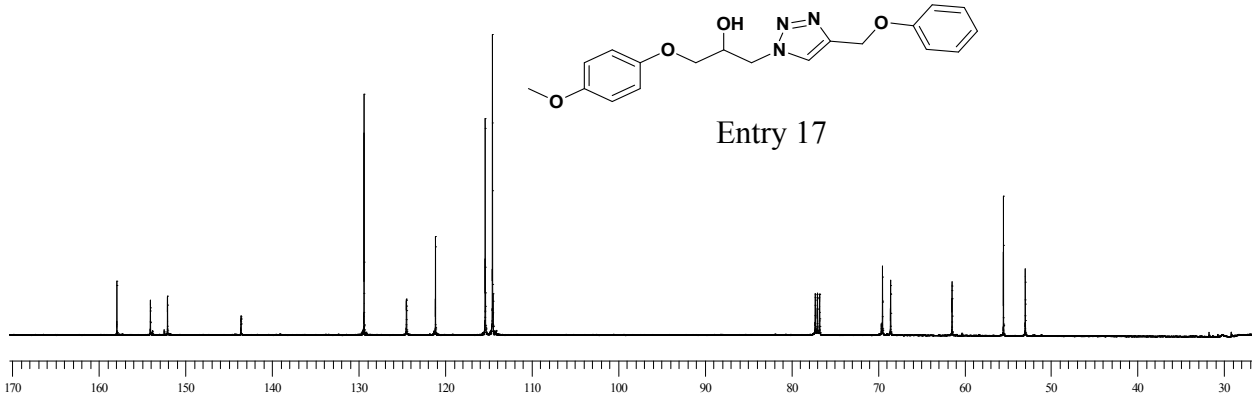

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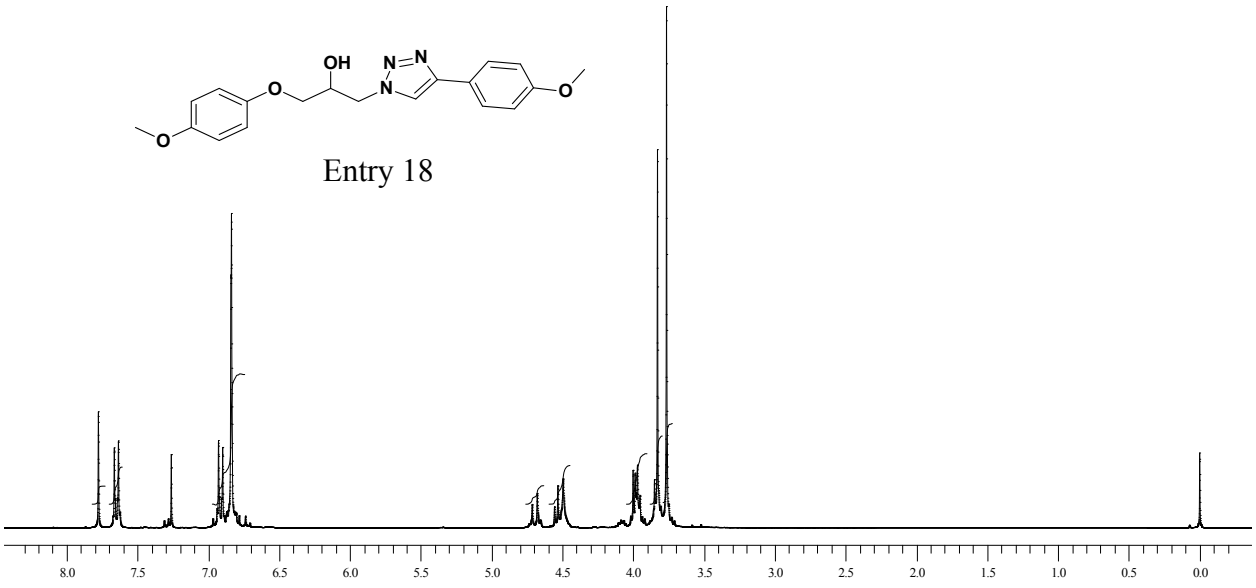

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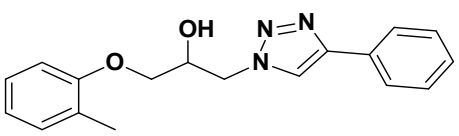

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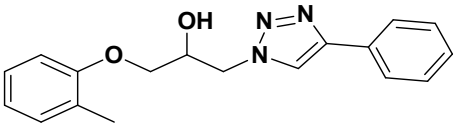

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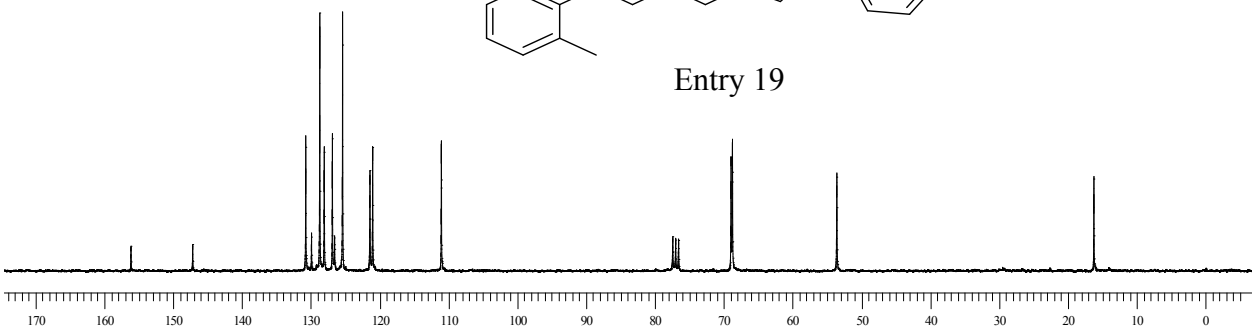

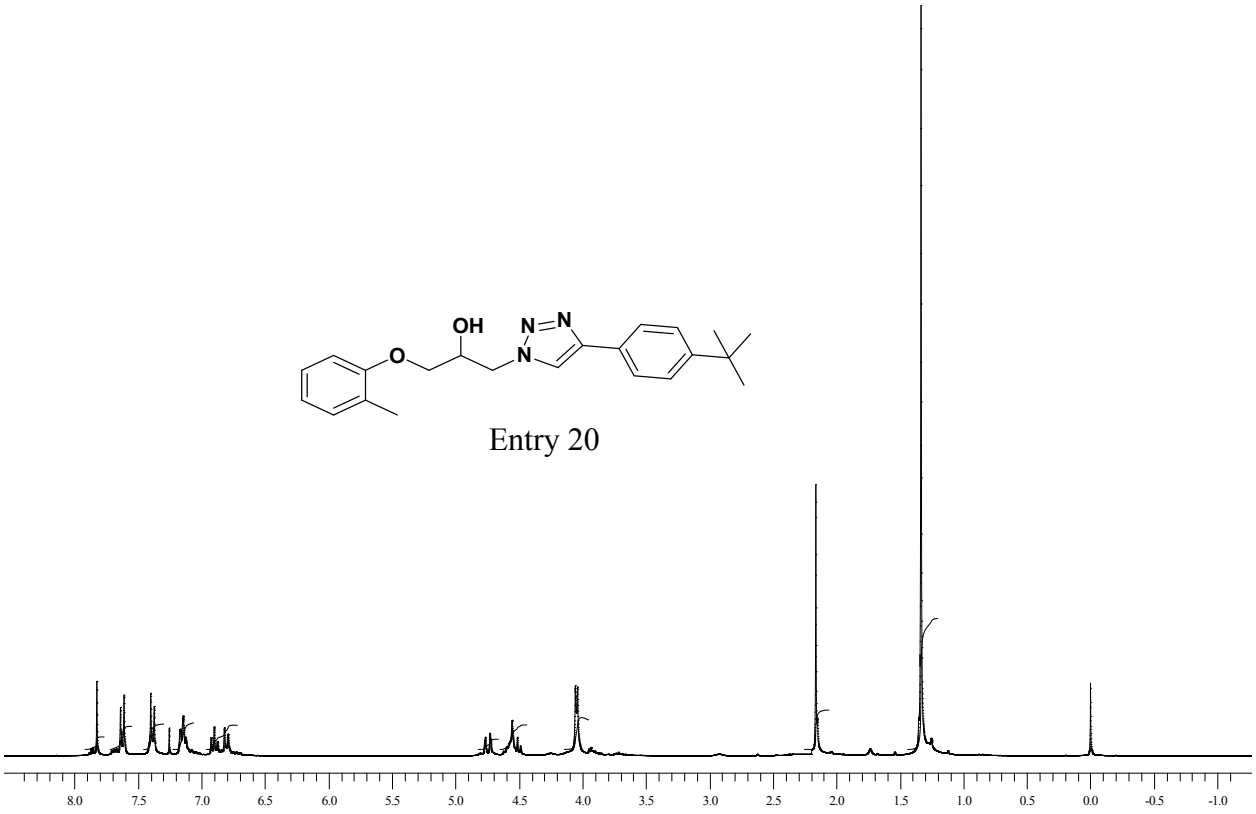

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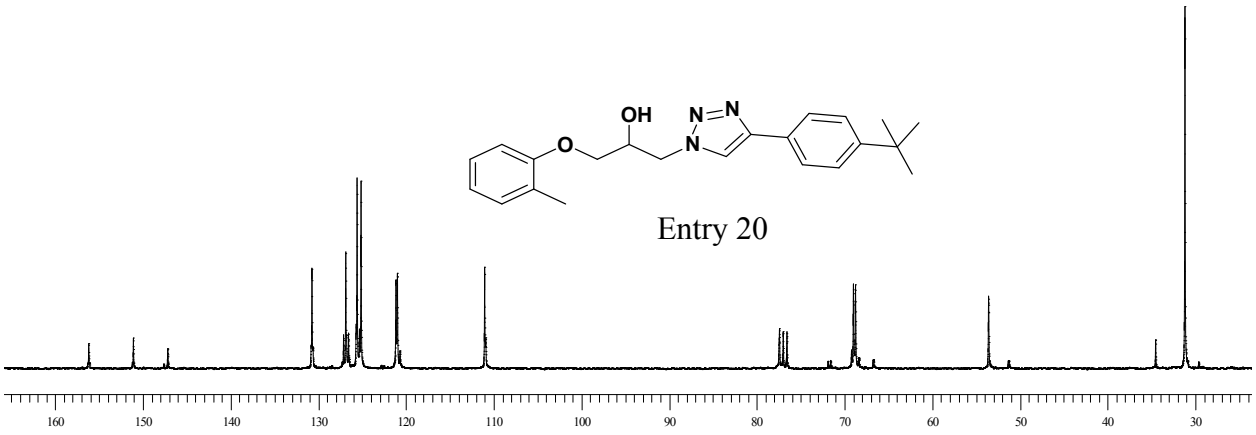

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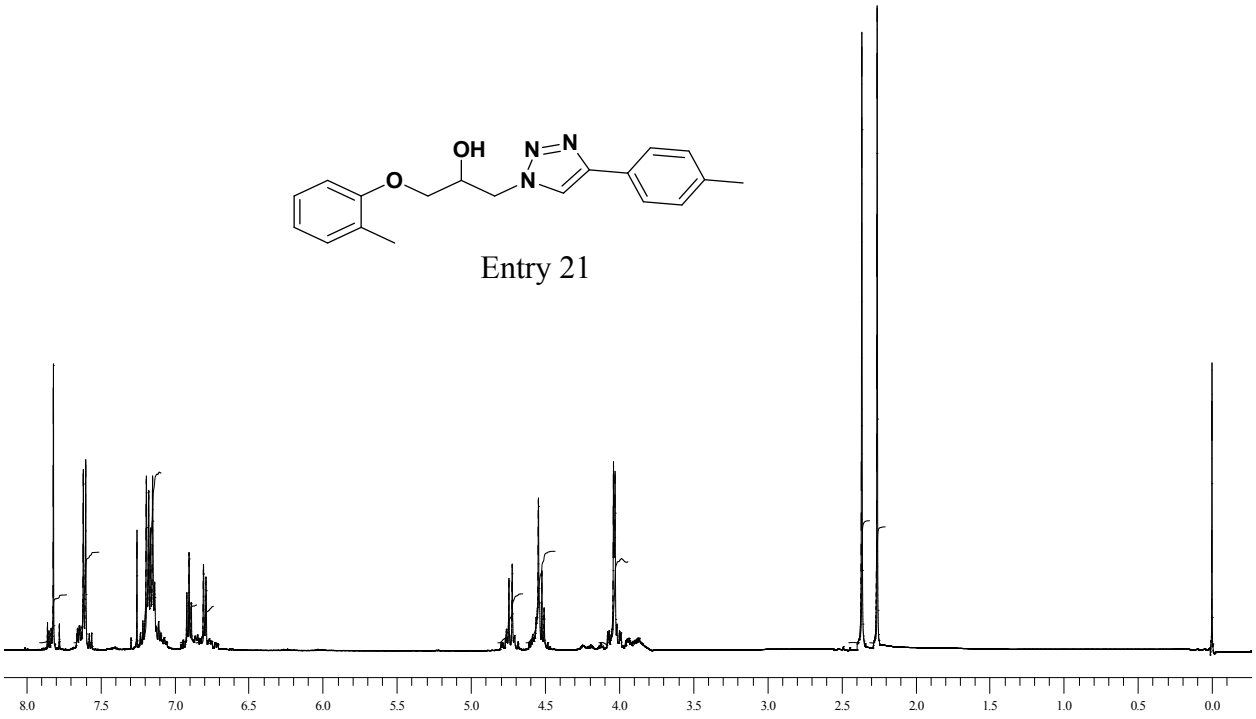

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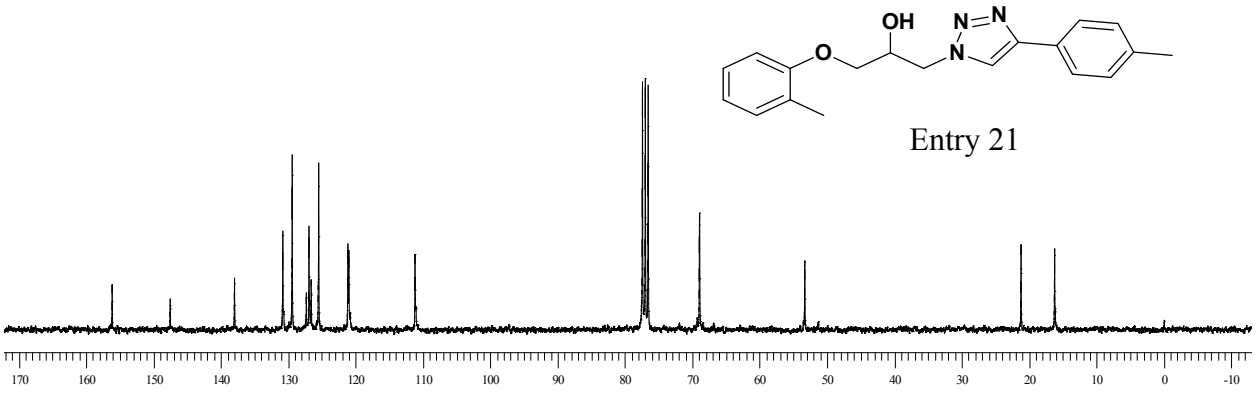

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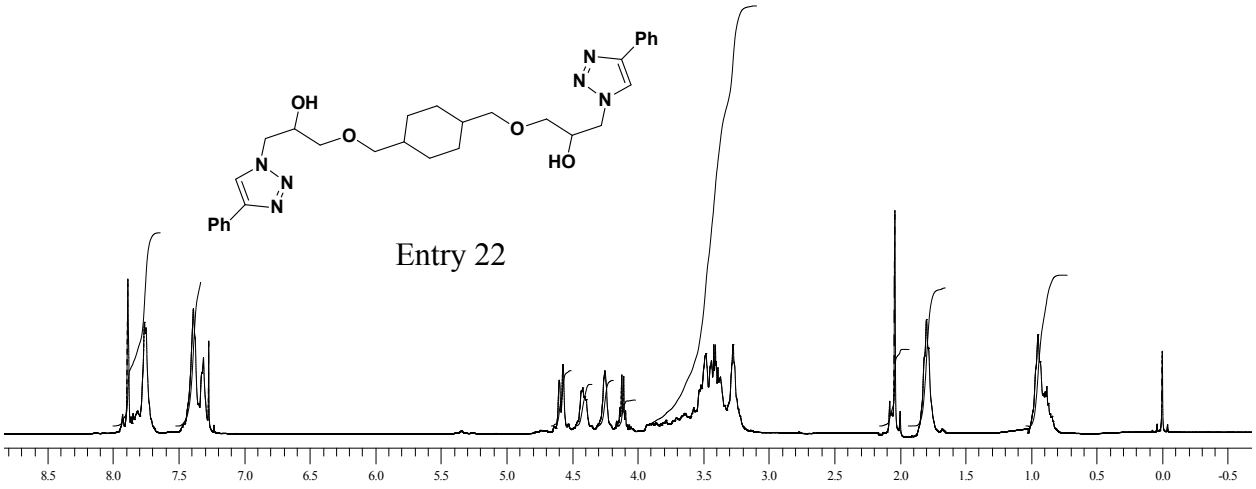
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