Supplementary Information for

Pd catalyzed cross coupling reactions of less activated alkenyl electrophiles (for tosylates and mesylates) with tosylhydrazones: synthesis of various 1,3-dienes

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1. Reagents

All reactions were carried out under a nitrogen atmosphere. 1,4-Dioxane and toluene were dried over Na with benzophenone-ketyl intermediate as indicator. Air- and moisture-sensitive solvents and solutions were transferred via syringe or stainless-steel cannula. All other chemicals were used as received from the appropriate suppliers. Solvents used were of analytical grade. All reactions were routinely checked by TLC. TLC was performed on aluminium-backed silica gel plates (silica gel 60 F254 grade, Merck DC) with spots visualized by UV light. Column chromatography was performed on silica gel LC 60A (70-200 micron).

Instrumental

All compounds were characterized by $^1$H NMR, $^{13}$C NMR as well as elemental analysis. Melting points were determined in open capillaries on a Veego electronic apparatus VMP-D (Veego Instrument Corporation, Mumbai, India) and are uncorrected. $^1$HNMR and $^{13}$C NMR spectra were recorded on a Bruker400 MHz model spectrometer using DMSO-d$_6$ as a solvent and TMS as internal standard with $^1$H resonant frequency of 400 MHz and $^{13}$C resonant frequency of 100 MHz. The $^1$H NMR, $^{13}$C NMR chemical shifts were reported as parts per million (ppm) downfield from TMS (Me$_4$Si). The splitting patterns are designated as follows; s, singlet; d, doublet; t, triplet; m, multiplet. Elemental analyses (C, H, N) were performed using a Heraeus CarloErba 1180 CHN analyzer (Hanau, Germany).
2. Preparation of alkenyl tosylates and mesylates substrates

Pyronyl tosylates and mesylates were prepared from their corresponding precursors with TsCl or MsCl in the presence of triethylamine in CH₂Cl₂ according to the literature method without modifications.¹ Other alkenyl tosylates and mesylates were prepared from their corresponding species according to the literature method without modifications.²

3. General Procedure for Preparation of Hydrazones.³

To an oven dried flat-bottomed flask previously equipped with a magnetic stir bar, was charged with p-toluenesulphonohydrazide (5 mmol) in dry methanol (10 mL) at 60 °C, the ketone (5 mmol) was added drop wise. After the completion of reaction the product was began to precipitate. The crude product was filtered, washed with petroleum ether: ethyl acetate (10:1) and dried to afford the corresponding pure N-tosylhydrazones. The reaction provides the N-tosylhydrazone derivatives in about 85−98% yields.

4. Typical procedure for Pd-catalyzed N-tosylhydrazones coupling with heteroaryl pseudohalides

To an oven dried flat-bottomed flask which was equipped with a condenser under nitrogen atmosphere was charged with N-tosylhydrazone 1 (1.0 mmol), base (3 mmol), ligand (3 mol %), Pd (1.5 mol %), stir it for two minutes thereafter alkeny tosylate 2 (1.0 mmol) was added in the above reaction mixture (5.0 mL). The reaction was stirred and heated to 90 °C for 1-2 hours. After compilation of reaction, the crude reaction mixture was cooled to room temperature and filtered
through a pad of Celite eluting with ethyl acetate. The filtrate was concentrated and purified by column chromatography on silica gel.

5. Characterization of coupling yield

\[ \text{\textbf{NMR}} \]

\[ \text{\textbf{H NMR}} \ (400 \text{ MHz, DMSO-}d_6) \ \delta \text{ ppm} : 7.82 \ (\text{dd, } J = 7.4, 2.5 \text{ Hz, 1H}), 7.44-7.30 \ (\text{m, 5H}), 7.17 \ (\text{dd, } J = 7.5, 2.0 \text{ Hz, 2H}), 7.07 \ (\text{dd, } J = 7.1, 1.5 \text{ Hz, 1H}), 6.20 \ (\text{s, 1H}), 5.52 \ (\text{s, 1H}), 5.21 \ (\text{s, 1H}), 3.49 \ (\text{s, 3H}). \]

\[ \text{\textbf{C NMR}} \ (100 \text{ MHz, DMSO-}d_6) \ \delta \text{ ppm} : 165.52, 144.30, 142.82, 139.03, 129.45, 128.75, 128.37, 128.05, 126.85, 124.75, 124.58, 121.75, 120.18, 117.70, 115.11, 29.56. \textbf{Anal. Calcd.} \text{ For C}_{18}H_{15}NO: C: 82.77; H: 5.79; N: 5.36. \textbf{Found:} C: 82.68; H: 5.57; N: 5.38. \textbf{mp} 202-204 °C.

\[ \text{\textbf{H NMR}} \ (400 \text{ MHz, DMSO-}d_6) \ \delta \text{ ppm} : 7.94 \ (\text{d, } J = 7.4 \text{ Hz, 2H}), 7.64-7.42 \ (\text{m, 4H}), 7.24 \ (\text{d, } J = 8.1 \text{ Hz, 2H}), 6.64 \ (\text{s, 1H}), 5.71 \ (\text{s, 1H}), 5.28 \ (\text{s, 1H}). \textbf{C NMR} \ (100 \text{ MHz, DMSO-}d_6) \ \delta \text{ ppm} : 161.37, 153.81, 151.78, 147.43, 146.12, 141.82, 131.87, 128.93, 126.55, 125.48, 123.27, 120.60, 119.42, 118.29, 109.17. \textbf{Anal. Calcd.} \text{ For C}_{17}H_{11}NO_4: C: 69.62; H: 3.78; N: 4.78. \textbf{Found:} C: 69.68; H: 3.55; N: 4.79. \textbf{mp} 159-162 °C.
**H NMR** (400 MHz, DMSO-d$_6$) $\delta$ ppm: 7.82 (dd, $J = 7.4, 1.5$ Hz, 1H), 7.59 (t, $J = 7.1$ Hz, 1H), 7.36-7.17 (m, 6H), 6.26 (s, 1H), 5.52 (s, 1H), 5.38 (s, 1H). 13C NMR (100 MHZ, DMSO-d$_6$) $\delta$ ppm: 165.26, 158.25 (d, $J = 240.2$ Hz), 152.76, 151.24, 140.35, 132.48, 131.19 (d, $J = 7.1$ Hz), 128.93, 128.81 (d, $J = 15.2$ Hz), 126.57 (d, $J = 7.6$ Hz), 125.48, 124.54 (d, $J = 3.3$ Hz), 120.69, 118.54, 117.24, 115.72 (d, $J = 13.4$ Hz), 105.32. **Anal. Calcd.** For C$_{17}$H$_{11}$FO$_2$: C, 76.68; H, 4.16. **Found:** C, 76.79; H, 4.16. **mp** 219-221°C.

**H NMR** (400 MHz, DMSO-d$_6$) $\delta$ ppm: 7.48-7.44 (m, 2H), 7.32 (dd, $J = 7.8, 2.1$ Hz, 1H), 7.28 – 7.12 (m, 3H), 7.03 (d, $J = 7.8$ Hz, 2H), 6.89 (s, 1H), 5.52 (s, 1H), 5.14 (s, 1H), 3.39 (s, 3H). 13C NMR (100 MHZ, DMSO-d$_6$) $\delta$ ppm: 164.8, 159.81(d, $J = 241.6$ Hz), 146.32, 142.41 (d, $J = 7.9$ Hz), 140.86, 138.54, 130.03, 129.39 (d, $J = 7.5$ Hz), 124.67 (d, $J = 16.4$ Hz), 121.86, 121.64 (d, $J = 3.2$ Hz), 120.36, 115.69 (d, $J = 13.2$ Hz), 115.31 (d, $J = 12.7$ Hz), 114.66, 113.57, 113.01, 31.24. **Anal. Calcd.** For C$_{18}$H$_{14}$FNO: C, 77.44; H, 5.05; N, 5.01. **Found:** C, 77.40; H, 5.05; N, 5.13. **mp** 231-233 °C.
\( {^1\text{H NMR}} \) (400 MHz, DMSO-\( \text{d}_6 \)) \( \delta \) ppm: 7.74 (dd, \( J = 7.9, 2.1 \) Hz, 1H), 7.61 (dd, \( J = 7.5, 2.0 \) Hz, 1H), 7.44 – 7.25 (m, 5H), 6.43 (s, 1H), 5.64 (s, 1H), 5.29 (s, 1H). \( {^{13}\text{C NMR}} \) (100 MHz, DMSO-\( \text{d}_6 \)) \( \delta \) ppm: 164.54, 162.23 (d, \( J = 236.7 \) Hz), 153.45, 152.67, 143.89, 139.37(d, \( J = 3.1 \) Hz), 131.71, 129.19 (d, \( J = 8.4 \) Hz), 125.71, 123.19, 120.73, 117.18, 116.30, 115.27(d, \( J = 23.6 \) Hz), 110.78. 

**Anal. Calcd.** For \( \text{C}_{17}\text{H}_{11}\text{FO}_2 \): C, 76.68; H, 4.16. **Found:** C, 76.71; H, 4.14. **mp** 219-221°C.

\( {^1\text{H NMR}} \) (400 MHz, DMSO-\( \text{d}_6 \)) \( \delta \) ppm: 8.19 (dd, \( J = 7.7, 2.1 \) Hz, 1H), 7.76 (dd, \( J = 7.4, 2.0 \) Hz, 1H), 7.62 (dd, \( J = 7.8, 2.6 \) Hz, 1H), 7.37-7.23 (m, 3H), 6.98 (dd, \( J = 7.7, 2.0 \) Hz, 2H), 6.28 (s, 1H), 5.62 (s, 1H), 5.34 (s, 1H), 3.68 (s, 3H), 2.28 (s, 3H). \( {^{13}\text{C NMR}} \) (100 MHZ, DMSO-\( \text{d}_6 \)) \( \delta \) ppm: 162.28, 144.58, 142.41, 140.11, 139.23, 137.37, 130.48, 130.79, 129.98, 129.15, 125.35, 124.39, 123.17, 121.49, 119.13, 115.68, 113.58, 29.78, 19.84. **Anal. Calcd.** For \( \text{C}_{19}\text{H}_{17}\text{NO} \): C, 82.88; H, 6.22; N, 5.09. **Found:** C, 82.79; H, 6.25; N, 5.19. **mp** 183-185°C.
$^1$H NMR (400 MHz, DMSO-d$_6$) δ ppm: 8.05 (dd, $J = 7.4$, 2.1 Hz, 1H), 7.41-7.29 (m, 2H), 7.28 (t, $J = 7.5$ Hz, 1H), 7.16 – 7.01 (m, 4H), 6.27 (s, 1H), 5.71 (s, 1H), 5.24 (s, 1H), 3.61 (s, 3H), 2.31 (s, 3H). $^{13}$C NMR (100 MHz, DMSO-d$_6$) δ ppm: 163.38, 146.67, 143.72, 139.11, 138.58, 137.81, 131.19, 129.24, 128.88, 128.45, 127.73, 124.49, 123.71, 121.39 117.58, 115.77, 113.87, 29.67, 21.87. Anal. Calcd. For C$_{19}$H$_{17}$NO: C, 82.88; H, 6.22; N, 5.09. Found: C, 82.81; H, 6.27; N, 5.11. mp 212-215°C.

![Diagram](image)

$^1$H NMR (400 MHz, DMSO-d$_6$) δ ppm: 7.84 (dd, $J = 7.4$, 1.9 Hz, 1H), 7.43-7.32 (m, 3H), 7.19-6.98 (m, 4H), 6.19 (s, 1H), 5.67 (s, 1H), 5.21 (s, 1H), 3.64 (s, 3H), 2.32 (s, 3H). $^{13}$C NMR (100 MHz, DMSO-d$_6$) δ ppm: 164.51, 144.84, 143.69, 140.58, 139.93, 137.51, 131.29, 129.47, 127.78, 124.13, 123.25, 121.81, 117.45, 115.71, 113.86, 28.96, 21.42. Anal. Calcd. For C$_{19}$H$_{17}$NO: C, 82.88; H, 6.22; N, 5.09. Found: C, 82.76; H, 6.20; N, 5.09. mp 198-200°C.

![Diagram](image)

$^1$H NMR (400 MHz, DMSO-d$_6$) δ ppm: 7.78-7.69 (m, 2H), 7.40-7.31 (m, 2H), 7.28 – 7.18 (m, 2H), 7.04-6.98 (m, 2H), 6.57 (s, 1H), 5.54 (s, 1H), 5.29 (s, 1H), 3.67 (s, 3H). $^{13}$C NMR (100 MHz, DMSO-d$_6$) δ ppm: 162.85, 157.71, 153.19, 151.32, 141.59, 132.05, 131.43, 130.89, 128.51,
125.74, 124.09, 123.37, 121.47, 120.53, 116.48, 111.96, 109.44, 56.27. **Anal. Calcd.** For C$_{18}$H$_{14}$O$_3$: C, 77.68; H, 5.07. **Found:** C, 77.64; H, 5.07. mp 225-228°C.

![Chemical Structure]

**$^1$H NMR** (400 MHz, DMSO-$d_6$) δ ppm: 7.83 (dd, $J = 7.3$, 2.0 Hz, 1H), 7.66 (dd, $J = 7.7$, 4.7 Hz, 1H), 7.41-7.25 (m, 3H), 7.01–6.85 (m, 3H), 6.36 (s, 1H), 5.69 (s, 1H), 5.45 (s, 1H), 3.73 (s, 3H).

**$^{13}$C NMR** (100 MHZ, DMSO-$d_6$) δ ppm: 164.85, 158.97, 153.52, 152.42, 143.71, 139.27, 131.33, 129.38, 125.74, 123.82, 123.27, 120.45, 117.63, 117.54, 117.38, 113.04, 110.59, 55.79. **Anal. Calcd.** For C$_{18}$H$_{14}$O$_3$: C, 77.68; H, 5.07. **Found:** C, 77.86; H, 5.12. mp 205-208°C.

![Chemical Structure]

**$^1$H NMR** (400 MHz, DMSO-$d_6$) δ ppm: 9.50 (s, 1H), 8.08 (dd, $J = 7.4$, 2.1 Hz, 1H), 7.41-7.32 (m, 3H), 7.08-6.98 (m, 2H), 6.82 (d, $J = 7.2$ Hz, 2H), 6.21 (s, 1H), 5.71 (s, 1H), 5.25 (s, 1H), 3.68 (s, 3H). **$^{13}$C NMR** (100 MHZ, DMSO-$d_6$) δ ppm: 164.12, 160.26, 145.70, 143.69, 139.43, 135.68, 129.21, 128.72, 124.47, 123.61, 121.87, 116.68, 115.51, 113.86, 29.88. **Anal. Calcd.** For C$_{18}$H$_{15}$NO$_2$: C, 77.96; H, 5.45; N, 5.05. **Found:** C, 77.91; H, 5.47; N, 5.05 mp 247-248°C.
$^1$H NMR (400 MHz, DMSO-$d_6$) $\delta$ ppm: 7.74 (d, $J = 8.1$ Hz, 2H), 7.40 (d, $J = 7.4$ Hz, 2H), 5.85 (s, 1H), 5.73 (s, 1H), 5.40 (s, 1H), 4.62 (m, 1H), 2.68 (dd, $J = 16.3$, 7.0 Hz, 1H), 2.29 (d, $J = 7.0$ Hz, 1H), 1.30 (d, $J = 6.8$ Hz, 3H). $^{13}$C NMR (100 MHZ, DMSO-$d_6$) $\delta$ ppm: 163.76, 156.73, 144.12, 141.47, 133.29, 128.90, 118.58, 115.45, 112.82, 110.37, 72.87, 31.07, 21.07. Anal. Calcd. For C$_{15}$H$_{13}$NO$_2$: C, 75.30; H, 5.48; N, 5.85. Found: C, 75.33; H, 5.54; N, 5.81. mp 238-240°C.

$^1$H NMR (400 MHz, DMSO-$d_6$) $\delta$ ppm: 7.31 (d, $J = 7.3$ Hz, 2H), 6.47 (d, $J = 7.3$ Hz, 2H), 6.20-6.16 (m, 2H), 5.81 (s, 1H), 5.57 (s, 1H), 5.21 (s, 2H), 2.23 (s, 3H). $^{13}$C NMR (100 MHZ, DMSO-$d_6$) $\delta$ ppm: 166.28, 162.82, 151.27, 147.45, 144.19, 134.55, 128.20, 114.61, 113.30, 109.90, 104.14, 21.87. Anal. Calcd. For C$_{14}$H$_{13}$NO$_2$: C, 74.00; H, 5.77; N, 6.16. Found: C, 74.09; H, 5.72; N, 6.11. mp 220-222°C
\[^1\text{H NMR}\ (400 \text{ MHz, DMSO-}d_6) \delta \text{ ppm:} \ 8.18 \ (\text{dd}, J = 8.1, 2.7 \text{ Hz}, 1\text{H}), \ 7.71 \ (d, J = 7.3 \text{ Hz}, 2\text{H}), \ 7.52-7.44 \ (m, 3\text{H}), \ 7.08-7.02 \ (m, 2\text{H}), \ 6.41 \ (s, 1\text{H}), \ 5.69 \ (s, 1\text{H}), \ 5.24 \ (s, 1\text{H}), \ 4.08 \ (q, J = 8.1 \text{ Hz}, 2\text{H}), \ 3.68 \ (s, 3\text{H}), \ 1.34 \ (t, J = 7.7 \text{ Hz}, 3\text{H}).\ ^{13}\text{C NMR} (100 \text{ MHZ, DMSO-}d_6) \delta \text{ ppm:} \ 162.47, \ 159.81, \ 145.66, \ 143.96, \ 142.53, \ 139.61, \ 131.72, \ 129.37, \ 128.78, \ 125.74, \ 124.47, \ 123.19, \ 122.36, \ 117.31, \ 115.67, \ 113.87, \ 61.27, \ 29.72, \ 14.36. \textbf{Anal. Calcd.} \text{ For C}_{21}\text{H}_{19}\text{NO}_3: \text{ C}, 75.66; \text{ H}, 5.74; \text{ N}, 4.20. \textbf{Found:} \text{ C}, 75.60; \text{ H}, 5.79; \text{ N}, 4.29. \textbf{mp} 215-217^\circ\text{C}.\

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\begin{align*}
\text{O} & \quad \text{O} \\
& \quad \text{O}
\end{align*}
\]

\[^1\text{H NMR}\ (400 \text{ MHz, DMSO-}d_6) \delta \text{ ppm:} \ 7.37 \ (d, J = 7.8 \text{ Hz}, 2\text{H}), \ 6.93 \ (d, J = 7.6 \text{ Hz}, 2\text{H}), \ 6.07 \ (s, 1\text{H}), \ 5.71 \ (s, 1\text{H}), \ 5.40 \ (s, 1\text{H}), \ 4.87 \ (s, 2\text{H}), \ 3.74 \ (s, 3\text{H}).\ ^{13}\text{C NMR} (100 \text{ MHZ, DMSO-}d_6) \delta \text{ ppm:} \ 176.72, \ 157.18, \ 149.89, \ 136.27, \ 135.74, \ 128.24, \ 119.05, \ 113.92, \ 110.54, \ 72.37, \ 55.61. \textbf{Anal. Calcd.} \text{ For C}_{13}\text{H}_{12}\text{O}_3: \text{ C}, 72.21; \text{ H}, 5.59. \textbf{Found:} \text{ C}, 72.19; \text{ H}, 5.60. \textbf{mp} 212-214^\circ\text{C}.\

\[
\begin{align*}
\text{O} & \quad \text{O} \\
& \quad \text{O}
\end{align*}
\]

\[^1\text{H NMR}\ (400 \text{ MHz, DMSO-}d_6) \delta \text{ ppm:} \ 7.71 \ (d, J = 7.6 \text{ Hz}, 1\text{H}), \ 7.09 \ (d, J = 7.7 \text{ Hz}, 1\text{H}), \ 6.94 \ (s, 1\text{H}), \ 6.48 \ (s, 1\text{H}), \ 6.07 \ (t, J = 6.3 \text{ Hz}, 1\text{H}), \ 3.82 \ (s, 3\text{H}), \ 2.30-2.26 \ (m, 4\text{H}), \ 1.90-1.83 \ (m, 2\text{H}).\ ^{13}\text{C NMR} (100 \text{ MHZ, DMSO-}d_6) \delta \text{ ppm:} \ 163.87, \ 159.56, \ 154.23, \ 137.51, \ 136.27, \ 129.71, \ 126.86,
116.41, 110.33, 108.53, 105.81, 54.22, 34.67, 32.63, 22.83. **Anal. Calcd.** For C$_{15}$H$_{14}$O$_{3}$: C, 74.36; H, 5.82. **Found:** C, 74.19; H, 5.97. **mp** 158-160 °C.

![Chemical structure](image)

**$^1$H NMR** (400 MHz, DMSO-d$_6$) δ ppm: 7.79 (dd, $J = 7.6$, 2.1 Hz, 1H), 7.48 – 7.36 (m, 3H), 7.06-6.93 (m, 4H), 6.18 (s, 1H), 5.68 (s, 1H), 5.16 (s, 1H), 3.79 (s, 3H), 3.57 (s, 3H). **$^{13}$C NMR** (100 MHZ, DMSO-d$_6$) δ ppm: 163.37, 161.65, 144.60, 143.69, 138.62, 136.08, 129.29, 128.53, 124.65, 123.53, 122.72, 117.38, 115.68, 113.95, 111.86, 58.35, 30.59. **Anal. Calcd.** For C$_{19}$H$_{17}$NO$_{2}$: C, 78.33; H, 5.05; N, 5.45. **Found:** C, 78.58; H, 5.09; N, 5.52. **mp** 252-254 °C.

![Chemical structure](image)

**$^1$H NMR** (400 MHz, DMSO-d$_6$) δ ppm: 7.49 (d, $J = 8.1$ Hz, 2H), 7.30 (d, $J = 7.9$ Hz, 2H), 6.31 (s, 1H), 6.19 (s, 1H), 5.59 (s, 1H), 5.45 (s, 1H), 2.31 (s, 3H). **$^{13}$C NMR** (100 MHZ, DMSO-d$_6$) δ ppm: 164.70, 161.78, 161.63, 144.17, 141.24, 131.91 (q, $J = 30.7$ Hz), 131.73, 126.90 (q, $J = 3.9$ Hz), 125.16 (d, $J = 271.14$ Hz), 114.46, 109.92, 104.45, 20.19. **Anal. Calcd.** For C$_{15}$H$_{11}$F$_{3}$O$_{2}$: C, 64.29; H, 3.96. **Found:** C, 64.37; H, 3.87. **mp** 198-200 °C.
**1H NMR** (400 MHz, DMSO-$d_6$) δ ppm: 9.24 (s, 1H), 7.75 (d, $J = 7.9$ Hz, 2H), 7.64 (d, $J = 7.6$ Hz, 2H), 5.79 (t, $J = 6.2$ Hz, 1H), 5.42 (s, 1H), 5.04 (s, 1H), 3.95 (t, $J = 5.8$ Hz, 2H), 3.45 (d, $J = 6.2$ Hz, 2H), 2.65 (t, $J = 6.0$ Hz, 2H), 2.07 (s, 3H), 1.42 (s, 9H).

**13C NMR** (100 MHZ, DMSO-$d_6$) δ ppm: 167.19, 158.79, 144.97, 141.53, 138.13, 136.54, 127.68, 124.52, 118.66, 118.19, 79.30, 49.28, 45.63, 31.27, 27.51, 24.05.

**Anal. Calcd.** For C$_{20}$H$_{26}$N$_2$O$_3$: C, 70.15; H, 7.65; N, 8.18. **Found:** C, 70.24; H, 7.71; N, 8.12. *mp* 237-239 °C.

\[ \text{CF}_3 \]

**1H NMR** (400 MHz, DMSO-$d_6$) δ ppm: 7.51 (dd, $J = 7.7$, 2.4 Hz, 1H), 7.17-7.07 (m, 3H), 5.97 (s, 1H), 5.59 (s, 1H), 5.38 (s, 1H), 4.27 (t, $J = 5.1$ Hz, 2H), 2.24 (t, $J = 5.3$ Hz, 2H). **13C NMR** (100 MHZ, DMSO-$d_6$) δ ppm: 165.67, 154.72, 144.67, 138.91, 133.67, 130.27, 129.52, 129.37, 125.49, 116.32, 112.32, 64.81, 29.37. **Anal. Calcd.** For C$_{13}$H$_{11}$ClO$_2$: C, 66.53; H, 4.72. **Found:** C, 66.57; H, 4.69. *mp* 208-211 °C.

\[ \text{CF}_3 \]
$^1$H NMR (400 MHz, DMSO-$d_6$) $\delta$ ppm : 7.48 (d, $J = 8.2$ Hz, 2H), 7.31 (d, $J = 8.0$ Hz, 2H), 5.63 (t, $J = 6.2$ Hz, 1H), 5.43 (s, 1H), 5.11 (s, 1H), 2.31-2.23 (m, 1H), 2.20–2.02 (m, 2H), 1.81–1.66 (m, 2H), 1.39-1.35 (m, 2H), 0.84 (s, 9H). $^{13}$C NMR (100 MHZ, DMSO-$d_6$) $\delta$ ppm: 145.07, 141.18, 139.17, 134.21, 131.39 (q, $J = 32.2$ Hz), 128.31 (d, $J = 3.4$ Hz), 123.17 (d, $J = 269.7$ Hz), 119.90, 118.19, 44.27, 32.36, 28.89, 27.10, 25.13, 24.95. Anal. Calcd. For C$_{19}$H$_{23}$F$_3$: C, 74.01; H, 7.52. Found: C, 74.07; H, 7.58. mp 217-220 °C.

References

7. $^1$H and $^{13}$C NMR Spectra

Compound 3a
Compound 3b
Compound 3c
Compound 3h
Compound 3k
Compound 3o
Compound 3p
Compound 3u

Bruker NMR Spectrometer

Compound Structure:

Bruker NMR Spectra:

Sample Details:
- Spectrum Type: Hahn-echo
- Number of Transients: 64
- Time Domain: 1024
- Frequency Domain: 2048
- Spectral Width: 10000 Hz
- Acquisition Time: 3.25 sec
- Spin Decoupling: Off
- Additional Details: 1D spectrum, 1H, 500.13 MHz