Supplementary Materials

TFA-PROTECTED α-AMINO ACID N-HYDROXYSUCCINIMIDE ESTER: APPLICATION FOR INTER- AND INTRAMOLECULAR ACYLATION

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SM-1. Procedure for the preparation of TFA-1-L-/d-phenylalanine (TFA-1-/d-Phe, 1-/d-2) and TFA-1-/d-proline (TFA-1-/d-Pro, 1-/d-20)

The TFA-α-amino acid was prepared with reported procedure\(^1\)\(^2\) with slightly modification. Triethylamine (33 mmol, 1.5 equiv.) was added to a solution of α-amino acid (22 mmol) in MeOH (22 mL). After 5 min, ethyl trifluoroacetate (29 mmol, 1.3 equiv.) was added and the reaction was allowed to stir for 24 h. The solvent was removed by rotary evaporation and the residue that remained was dissolved in H₂O and acidified with concentrated HCl. The mixture was extracted with ethyl acetate for several times and the organic layers were combined and washed with brine, dried with MgSO₄, filtered, and concentrated by rotary evaporation. Further subjection into high vacuum for overnight, if needed to solidify the product (TFA-1-L-/d-Phe, 1-/d-2 and TFA-1-L-/d-Pro, 1-/d-20).

(5)-3-phenyl-2-(2,2,2-trifluoroacetamido)propanoic acid (TFA-1-L-Phe, 1-2).
Colorless amorphous mass. [α]_D = +13 (c 1.0, MeOH); Lit.\(^3\) [α]_D = +17.2 (c 2, Ethanol). IR (neat) ν : 3319, 3099, 3033, 2929, 1739, 1700 cm\(^{-1}\); \(^1\)H-NMR (270 MHz, CDCl₃) δ: 7.38–7.30 (3H, m, Ar-H), 7.14 (2H, d, J = 7.6 Hz, Ar-H), 6.72 (1H, br s, NH), 4.94 (1H, dd, J = 7.6, 5.6 Hz, CHNH), 3.31 (1H, dd, J = 14.2, 5.6 Hz, CH₂CH), 3.22 (1H, dd, J = 14.2, 5.6 Hz, CH₂CH) ppm. \(^{13}\)C-NMR (67.5 MHz, CDCl₃) δ: 174.2, 156.7 (q, \(^{1}J_{CF} = 38.2\) Hz), 134.2, 129.2 (2 x CH), 129.0 (2 x CH), 127.8, 115.5 (q, \(^{1}J_{CF} = 287.2\) Hz), 53.2, 36.9 ppm. HRMS-ESI (m/z) [M + H]\(^{+}\) calcd for C₁₁H₁₅F₃N₃O₂ 262.0691, found 262.0699.

(5)-3-phenyl-2-(2,2,2-trifluoroacetamido)propanoic acid (TFA-1-d-Phe, d-2).
Colorless amorphous mass. [α]_D = −13 (c 1.0, MeOH); Lit.\(^4\) [α]_D = −17.2 (c 2, Ethanol). IR (neat) ν : 3320, 3093, 3033, 2934, 1740, 1702 cm\(^{-1}\); \(^1\)H-NMR (270 MHz, CDCl₃) δ: 7.34–7.30 (3H, m, Ar-H), 7.14 (2H, d, J = 7.3 Hz, Ar-H), 6.69 (1H, br s, NH), 4.94 (1H, dd, J = 7.9, 5.8 Hz, CHNH), 3.32 (1H, dd, J = 14.2, 5.6 Hz, CH₂CH), 3.22 (1H, dd, J = 14.2, 5.6 Hz, CH₂CH) ppm. \(^{13}\)C-NMR (67.5 MHz, CDCl₃) δ: 174.6, 156.8 (q, \(^{1}J_{CF} = 38.4\) Hz), 134.2, 129.2 (2 x CH), 129.0 (2 x CH), 127.8, 115.5 (q, \(^{1}J_{CF} = 287.3\) Hz), 53.3, 36.9 ppm. HRMS-ESI (m/z) [M + H]\(^{+}\) calcd for C₁₁H₁₅F₃N₃O₂ 262.0691, found 262.0694.

(5)-1-(2,2,2-Trifluoroacetyl)pyrrolidine-2-carboxylic acid (TFA-1-L-Pro, 1-20).
Colorless amorphous mass. [α]_D = −86 (c 1.0, CHCl₃); Lit.\(^5\) [α]_D = −65.19 (c 1.08, Ph-H). IR (neat) ν : 1739, 1705 cm\(^{-1}\); \(^1\)H-NMR (270 MHz, CDCl₃) δ: 4.59 (1H, dd, J = 8.4, 3.8 Hz, CH₂CH), 3.90–3.69 (2H, m, CH₂), 2.36–1.99 (4H, m, 2 x CH₂) ppm. \(^{13}\)C-NMR (67.5 MHz, CDCl₃) δ: 176.2, 176.0, 156.1 (q, \(^{1}J_{CF} = 37.8\) Hz), 116.0 (q, \(^{1}J_{CF} = 287.0\) Hz), 60.0, 59.1 (q, J = 3.4 Hz), 48.0, 47.2 (q, J = 3.4 Hz), 31.5, 28.3, 24.8, 21.0 ppm. HRMS-ESI (m/z) [M + H]\(^{+}\) calcd for C₇H₁₀F₃N₂O₃ 212.0535, found 212.0536.

(R)-1-(2,2,2-Trifluoroacetyl)pyrrolidine-2-carboxylic acid (TFA-1-d-Pro, d-20).
Colorless amorphous mass. [α]_D = +86 (c 1.0, CHCl₃). IR (neat) ν : 1738, 1709 cm\(^{-1}\); \(^1\)H-NMR (270 MHz, CDCl₃) δ: 4.59 (1H, dd, J = 8.2, 3.6 Hz, CH₂CH), 3.87–3.67 (2H, m, CH₂), 2.37–1.96 (4H, m, 2 x CH₂) ppm. \(^{13}\)C-NMR (67.5 MHz, CDCl₃) δ: 175.9, 175.7, 156.1 (q, \(^{1}J_{CF} = 37.8\) Hz), 116.0 (q, \(^{1}J_{CF} = 286.8\) Hz), 60.0, 59.1 (q, J = 3.4 Hz), 48.0, 47.2 (q, J = 3.4 Hz), 31.5, 28.3, 24.8, 21.0 ppm. HRMS-ESI (m/z) [M + H]\(^{+}\) calcd for C₇H₁₀F₃N₂O₃ 212.0535, found 212.0555.

Triethylamine (136 mmol, 8 equiv.) was added to a solution of α-amino acid (17 mmol) in MeOH (40 mL). After 5 min, ethyl trifluoroacetate (51 mmol, 3 equiv.) was added and the reaction was allowed to stir for 7 d. The solvent was removed by rotary evaporation and the residue that remained was dissolved in H₂O and acidified with concentrated HCl. The mixture was extracted with ethyl acetate for several times and the organic layers were combined and washed with brine, dried by MgSO₄, filtered, and concentrated by rotary evaporation. Further subjection into high vacuum for overnight, if needed to solidify the product (TFA-L-/D-Tyr, L-/D-15).

(S)-3-(4-hydroxyphenyl)-2-(2,2,2-trifluoroacetamido)propanoic acid (TFA-L-Tyr, L-15).
Yellowish amorphous mass. [α]D = +26 (c 1.0, MeOH). IR (neat) ν: 3302, 3098, 2932, 1734 cm⁻¹. ¹H-NMR (270 MHz, ACETONE-D₆) δ: 8.55 (1H, br s, OH), 7.19 (2H, d, J = 8.2 Hz, Ar-H), 6.83 (2H, d, J = 8.6 Hz, Ar-H), 4.78 (1H, td, J = 8.7, 4.5 Hz, CHNH), 3.31 (1H, dd, J = 14.2, 4.6 Hz, CH₂CH), 3.08 (1H, dd, J = 14.0, 9.7 Hz, CH₂CH) ppm. ¹³C-NMR (67.5 MHz, ACETONE-D₆) δ: 171.6, 157.3 (q, ²JCF = 36.9 Hz), 157.1, 131.0 (2 x CH), 128.2, 116.8 (q, ¹JCF = 287.2 Hz), 116.0 (2 x CH), 55.0, 36.4 ppm. HRMS-ESI (m/z) [M + Na]⁺ calcd for C₁₁H₁₀F₃NO₄Na 300.0460, found 300.0444.

(R)-3-(4-hydroxyphenyl)-2-(2,2,2-trifluoroacetamido)propanoic acid (TFA-D-Tyr, D-15).
Yellowish amorphous mass. [α]D = –26 (c 1.0, MeOH). IR (neat) ν: 3295, 3098, 2932, 1732 cm⁻¹. ¹H-NMR (270 MHz, ACETONE-D₆) δ: 8.51 (1H, br s, OH), 7.15 (2H, d, J = 8.2 Hz, Ar-H), 6.80 (2H, d, J = 8.2 Hz, Ar-H), 4.78 (1H, td, J = 8.7, 4.9 Hz, CHNH), 3.29 (1H, dd, J = 14.2, 4.9 Hz, CH₂CH), 3.05 (1H, dd, J = 14.2, 9.6 Hz, CH₂CH) ppm. ¹³C-NMR (67.5 MHz, ACETONE-D₆) δ: 171.1, 157.5 (q, ²JCF = 37.1 Hz), 157.0, 131.0 (2 x CH), 128.1, 116.8 (q, ¹JCF = 287.3 Hz), 116.1 0 (2 x CH), 55.0, 36.4 ppm. HRMS-ESI (m/z) [M + Na]⁺ calcd for C₁₁H₁₀F₃NO₄Na 300.0460, found 300.0469.
SM-3 The conditions and results of Friedel–Crafts reaction of N-TFA-L-/D-phenylalanine succinimide ester derivatives (TFA-L-/D-Phe-OSu, L-/D-3) into various arenes catalyzed by AlCl₃ at room temperature.⁹

\[
\text{TFA-Phe-OSu (L-/D-3)} \xrightarrow{\text{Benzene, AlCl₃}} \text{TFA-L-/D-Phe-Ph (L-/D-4)} + \text{TFA-L-/D-Phe-Cyc (L-/D-5)}
\]

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<tr>
<th>Entry</th>
<th>Material</th>
<th>AlCl₃ (equiv.)</th>
<th>Benzene (equiv.)</th>
<th>% Yield</th>
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<td></td>
<td></td>
<td>TFA-L-/D-Phe-Ph (L-/D-4)</td>
<td>TFA-L-/D-Phe-Cyc (L-/D-5)</td>
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<tr>
<td>1</td>
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<td>150</td>
<td>37%</td>
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<tr>
<td>2</td>
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<td>12</td>
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<td>37%</td>
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<tr>
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<td>L-3</td>
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<tr>
<td>7</td>
<td>L-3</td>
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<td>–</td>
<td>–</td>
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<tr>
<td>8</td>
<td>D-3</td>
<td>12</td>
<td>–</td>
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¹Proportion was calculated by ¹H NMR in acetone-D₆. ²Utilization with 300 equivalent CH₂Cl₂.
SM-4. Optimization of TFA-L-/d-tyrosine-OSu (L-/d-16) synthesis

![Chemical structure diagram]

<table>
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<tr>
<th>Entry&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Start Material</th>
<th>NHS (equiv.)</th>
<th>WSCD-HCl (equiv.)</th>
<th>Condition</th>
<th>%Yield&lt;sup&gt;b&lt;/sup&gt;</th>
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<td>1</td>
<td>L-15&lt;sup&gt;c&lt;/sup&gt;</td>
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<td>1.0</td>
<td>2h, rt</td>
<td>66%&lt;sup&gt;g&lt;/sup&gt;</td>
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<td>2</td>
<td>D-15&lt;sup&gt;c&lt;/sup&gt;</td>
<td>1.1</td>
<td>1.0</td>
<td>2h, rt</td>
<td>70%&lt;sup&gt;g&lt;/sup&gt;</td>
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<tr>
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<td>1.0</td>
<td>2h, rt</td>
<td>66%&lt;sup&gt;g&lt;/sup&gt;</td>
</tr>
<tr>
<td>5&lt;sup&gt;b&lt;/sup&gt;</td>
<td>L-15&lt;sup&gt;d&lt;/sup&gt;</td>
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<td>1.0</td>
<td>3h, rt</td>
<td>74%</td>
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<td>1.0&lt;sup&gt;f&lt;/sup&gt;</td>
<td>2h, rt</td>
<td>70%&lt;sup&gt;g&lt;/sup&gt;</td>
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<td>D-15&lt;sup&gt;e&lt;/sup&gt;</td>
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<td>1.4</td>
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<td>68%&lt;sup&gt;g&lt;/sup&gt;</td>
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<td>10</td>
<td>D-15&lt;sup&gt;e&lt;/sup&gt;</td>
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<td>1.4</td>
<td>2h, rt</td>
<td>63%&lt;sup&gt;g&lt;/sup&gt;</td>
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<td>58%&lt;sup&gt;g&lt;/sup&gt;</td>
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<td>1.8</td>
<td>1.0</td>
<td>2h, rt</td>
<td>54%&lt;sup&gt;g&lt;/sup&gt;</td>
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</tbody>
</table>

<sup>a</sup>Solvent was removed under reduced pressure. Then, residue was dissolve in ethyl acetate and washed by sat. NaCl and NaHCO₃ 0.1M.  
<sup>b</sup>Solvent was removed under reduced pressure. Then, residue was dissolve in ethyl acetate and washed by sat. NaCl and NaHCO₃ 0.01M.  
<sup>c</sup>Conc. 0.08M in acetone.  
<sup>d</sup>Conc. 0.04M in acetone.  
<sup>e</sup>Conc. 0.06M in acetone.  
<sup>f</sup>WSCD-HCl was dissolved in CH₂Cl₂ (0.06M) before addition at 0 °C.  
<sup>g</sup>Contaminated with unidentified compounds, observed by appearance of other α-protons in ¹H-NMR (ratio 1.00 : 0.01~0.18).
SM-5. NMR Spectra

(S)-3-phenyl-2-(2,2,2-trifluoroacetamido)propanoic acid (TFA-L-Phe, l-2)

$^1$H-NMR (270 MHz, CDCl$_3$)

$^{13}$C-NMR (67.5 MHz, CDCl$_3$)
(R)-3-phenyl-2-(2,2,2-trifluoroacetamido)propanoic acid (TFA-O-Phe, O-2)

$\text{H-NMR (270 MHz, CDCl}_3\text{)}$

$\text{C-NMR (67.5 MHz, CDCl}_3\text{)}$
(S)-2,5-dioxopyrrolidin-1-yl 3-phenyl-2-(2,2,2-trifluoroacetamido)propanoate (TFA-3-Phe-OSu, 1-3)

^1H-NMR (270 MHz, CDCl₃)

^13C-NMR (67.5 MHz, CDCl₃)
(R)-2,5-dioxopyrrolidin-1-yl 3-phenyl-2-(2,2,2-trifluoroacetamido)propanoate (TFA-d-Phe-OSu, d-3)

$^1$H-NMR (270 MHz, CDCl$_3$)

$^{13}$C-NMR (67.5 MHz, CDCl$_3$)
(S)-2,2,2-trifluoro-N-(1-oxo-1,3-diphenylpropan-2-yl)acetamide (TFA-L-Phe-Ph, 1-4)

$^1$H-NMR (270 MHz, CDCl$_3$)

$^13$C-NMR (67.5 MHz, CDCl$_3$)
(R)-2,2,2-trifluoro-N-(1-oxo-1,3-diphenylpropan-2-yl)acetamide (TFA-δ-Phe-Ph, δ-4)

\[ \text{H-NMR (270 MHz, CDCl}_3 \text{)} \]

\[ \text{C-NMR (67.5 MHz, CDCl}_3 \text{)} \]
(5)-2,2,2-trifluoro-N-(1-oxo-2,3-dihydro-1H-inden-2-yl)acetamide (TFA-L-cPhe, L-5)
(R)-2,2,2-trifluoro-N-(1-oxo-2,3-dihydro-1H-inden-2-yl)acetamide (TFA-\textit{d}-cPhe, \textit{d}-5)

\[ \text{NH} \quad \text{TFA} \]

$^1$H-NMR (270 MHz, ACETONE-D$_6$)

$^{13}$C-NMR (67.5 MHz, ACETONE-D$_6$)
(S)-2,2,2-trifluoro-N-(1-oxo-3-phenyl-1-(p-tolyl)propan-2-yl)acetamide (TFA-L-Phe-Ph(4-Me), l-6)

$\text{H-NMR (270 MHz, CDCl}_3$)

$\text{C-NMR (67.5 MHz, CDCl}_3$)
(R)-2,2,2-trifluoro-N-(1-oxo-3-phenyl-1-(p-tolyl)propan-2-yl)acetamide (TFA-d-Phe-Ph(4-Me), d-6)

$^1$H-NMR (270 MHz, CDCl$_3$)

$^{13}$C-NMR (67.5 MHz, CDCl$_3$)
(S)-2,2,2-trifluoro-N-(1-(4-methoxyphenyl)-1-oxo-3-phenylpropan-2-yl)acetamide (TFA-L-Phe-Ph(4-OMe), L-7)

\[
\text{H-NMR (270 MHz, CDCl}_3\text{)}
\]

\[
\text{C-NMR (67.5 MHz, CDCl}_3\text{)}
\]
(R)-2,2,2-trifluoro-N-(1-(4-methoxyphenyl)-1-oxo-3-phenylpropan-2-yl)acetamide (TFA-d-Phe-Ph(4-OMe), d-7)

$^1$H-NMR (270 MHz, CDCl$_3$)

$^{13}$C-NMR (67.5 MHz, CDCl$_3$)
(S)-N-(1-(3,4-dimethylphenyl)-1-oxo-3-phenylpropan-2-yl)-2,2,2-trifluoroacetamide (TFA-L-Phe-Ph(3,4-Me), L-8)

\[
\text{H-NMR (270 MHz, CDCl}_3\text{)}
\]

\[
\text{C-NMR (67.5 MHz, CDCl}_3\text{)}
\]
(R)-N-(1-(3,4-dimethylphenyl)-1-oxo-3-phenylpropan-2-yl)-2,2,2-trifluoroacetamide  (TFA-\textsuperscript{-}\textsuperscript{\textalpha}-Phe-Ph(3,4-Me), d\textsuperscript{-8})

\[
\text{\includegraphics{structure.png}}
\]

\(^1\text{H-NMR} \ (270 \text{ MHz, CDCl}_3)\)

\(^{13}\text{C-NMR} \ (67.5 \text{ MHz, CDCl}_3)\)
(S)-N-(1-(2,4-dimethylphenyl)-1-oxo-3-phenylpropan-2-yl)-2,2,2-trifluoroacetamide  (TFA-L-Phe-Ph(2,4-Me), L-9)

\[
\begin{array}{c}
\text{TFA} \\
\text{NH} \\
\end{array}
\]

$^1$H-NMR (270 MHz, CDCl$_3$)

$^{13}$C-NMR (67.5 MHz, CDCl$_3$)
(R)-N-(1-(2,4-dimethylphenyl)-1-oxo-3-phenylpropan-2-yl)-2,2,2-trifluoroacetamide (TFA-α-Phe-Ph(2,4-Me), δ -9)

$^1$H-NMR (270 MHz, CDCl$_3$)

$^{13}$C-NMR (67.5 MHz, CDCl$_3$)
(S)-N-(1-(2,5-dimethylphenyl)-1-oxo-3-phenylpropan-2-yl)-2,2,2-trifluoroacetamide (TFA-L-Phe-Ph(2,5-Me), L-10)

$^1$H-NMR (270 MHz, CDCl$_3$)

$^{13}$C-NMR (67.5 MHz, CDCl$_3$)
(R)-N-(1-(2,5-dimethylphenyl)-1-oxo-3-phenylpropan-2-yl)-2,2,2-trifluoroacetamide (TFA-\textsuperscript{d}-Phe-Ph(2,5-Me), \textsuperscript{d}-10)

\[ \text{\textsuperscript{1}H-NMR (270 MHz, CDCl}_3\text{)} \]

\[ \text{\textsuperscript{13}C-NMR (67.5 MHz, CDCl}_3\text{)} \]
(S)-2,2,2-trifluoro-N-(1-oxo-3-phenyl-1-(1H-pyrrol-2-yl)propan-2-yl)acetamide (TFA-t-Phe-(2-Pyr), t-11)

\[ \text{Formula Image} \]

\[^1^H\text{-NMR (270 MHz, CDCl}_3\)]

\[^{13}C\text{-NMR (67.5 MHz, CDCl}_3\)]
(R)-2,2,2-trifluoro-N-(1-oxo-3-phenyl-1-(1H-pyrrol-2-yl)propan-2-yl)acetamide (TFA-o-Phe-(2-Pyr), δ-11)

$^1$H-NMR (270 MHz, CDCl$_3$)

$^{13}$C-NMR (67.5 MHz, CDCl$_3$)
(S)-2,2,2-trifluoro-N-(1-(1-methyl-1H-pyrrol-2-yl)-1-oxo-3-phenylpropan-2-yl)acetamide (TFA-1-Phe-(2-(N-Me)Pyr), 1-12).

$^1$H-NMR (270 MHz, CDCl$_3$)

$^1$C-NMR (67.5 MHz, CDCl$_3$)
(R)-2,2,2-trifluoro-N-(1-(1-methyl-1H-pyrrol-2-yl)-1-oxo-3-phenylpropan-2-yl)acetamide (TFA-\(\alpha\)-Phe-(2-(N-Me)Pyr), \(\alpha\)-12).

\[\text{\(1^1\)H-NMR (270 MHz, CDCl}_3\text{)}\]

\[\text{\(1^3\)C-NMR (67.5 MHz, CDCl}_3\text{)}\]
(5)-2,2,2-trifluoro-N-(1-(1-methyl-1H-pyrrol-3-yl)-1-oxo-3-phenylpropan-2-yl)acetamide (TFA-\(\alpha\)-Phe-(3-(N-Me)Pyr), \(\alpha\)-13).

\[ \text{\(\alpha\)-H-NMR (270 MHz, CDCl}_3\text{)} \]

\[ \text{\(\alpha\)-C-NMR (67.5 MHz, CDCl}_3\text{)} \]
(R)-2,2,2-trifluoro-\(N\)-(1-(1-methyl-1H-pyrrolyl-3-yl)-1-oxo-3-phenylpropan-2-yl)acetamide (TFA-t-Phe-(3-(N-Me)Pyr), t-13).

\[
\begin{align*}
\text{TFA} & \quad \text{CH}_3 \\
\text{NH} & \quad \text{O}
\end{align*}
\]

\(^1\text{H-NMR (270 MHz, CDCl}_3\))

\(^{13}\text{C-NMR (67.5 MHz, CDCl}_3\))
(S)-3-(4-hydroxyphenyl)-2-(2,2,2-trifluoroacetamido)propanoic acid (TFA-\(\text{L}^-\)-Tyr, \(\text{L}-15\)).

\[
\text{HO} \quad \text{TFA}^- \quad \text{NH} \quad \text{CO} \quad \text{OH}
\]

\(\text{H-NMR (270 MHz, ACETONE-D}_6\))

\(\text{C-NMR (67.5 MHz, ACETONE-D}_6\))
(R)-3-(4-hydroxyphenyl)-2-(2,2,2-trifluoroacetamido)propanoic acid (TFA-\(\alpha\)-Tyr, \(\alpha\)-15).
(S)-2,5-dioxopyrrolidin-1-yl 3-(4-hydroxyphenyl)-2-(2,2,2-trifluoroacetamido)propanoate (TFA-L-Tyr-OSu, l-16).

$^1$H-NMR (270 MHz, ACETONE-D$_6$)  

$^{13}$C-NMR (67.5 MHz, ACETONE-D$_6$)
(R)-2,5-dioxopyrrolidin-1-yl 3-(4-hydroxyphenyl)-2-(2,2,2-trifluoroacetamido)propanoate (TFA-\(\alpha\)-Tyr-OSu, \(\alpha\)-16).

\[
\text{HO} \quad \text{TFA}^+ \quad \text{NH}
\]

\(^1\)H-NMR (270 MHz, ACETONE-D\(_6\))

\(^{13}\)C-NMR (67.5 MHz, ACETONE-D\(_6\))
(5)-2,2,2-trifluoro-N-(3-(4-hydroxyphenyl)-1-oxo-1-phenylpropan-2-yl)acetamide (TFA-L-Tyr-Ph, 1-17).
(R)-2,2,2-trifluoro-N-(3-(4-hydroxyphenyl)-1-oxo-1-phenylpropan-2-yl)acetamide (TFA-D-Tyr-Ph, δ-17).

$^1$H-NMR (270 MHz, ACETONE-D$_6$)

$^{13}$C-NMR (67.5 MHz, ACETONE-D$_6$)
2,2,2-trifluoro-N-(2-(4-hydroxyphenyl)-1-phenylethyl)acetamide (18).

\[ \text{HO-} \quad \text{TFA-} \quad \text{NH} \]

\(^1\)H-NMR (270 MHz, ACETONE-D\(_6\))

\(^{13}\)C-NMR (67.5 MHz, ACETONE-D\(_6\))
(S)-1-(2,2,2-Trifluoroacetyl)pyrrolidine-2-carboxylic acid (TFA-1-Pro, 1-20).

\[
\text{H-NMR (270 MHz, CDCl}_3\text{)}
\]

\[
\text{C-NMR (67.5 MHz, CDCl}_3\text{)}
\]
(R)-1-(2,2,2-Trifluoroacetyl)pyrrolidine-2-carboxylic acid (TFA-ω-Pro, ω-20).

$\text{OH}$

TFA

$^{1}H$-NMR (270 MHz, CDCl$_3$)

$^{13}C$-NMR (67.5 MHz, CDCl$_3$)

38
(5)-2,5-dioxopyrrolidin-1-yl 1-(2,2,2-trifluoroacetyl)pyrroldine-2-carboxylate (TFA-1-Pro-OSu, 1-21).

\[
\begin{align*}
\text{\textsuperscript{1}H-NMR (270 MHz, CDCl}_3) \\
\text{\textsuperscript{13}C-NMR (67.5 MHz, CDCl}_3)
\end{align*}
\]
(R)-2,5-dioxopyrrolidin-1-yl 1-(2,2,2-trifluoroacetyl)pyrrolidine-2-carboxylate (TFA- d-Pro-OSu, n-21).

$^1$H-NMR (270 MHz, CDCl$_3$)

$^{13}$C-NMR (67.5 MHz, CDCl$_3$)
\((S)\)-1-(2-benzoylpyrrolidin-1-yl)-2,2,2-trifluoroethanone (TFA-L-Pro-Ph, t-22).

\[
\begin{array}{c}
\text{TFA} \\
\text{\textbullet} \\
\text{O} \\
\text{\textbullet} \\
\text{\textbullet} \\
\text{\textbullet} \\
\text{\textbullet} \\
\text{\textbullet} \\
\text{\textbullet} \\
\text{\textbullet} \\
\text{\textbullet} \\
\end{array}
\]

\(^1\)H-NMR (270 MHz, CDCl\(_3\))

\(^1\)C-NMR (67.5 MHz, CDCl\(_3\))
(R)-1-(2-benzoylpyrrolidin-1-yl)-2,2,2-trifluoroethanone (TFA-t-Pro-Ph, t-22).

$^1$H-NMR (270 MHz, CDCl$_3$)

$^{13}$C-NMR (67.5 MHz, CDCl$_3$)
SM-6. NMR Spectra of Acetyl-Protected-L-Proline

$^1$H-NMR (270 MHz, CDCl$_3$)

$^{13}$C-NMR (67.5 MHz, CDCl$_3$)