Supporting Information

Boric acid catalyzed Ugi three-component reaction in aqueous media

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General: All the reagents and solvents were purchased from Sigma-Aldrich or Merck chemical Co. Column chromatography was performed using Spectrochem silica gel (100-200). Organic solvents were concentrated under reduced pressure on Ika rotary evaporator. The progress of reaction was checked by thin-layer chromatography. The plates were visualized first with UV illumination followed by iodine. $^1$H and $^{13}$C NMR spectra were obtained using either a Bruker DRX-200 or AV-300 spectrometer. Chemical shifts are reported in ppm from tetramethylsilane with the solvent resonance as the internal standard and $^1$H NMR Spectra are reported in the order: multiplicity, coupling constant (J value) in hertz (Hz) and no of protons; signals were characterized as s (singlet), d (doublet), t (triplet), m (multiplet). $^{13}$C NMR spectra were recorded at 50 or 75 MHz. Mass spectra were obtained using JEOL SX-102 (ESI) instrument. Elemental analysis was performed using a Perkin-Elmer Autosystem XL Analyzer.

General experiment procedure for the synthesis of 2-arylamino-2-phenylacetamide (4)

Aniline (1 mmol), Aldehyde (1 mmol), Isocyanide (1 mmol) and Boric acid (10 mol %) were placed into a 50 mL flask and (5 mL) water was added to the mixture and stirred for 1h at room temperature for an appropriate time given in Table 3 and the progress of the reaction was monitored by TLC. After completion of the reaction, the reaction mixture was extracted with ethyl acetate. The solvent was evaporated to yield a crude residue, which upon purification via silica gel column chromatography using EtOAc/Hexane gave pure products.

General procedure for the synthesis of α-Amino Acid (5)

In a 25 mL round-bottom flask, 2-arylamino-2-phenylacetamide 4 (1 mmol) in 6N HCl (20 mL) was heated at 100 ºC for 24 h, cooled at room temperature than extracted with ethyl acetate/water and apply column chromatography to yield compound.
Table 4. Synthesis of α-Amino acid by acidic hydrolysis of 2-arylamino-2-phenylacetamide.

| Entry | R¹ | R² | R³ | Prod. | Time (h) | Yield (%)
<table>
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<tr>
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<tr>
<td>4a</td>
<td>H</td>
<td>H</td>
<td>tBuNC</td>
<td>5a</td>
<td>22</td>
<td>70</td>
</tr>
<tr>
<td>4b</td>
<td>4-OMe</td>
<td>4-Cl</td>
<td>cHex</td>
<td>5b</td>
<td>20</td>
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<td>4-OMe</td>
<td>4-Cl</td>
<td>tBuNC</td>
<td>5b</td>
<td>21</td>
<td>72</td>
</tr>
<tr>
<td>4d</td>
<td>2,4-diMe</td>
<td>H</td>
<td>cHex</td>
<td>5c</td>
<td>22</td>
<td>69</td>
</tr>
</tbody>
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*Reaction Conditions: 2-arylamino-2-phenylacetamide 4 in 6N HCl at 100 °C for a given time.*

*Isolated Yield.

Characterization data for synthesized compounds:

**N-tert-butyl-2-phenyl-2-(phenylamino)acetamide (4a)**

White solid, ESI MS (m/z) = 283 (M+H). ¹H NMR (300 MHz; CDCl₃) δH : 1.49 (s, 9H), 4.49 (s, 1H, NH), 6.06 (s, 1H, NH), 6.57 (d, J = 5.7 Hz, 2H), 6.66 (t, J = 5.5 Hz, 1H), 6.98 (d, J = 3.7 Hz, 2H), 7.14 (t, J = 5.8 Hz, 2H), 7.28 (m, 3H). ¹³C NMR (75 MHz; CDCl₃) δC : 29.0, 49.6, 63.3, 112.7, 118.4, 127.4, 127.8, 127.8, 128.0, 128.8, 128.9, 139.2, 145.8, 169.7. Analysis calculated for: C₁₈H₂₂N₂O: C 76.56, H 7.85, N 9.92, Found : C 76.42, H 7.97, N 9.81.

**2-(4-Chlorophenyl)-N-cyclohexyl-2-(4-methoxyphenylamino)acetamide (4b)**

White solid, ESI MS (m/z) = 373 (M+H). ¹H NMR (300 MHz; CDCl₃) δH : 1.13-1.28 (m, 5H), 1.45 (t, J = 4.31 Hz, 3H), 1.65 (t, J = 10.6 Hz, 2H), 3.39-3.61 (m, 1H), 3.67 (s, 3H, OCH₃), 4.13 (s, 1H, NH), 4.43 (s, 1H, CH), 6.03 (s, 1H, NH), 6.76 (q, J = 6.6 Hz, 4H), 7.06 (d, J = 6.2 Hz, 2H), 7.16 (d, J = 6.3 Hz, 2H). ¹³C NMR (75 MHz; CDCl₃) δC : 25.2, 26.3, 32.8, 49.6, 55.3, 61.6, 114.1, 115.1, 128.6, 129.0, 131.3, 135.8, 140.9, 153.8, 169.5. Analysis calculated for: C₂₁H₂₅ClN₂O₂: C 67.64, H 6.76, N 7.51, Found : C 67.77, H 6.52, N 7.40.
N-tert-butyl-2-(4-chlorophenyl)-2-(4-methoxyphenylamino)acetamide (4c)

White solid, mp 126-128 °C ESI MS (m/z) = 347 (M+H), $^1$H NMR (300 MHz; CDCl$_3$) δ$_H$: 1.49 (s, 9H), 3.67 (s, 3H, OCH$_3$), 4.45 (s, 1H, NH), 6.06 (s, 1H, NH), 6.74 (dd, $J$ = 6.6, 6.6 Hz, 4H), 7.06 (dd, $J$ = 6.4, 6.3 Hz, 4H). $^{13}$C NMR (75MHz; CDCl$_3$) δ$_C$: 28.9, 49.6, 55.3, 63.1, 114.1, 114.5, 128.3, 128.5, 133.1, 137.0, 140.6, 153.8, 168.8. Analysis calculated for: C$_{19}$H$_{23}$ClN$_2$O$_2$, C 65.79, H 6.68, N 8.08. Found: C 65.86, H 6.78, N 7.98.

N-cyclohexyl-2-(2,4-dimethylphenylamino)-2-phenylacetamide (4d)

Yellow solid, ESI MS (m/z) = 337 (M+H), $^1$H NMR (300 MHz; CDCl$_3$) δ$_H$: 1.18-1.47 (m, 6H), 1.68 (d, $J$ = 16.8 Hz, 4H), 2.28 (s, 6H, CH$_3$), 3.59-3.79 (m, 1H), 4.07 (s, 1H, NH), 4.53 (s, 1H, CH), 6.03 (s, 1H, NH), 6.35 (d, $J$ =3.4 Hz, 1H), 6.76 (s, 1H), 6.84 (d, $J$ = 6.09 Hz, 1H), 7.01 (d, $J$ = 4.71 Hz, 2H), 7.32 (t, $J$ = 5.52 Hz, 3H). $^{13}$C NMR (75 MHz; CDCl$_3$) δ$_C$: 18.3, 20.5, 25.2, 26.3, 32.8, 49.8, 62.4, 113.2, 122.4, 127.7, 127.8, 128.0, 128.9, 130.8, 132.0, 139.1, 142.6, 170.2. Analysis calculated for: C$_{22}$H$_{28}$N$_2$O, C 78.53, H 8.39, N 8.33. Found: C 78.68, H 8.47, N 8.21.

N-tert-butyl-2-(4-chlorophenylamino)-2-phenylacetamide (4e)

White solid, ESI MS (m/z) = 351 (M+H), $^1$H NMR (300 MHz; CDCl$_3$) δ$_H$: 1.48 (s, 9H), 4.45 (s, 1H, NH), 4.98 (s, 1H, CH), 6.06 (s, 1H, NH), 6.55 (d, $J$ = 5.6 Hz, 2H), 7.06-7.16 (m, 6H), $^{13}$C NMR (75 MHz; CDCl$_3$) δ$_C$: 29.0, 49.6, 63.4, 113.8, 123.9, 128.3, 128.5, 128.9, 129.3, 133.1, 137.0, 144.3, 168.8. Analysis calculated for: C$_{18}$H$_{20}$ClN$_2$O, C 61.55, H 5.74, N 7.97. Found: C 61.46, H 5.82, N 7.88.

N-tert-butyl-2-(4-chlorophenylamino)-2-phenylacetamide (4f)

White solid, ESI MS (m/z) = 317 (M+H), $^1$H NMR (300 MHz; CDCl$_3$) δ$_H$: 1.49 (s, 9H), 4.19 (s, 1H, NH), 4.73 (s, 1H, CH), 6.08 (s, 1H, NH), 6.56 (d, $J$ = 5.6 Hz, 2H), 7.01 (d, $J$ = 3.6 Hz, 2H), 7.14 (d, $J$ = 5.9 Hz, 2H), 7.28-7.34 (m, 3H), $^{13}$C NMR (75 MHz; CDCl$_3$) δ$_C$: 28.8, 49.6, 63.8, 113.5, 123.9, 127.4, 127.7, 127.8, 128.0, 128.9, 129.3, 139.0, 144.5, 169.3. Analysis calculated for: C$_{18}$H$_{22}$ClN$_2$O, C 68.24, H 6.68, N 8.84. Found: C 68.14, H 6.76, N 8.96.
2-(4-Bromophenyl)-N-tert-butyl-2-(4-methoxyphenylamino)acetamide (4g)

White solid, ESI MS (m/z) = 391 (M+H), $^1$H NMR (300 MHz; CDCl₃) δH: 1.48 (s, 9H), 3.67 (s, 3H, OCH₃), 4.59 (s, 1H, NH), 4.85 (s, 1H, CH), 6.09 (s, 1H, NH), 6.74-6.83 (m, 4H), 6.90 (d, J = 6.3 Hz, 2H), 7.47 (d, J = 6.1 Hz, 2H), $^{13}$C NMR (50 MHz; CDCl₃) δC : 29.1, 49.6, 55.3, 63.6, 114.2, 114.5, 121.8, 128.7, 131.6, 137.7, 140.6, 153.8, 169.8. Analysis calculated for: C₁₉H₂₃BrN₂O₂, C 58.32, H 5.92, N 7.16, Found : C 58.21, H 6.02, N 7.28.

2-(4-Chlorophenyl)-N-cyclohexyl-2-(3-methoxyphenylamino)acetamide (4h)

White solid, ESI MS (m/z) = 373 (M+H), $^1$H NMR (300 MHz; CDCl₃) δH: 1.10 - 1.39 (m, 5H), 1.35 (t, J = 4.3 Hz, 3H), 1.65 (t, J = 7.2 Hz, 2H), 3.39-3.60 (m, 1H), 3.67 (s, 3H, OCH₃), 4.50 (s, 1H, NH), 5.01 (s, 1H, CH), 6.03 (s, 1H, NH), 6.78 (d, J = 8.7 Hz, 4H), 7.01 (d, J = 5.4 Hz, 1H), 7.33 (d, J = 5.6 Hz, 3H), $^{13}$C NMR (50 MHz; CDCl₃) δC : 25.2, 26.3, 32.8, 49.7, 55.4, 61.3, 101.1, 104.3, 106.1, 128.6, 129.4, 133.1, 135.8, 147.3, 159.6, 169.8. Analysis calculated for : C₂₁H₂₅ClN₂O₂, C 67.64, H 6.76, N 7.51, Found : C 67.77, H 6.84, N 7.41.

N-cyclohexyl-2-(4-methoxyphenylamino)-2-phenylacetamide (4i)

White solid, MS (m/z) = 339 (M+H), $^1$H NMR (300 MHz; CDCl₃) δH : 1.27-1.61 (m, 7H), 1.65 (t, J = 11.7 Hz, 3H), 3.41-3.61 (m, 1H), 3.69 (s, 3H, OCH₃), 4.39 (s, 1H, NH), 4.73 (s, 1H, CH), 6.03 (s, 1H, NH), 6.76-6.83 (m, 4H), 6.98 (d, J = 4.5 Hz, 2H), 7.32 (d, J = 5.3 Hz, 3H), $^{13}$C NMR (50 MHz; CDCl₃) δC : 25.3, 26.4, 32.7, 49.8, 55.2, 62.5, 114.2, 115.2, 128.0, 128.1, 128.3, 128.6, 128.8, 138.3, 141.3, 153.8, 169.9. Analysis calculated for: C₂₁H₂₆N₂O₂, C 74.52, H 7.74, N 8.28, Found : C 74.60, H 7.67, N 8.36.

N-tert-butyl-2-(4-chlorophenyl)-2-(2,4-dimethylphenylamino)acetamide (4j)

Yellow solid, MS (m/z) = 345 (M+H), $^1$H NMR (300 MHz; CDCl₃) δH : 1.51 (s, 9H), 2.28 (s, 6H, CH₃), 4.23 (s, 1H, NH), 4.98 (s, 1H, CH), 6.06 (s, 1H, NH), 6.33 (d, J = 7.8 Hz, 1H), 6.76 (s, 1H), 6.84 (d, J = 9.27 Hz, 1H), 7.07-7.14 (m, 4H), $^{13}$C NMR (75 MHz; CDCl₃) δC : 18.5, 20.5, 29.0, 49.5, 63.7, 112.9, 122.8, 127.8, 128.2, 130.8, 132.0, 133.1, 137.5, 141.7, 169.1. Analysis calculated for : C₂₀H₂₅ClN₂O, C 69.65, H 7.31, N 8.12, Found : C 69.77, H 7.21, N 8.11.
**N-tert-butyl-2-(3,5-dimethoxyphenyl)-2-(phenylamino)acetamide (4k)**

White solid, MS \( (m/z) = 343 \) (M+H), \(^1\)H NMR (300 MHz; CDCl\(_3\)) \( \delta H : 1.48 \) (s, 9H), 3.75, (s, 3H, OCH\(_3\)), 3.80 (s, 3H, OCH\(_3\)), 4.40 (s, 1H, NH), 4.95 (s, 1H, CH), 6.06 (s, 1H, NH), 6.29 (s, 2H), 6.47 (d, \( J = 1.4 \) Hz, 1H), 6.57 (d, \( J = 5.6 \) Hz, 2H), 6.66 (t, \( J = 4.5 \) Hz, 1H), 7.14 (t, \( J = 5.2 \) Hz, 2H). \(^1^3\)C NMR (50 MHz; CDCl\(_3\)) \( \delta C \) : 29.0, 49.3, 55.2, 63.4, 99.5, 104.8, 112.2, 118.4, 128.8, 143.1, 146.1, 161.5, 168.8. Analysis calculated for : C\(_{20}\)H\(_{26}\)N\(_2\)O\(_3\), C 70.15, H 7.65, N 8.18, Found : C 70.28, H 7.52, N 8.28.

**N-cyclohexyl-2-(3,5-dimethoxyphenyl)-2-(phenylamino)acetamide (4l)**

White solid, MS \( (m/z) = 369 \) (M+H), \(^1\)H NMR (300 MHz; CDCl\(_3\)) \( \delta H : 1.29-1.49 \) (m, 5H), 1.50-1.71 (m, 5H), 3.40-3.59 (m, 1H), 3.74, (s, 3H, OCH\(_3\)), 3.79 (s, 3H, OCH\(_3\)), 4.76 (s, 1H, NH), 5.05 (s, 1H, CH), 5.83 (s, 1H, NH), 6.29 (s, 2H), 6.47 (d, \( J = 1.4 \) Hz, 1H), 6.59-6.70 (m, 3H), 7.14 (t, \( J = 4.6 \) Hz, 2H). \(^1^3\)C NMR (75 MHz; CDCl\(_3\)) \( \delta C \) : 25.2, 26.3, 32.8, 50.0, 55.2, 99.5, 104.7, 112.7, 118.4, 128.8, 142.5, 146.7, 161.2, 169.1. Analysis calculated for : C\(_{22}\)H\(_{28}\)N\(_2\)O\(_3\), C 71.71, H 7.66, N 7.60, Found : C 71.62, H 7.76, N 7.51.

**2-(4-Bromophenyl)-N-tert-butyl-2-(3-methoxyphenylamino)acetamide (4m)**

White solid, MS \( (m/z) = 391 \) (M+H), \(^1\)H NMR (300 MHz; CDCl\(_3\)) \( \delta H : 1.49 \) (s, 9H), 3.67, (s, 3H, OCH\(_3\)), 4.39 (s, 1H, NH), 4.93 (s, 1H, CH), 5.78 (s, 1H, NH), 6.74 (dd, \( J = 6.3, 6.3 \) Hz, 4H), 6.97 (d, \( J = 5.1 \) Hz, 1H), 7.19 (t, \( J = 4.6 \) Hz, 2H), 7.43 (d, \( J = 5.8 \) Hz, 1H). \(^1^3\)C NMR (50 MHz; CDCl\(_3\)) \( \delta C \) : 28.9, 49.4, 55.3, 62.1, 114.1, 114.3, 121.4, 126.6, 130.0, 130.1, 141.7, 141.8, 159.8, 168.5. Analysis calculated for : C\(_{19}\)H\(_{23}\)BrN\(_2\)O\(_2\), C 58.32, H 5.92, N 7.16, Found : C 58.42, H 5.81, N 7.27.

**N-tert-butyl-2-(4-fluorophenylamino)-2-(4-methoxyphenyl)acetamide (4n)**

White solid, MS \( (m/z) = 331 \) (M+H), \(^1\)H NMR (300 MHz; CDCl\(_3\)) \( \delta H : 1.49 \) (s, 9H), 3.76, (s, 3H, OCH\(_3\)), 4.50 (s, 1H, NH), 4.92 (s, 1H, CH), 5.96, (s, 1H, NH), 6.47 (s, 2H), 6.82 (m, 4H), 7.07 (t, \( J = 6.3 \) Hz, 2H). \(^1^3\)C NMR (50 MHz; CDCl\(_3\)) \( \delta C \) : 29.0, 49.6, 55.1, 64.6, 113.8, 114.3, 114.4, 115.4, 115.6, 128.3, 129.7, 134.3, 141.2, 141.3, 153.2, 160.8, 169.4. Analysis calculated for : C\(_{19}\)H\(_{23}\)F\(_2\)N\(_2\)O\(_2\), C 69.07, H 7.02, N 8.48, Found : C 68.98, H 6.98, N 8.55.
**2-(4-Bromophenyl)-N-tert-butyl-2-(phenylamino)acetamide (4o)**

Pale Yellow solid, MS (m/z) = 361 (M+H), $^1$H NMR (300 MHz; CDCl$_3$) δ$_H$: 1.50 (s, 9H), 4.50 (s, 1H, NH), 4.69 (s, 1H, CH), 6.06 (s, 1H, NH), 6.57 (d, $J = 5.6$ Hz, 2H), 6.66 (t, $J = 5.4$ Hz, 1H), 6.90 (d, $J = 6.4$ Hz, 2H), 7.14 (t, $J = 5.5$ Hz, 2H), 7.46 (d, $J = 6.4$ Hz, 2H). $^{13}$C NMR (50 MHz; CDCl$_3$) δ$_C$: 29.1, 49.6, 63.3, 112.7, 118.4, 121.8, 128.7, 128.8, 131.6, 137.7, 145.5, 169.5. Analysis calculated for: C$_{18}$H$_{21}$BrN$_2$O, C 59.84, H 5.86, N 7.75, Found: C 59.96, H 5.75, N 7.67.

**2-Phenyl-2-(phenylamino)acetic acid (5a)**

White solid, ESI MS (m/z) = 228 (M+H). $^1$H NMR (300 MHz DMSO) δ$_H$: 4.33 (s, 1H, NH), 4.92 (s, 1H, CH), 6.29 (d, $J = 5.7$ Hz, 2H), 6.69 (t, $J = 1.0$ Hz, 1H), 7.14 (t, $J = 5.7$ Hz, 2H), 7.30-7.35 (m, 5H), 8.35 (s, 1H). $^{13}$C NMR (75 MHz, DMSO) δ$_C$: 60.3, 114.2, 118.4, 127.19, 127.7, 128.1, 128.9, 129.3, 136.5, 145.8, 169.4. Analysis calculated for: C$_{14}$H$_{13}$NO$_2$, C 73.99, H 5.77, N 6.16, Found: C 74.09, H 5.62, N 6.25.

**2-(4-Chlorophenyl)-2-(4-methoxyphenylamino)acetic acid (5b)**

White Solid, ESI MS (m/z) = 292 (M+H). $^1$H NMR (300 MHz, DMSO) δ$_H$: 3.67 (s, 3H, OCH$_3$), 4.48 (s, 1H, NH), 4.80 (s, 1H, CH), 6.51 (d, $J = 6.5$ Hz, 2H), 6.80 (d, $J = 6.5$ Hz, 2H), 7.26 (d, $J = 6.4$ Hz, 2H), 7.42 (d, $J = 6.4$ Hz, 2H), 8.30 (s, 1H). $^{13}$C NMR (50 MHz, DMSO) δ$_C$: 55.3, 59.6, 115.3, 116.1, 128.5, 128.8, 129.2, 130.3, 133.6, 135.7, 141.4, 153.8, 170.3. Analysis calculated for: C$_{15}$H$_{14}$ClNO$_3$, C 61.76, H 4.84, N 4.80, Found: C 61.85, H 4.73, N 4.93.

**2-(2,4-Dimethylphenylamino)-2-phenylacetic acid (5c)**

White solid, ESI MS (m/z) = 256 (M+H). $^1$H NMR (300 MHz, DMSO) δ$_H$: 2.25 (s, 6H, CH$_3$), 4.30 (s, 1H, NH), 4.90 (s, 1H, CH), 6.04 (d, $J = 6.0$ Hz, 1H), 6.76 (s, 1H), 6.84 (d, $J = 6.0$ Hz, 1H), 7.30-7.35 (m, 5H), 8.35 (s, 1H). $^{13}$C NMR (50 MHz, DMSO) δ$_C$: 18.2, 20.5, 60.7, 113.8, 121.7, 127.9, 128.1, 128.8, 129.0, 130.8, 132.7, 137.94, 142.8, 168.7. Analysis calculated for: C$_{16}$H$_{17}$NO$_2$, C 75.27, H 6.71, N 5.49, Found: C 75.37, H 6.62, N 5.58.
Fig. (4a)
Fig. (4b)
Fig. (4c)
Fig. (4d)
Fig. (4e)
Fig. (4f)
Fig. (4h)
Fig. (4i)
Fig. (4j)
Fig. (4l)
Fig. (4m)
Fig. (4n)
Fig. (4o)
Fig. (5a)