Supporting Information for

Enzymatic \( C(sp^3) \)–H amination: P450-catalyzed conversion of carbonazidates into oxazolidinones

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Table S1. Amino acid mutations in the P450\textsubscript{BM3} variants investigated in this study.

| P450\textsubscript{BM3} variants | Amino acid mutations compared to wild-type P450\textsubscript{BM3} |
|---------------------------------|---------------------------------------------------------------|
| P450\textsubscript{BM3}        | -                                                             |
| FL#62                          | V78A, F81S, A82V, F87A, P142S, T175I, A180T, A184V, A197V, F205C, S226R, H236Q, E252G, R255S, A290V, L353V |
| FL#62(T268A)                   | V78A, F81S, A82V, F87A, P142S, T175I, A180T, A184V, A197V, F205C, S226R, H236Q, E252G, R255S, T268A, A290V, L353V |
| I-A1                           | V78A, F81T, F87A, P142S, T175I, A180T, A184V, A197V, F205C, S226R, H236Q, E252G, R255S, A290V, L353V |
| I-B1                           | V78A, F81R, A82F, F87A, P142S, T175I, A180T, A184V, A197V, F205C, S226R, H236Q, E252G, R255S, A290V, L353V |
| I-B3                           | V78F, F81R, F87V, P142S, T175I, A180T, A184V, A197V, F205C, S226R, H236Q, E252G, R255S, A290V, L353V |
| I-G1                           | V78A, A82T, P142S, T175I, A180T, A184H, A197V, F205C, S226R, H236Q, E252G, R255S, A290V, L353V |
| IV-F8                          | F81T, F87T, P142S, T175I, A180T, A184V, A197V, F205C, S226R, H236Q, E252G, R255S, A290V, L353V |
| V-D11                          | V78Y, F81P, A82A, F87A, P142S, T175I, A184V, A197V, F205C, S226R, H236Q, E252G, R255S, A328V, L353V |
| V-H2                           | V78S, F81I, F87A, P142S, T175I, A180T, A184V, A197V, F205C, S226R, H236Q, E252G, R255S, A290V, L353V |
Figure S1. A) Chemical structures of the five probes used for high-throughput fingerprinting of the engineered CYP102A1 libraries.\textsuperscript{1,2} Probe P1 and P2 activity were used as predictor for C—H amination activity on carbonazidates 23 and 24, respectively. B) Fingerprint profiles for the FL#62-derived P450 variants described in Figure 1. Fingerprints are normalized to the probe activity of reference enzyme P450BM3(F87A). Standard deviation for normalized activity values are <15%.
**Figure S2.** Representative HPLC traces for analysis of the C—H amination reactions. Overlay plot of the HPLC chromatogram corresponding to the reaction with FL#62 and carbonazidate 4 (blue), control reaction with no enzyme (red), and authentic oxazolidinone 5 standard prepared synthetically (see Synthetic Procedures). Carbamate and alcohol products elute at 13-14 min.
Figure S3. Cis/trans rearrangement. A) Overlay plot of HPLC traces corresponding to the cis and trans oxazolidinones (Z)-21 and (E)-21 injected alone (blue and red, respectively) and as a 1:2 mixture (black) and the trace corresponding to the reaction of FL#62 with (Z)-12 (brown). B) GC traces corresponding to the 1:2 mixture of authentic (Z)-21 and (E)-21 products (top panel) and to the reaction of FL#62 with (Z)-12 (bottom panel).
**Figure S4.** Calibration curves used for the quantification of the oxazolidinone products by HPLC. The graphs report the HPLC peak areas corresponding to the oxazolidinone product plotted against the oxazolidinone concentration.

\[
y = 4709.3x + 91457
\]

\[R^2 = 0.998\]

\[
y = 6365.3x + 209898
\]

\[R^2 = 0.9856\]

\[
y = 7200.9x + 173164
\]

\[R^2 = 0.9992\]
The graphs show the relationship between peak area and the concentration of different products. The equations and correlation coefficients are as follows:

For the first graph:
- Equation: $y = 15241x + 9242.6$
- $R^2 = 0.9941$

For the second graph:
- Equation: $y = 9567.9x + 462098$
- $R^2 = 0.9987$

For the third graph:
- Equation: $y = 17771x + 167886$
- $R^2 = 0.9954$
\[ y = 8371.4x + 50073 \quad R^2 = 0.9992 \]

\[ y = 17673x + 397841 \quad R^2 = 0.9887 \]

\[ y = 6222.1x + 128171 \quad R^2 = 0.9967 \]
Figure S5. GC-MS traces for oxazolidinone products 20 and D-20 as obtained for the authentic standards (a, b) and from the inter- and intermolecular H/D competition experiments. KIE values were obtained from integration of the MS signals corresponding to the characteristic fragmentation products with m/z of 105 (for 20) and 106 (for D-20).

a) GC-MS trace and EI-MS spectrum for authentic standard 20.

b) GC-MS trace and EI-MS spectrum for authentic standard D-20.
c) EI-MS spectrum for a 1:1 mixture of 20 and D-20.

![EI-MS spectrum for a 1:1 mixture of 20 and D-20.]

d) EI-MS spectrum for oxazolidinone products obtained from intermolecular competition experiment.

![EI-MS spectrum for oxazolidinone products obtained from intermolecular competition experiment.]

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e) EI-MS spectrum for oxazolidinone products obtained from intramolecular competition experiment.
Synthetic Procedures

General information

All the chemicals and reagents were purchased from commercial suppliers (Sigma-Aldrich, AK Scientific, Acros) and used without any further purification, unless otherwise stated. All dry reactions were carried out under argon or nitrogen in oven-dried glassware with magnetic stirring using standard gas-light syringes, cannulae and septa. \(^1\)H and \(^13\)C NMR spectra were measured on Bruker DPX-400 (operating at 400 MHz for \(^1\)H and 100 MHz for \(^13\)C) or Bruker DPX-500 (operating at 500 MHz for \(^1\)H and 125 MHz for \(^13\)C). Tetramethylsilane (TMS) served as the internal standard (0 ppm) for \(^1\)H NMR and CDCl\(_3\) was used as the internal standard (77.0 ppm) for \(^13\)C NMR. Silica gel chromatography purifications were carried out using AMD Silica Gel 60 230-400 mesh.

A. Synthesis of acyloxycarbamate substrates

2-phenylpropyl hydroxycarbamate (61)

To flame dried 100 mL round bottom was added 2-phenylpropan-1-ol (1.03 mL, 7.3 mM), 1,1’-carbonyldiimidazole (1.31 g, 8.1 mM), and 15 mL dry CH\(_2\)Cl\(_2\). Reaction was allowed to stir under inert atmosphere until starting material was consumed (45 min). Reaction was washed twice with 15 mL of saturated NH\(_4\)Cl followed by once with 15 mL brine. Organics were dried over sodium sulfate and concentrated under reduced pressure. The resulting product was immediately carried on with addition of 24 mL of pyridine and hydroxylamine hydrochloride (1.52 g, 22 mM). After 3 h, 60 mL of CH\(_2\)Cl\(_2\) was added and the organics were washed twice with 100 mL 10% aqueous sulfuric acid and once with 100 mL brine. The combined organic layers were dried over sodium sulfate, concentrated under reduced pressure, and the product was purified by column chromatography (30% EtOAc in hexane) to afford 2-phenylpropyl hydroxycarbamate 61 (0.63 g, 44%). \(^1\)H NMR (500 MHz, CDCl\(_3\)):\(\delta\) 1.30 (d, 3H, \(J = 7.0\) Hz), 3.07-3.15 (m, 1H), 4.20-4.29 (m, 2H), 7.19-7.25 (m, 3 H), 7.31 (t, 2H, \(J = 7.1\) Hz); \(^13\)C NMR (125 MHz, CDCl\(_3\)): \(\delta\) 17.9, 39.1, 70.9, 126.8, 127.3, 128.6, 142.8, 159.7.LC-MS (ESI) calculated for C\(_{10}\)H\(_{13}\)NO\(_3\) [M+Na]\(^+\) \(m/z\): 218.1; found: 218.1
2-phenylpropyl acetoxycarbamate (1)

To a flame dried 10 mL round bottom flask at 0°C under inert atmosphere was added 2-phenylpropyl hydroxycarbamate 61 (91 mg, 0.47 mM), acetyl chloride (30 μL, 0.42 mM), 4-(dimethylamino) pyridine (11 mg, 0.10 mM), 2 mL dry CH₂Cl₂, and 1 mL triethylamine. Reaction was stirred at 0 °C for five minutes before being allowed to warm to room temperature. After 12 h, 10 mL of saturated aqueous sodium bicarbonate was added and reaction was extracted three times with 10 mL of CH₂Cl₂. Combined organics were washed with brine, dried over sodium sulfate, and the residue was purified by flash column chromatography (5-30% ethyl acetate in hexanes) to afford 2-phenylpropyl acetoxycarbamate (1) (42.3 mg, 38%). δ¹H NMR (500 MHz, CDCl₃): δ 1.31 (d, 3H, J = 7.0 Hz), 2.15 (s, 3H), 3.09-3.17 (m, 1H), 4.28 (d, 2H, J = 7.0 Hz), 7.20-7.28 (m, 3H), 7.32 (t, 2H, J = 7.8 Hz), 8.11 (s, 1H); ¹³C NMR (125 MHz, CDCl₃): δ 17.9, 18.3, 39.0, 71.3, 126.9, 127.3, 128.6, 142.6, 156.5, 169.8; LC-MS (ESI) calculated for C₁₂H₁₅ NO₄ [M+Na]⁺ m/z: 260.2; found: 260.2.

2-phenylpropyl (4-nitrophenoxy)carbamate (2)

To a flame dried 10 mL round bottom flask at 0 °C under inert atmosphere was added 2-phenylpropyl hydroxycarbamate 61 (93.8 mg, 0.48 mM), 4-nitrochlorobenzene (76 mg, 0.48 mM), potassium carbonate (138 mg, 1 mM), and 5 mL dry dimethylformamide. Reaction was stirred for 5 minutes at 0 °C before being allowed to warm to room temperature for 12 h. Water (10 mL) was added and reaction was extracted three times with 10 mL CH₂Cl₂. Combined organics were washed with brine, dried over sodium sulfate, and the residue was purified by flash column chromatography (5-30% EtOAc in hexane) to afford 2-phenylpropyl (4-nitrophenoxy)carbamate (2) (37 mg, 24%). δ¹H NMR (500 MHz, CDCl₃): δ 1.28 (d, 3H, J = 7.0 Hz), 3.12 (q, 1H, J = 6.9 Hz), 4.28-4.38 (m, 2H), 7.12 (d, 2H, J = 9.2 Hz), 7.16 (d, 2H, J = 7.3 Hz), 7.21-7.31 (m, 3 H), 7.81 (bs, 1H), 8.18 (d, 2H, J = 9.0 Hz; ¹³C NMR (125 MHz, CDCl₃): δ 17.8, 39.0, 71.5, 113.5, 125.8, 126.9, 127.3, 128.6, 142.3, 143.2, 157.1, 164.3; LC-MS (ESI) calculated for C₁₆H₁₆ N₂O₅ [M+H]⁺ m/z: 317.2; found: 317.2.
O-(2,4-dinitrophenyl)hydroxylamine (28)

![Image of O-(2,4-dinitrophenyl)hydroxylamine]

This compound was prepared following a reported procedure.\(^3\) \(^1\)H NMR (500 MHz, CDCl\(_3\)): \(\delta\) 6.39 (s, 2H), 8.06 (d, 1H, \(J = 9.5\) Hz), 9.45 (dd, 1H, \(J_1 = 2.5, J_2 = 9.4\) Hz), 8.82 (d, 1H, \(J = 2.6\) Hz); \(^1\)C NMR (125 MHz, CDCl\(_3\)): 116.4, 122.0, 129.3, 136.5, 140.7, 159.6; LC-MS (ESI, Neg) calculated for C\(_{16}\)H\(_{16}\)N\(_2\)O\(_5\) [M-H]\(^-\) m/z: 198.2; found: 198.2.

2-phenylpropyl (2,4-dinitrophenoxy)carbamate (3)

![Image of 2-phenylpropyl (2,4-dinitrophenoxy)carbamate]

To a flame dried 10 mL round bottom flask at 0 °C under inert atmosphere was added 2-phenylpropan-1-ol (103 \(\mu\)L, 0.73 mM), 20% phosgene in toluene (912 \(\mu\)L, 2.64 mM), and 2 mL dry toluene. Reaction was stirred for five minutes at 0 °C before being allowed to warm to room temperature. After three hours starting material was consumed, reaction was opened, and argon purged through solution for twenty minutes to remove excess phosgene. Toluene was removed under reduced pressure and replaced with 3 mL of dry CH\(_2\)Cl\(_2\). Solution was cooled to 0 °C before adding O-(2,4-dinitrophenyl)hydroxylamine (160 mg, 0.80 mM) and triethylamine (122 \(\mu\)L, 0.88 mM). Reaction was stirred at 0 °C for 5 mins before warming to room temperature for 12 h. 10 mL of saturated aqueous sodium bicarbonate was added and reaction was extracted three times with 10 mL of CH\(_2\)Cl\(_2\). Combined organics were washed with brine, dried over sodium sulfate, and the residue was purified by flash column chromatography (5-30% EtOAc in hexane) to afford 2-phenylpropyl (2,4-dinitrophenoxy)carbamate (3) (31.0 mg, 12%). \(^1\)H NMR (500 MHz, CDCl\(_3\)): \(\delta\) 1.40 (d, 3H, \(J = 7.1\) Hz), 3.20-3.28 (m, 1H), 4.35-4.47 (m, 2H), 7.24-7.29 (m, 3H), 7.35 (t, 2H, \(J = 7.3\) Hz), 7.48 (d, 1H, \(J = 9.0\) Hz), 8.51 (dd, 1 H, \(J_1 = 2.2, J_2 = 8.9\) Hz), 8.96 (d, 1H, \(J = 2.3\) Hz); \(^1\)C NMR (125 MHz, CDCl\(_3\)): \(\delta\)17.7, 38.9, 75.0, 121.9, 126.2, 127.1, 127.3, 128.7, 129.2, 141.3, 141.9, 145.2, 148.5, 151.3; MS analysis could not be performed due to decomposition upon ESI ionization conditions.
B. Synthesis of carbonazidate substrates.

Carbonazidates $4^4, 7^7, 23^6$ and $24^7$ were synthesized according to reported procedures. The corresponding spectral data were found to be in agreement with the reported ones.

2-phenylpropyl carbonazidate (4)

![Chemical structure of 2-phenylpropyl carbonazidate (4)](image)

$^1$H NMR (400 MHz, CDCl$_3$): δ 7.39-7.27 (m, 5H), 4.40-4.36 (m, 1H), 4.32-4.27 (m, 1H), 3.22-3.17 (m, 1H), 1.38 (d, 3H, $J = 7.1$ Hz); $^{13}$C NMR (100 MHz, CDCl$_3$): δ 157.08, 141.9, 128.4, 127.0, 126.7, 72.9, 38.6, 17.4; LC-MS (ESI) calculated for C$_{10}$H$_{12}$N$_3$O$_2$[M+H]$^+$ $m/z$: 206.2, Observed: 206.3.

Synthesis of 2-(p-tolyl)propyl carbonazidate (6)

To a stirred solution of 2-(p-tolyl)propan-1-ol (29)$^6$ (400 mg, 2.67 mmol) in dry THF (3.0 mL) at 0 °C, COCl$_2$ (20% in toluene, 3 mmol) was added slowly and stirred for 1-2 h at room temperature. After the completion of reaction (as observed from TLC), nitrogen was bubbled through the reaction for 1 h to remove excess phosgene. The reaction mixture was then concentrated and the obtained residue was flash chromatographed on a silica gel which furnished 2-(p-tolyl)propyl carbonochloridate (30) in 85% yield as a colorless oil. R$_f$ = 0.82 (2% EtOAc in hexane); $^1$H NMR (500 MHz, CDCl$_3$): δ 7.23-7.18 (m, 4H), 4.49-4.45 (m, 1H), 4.40-4.36 (m, 1H), 3.25-3.21 (m, 1H), 2.41 (s, 3H), 1.41 (d, 3H, $J = 7.3$ Hz); $^{13}$C NMR (125 MHz, CDCl$_3$): δ150.5, 138.4, 136.6, 129.3, 127.0, 76.5, 38.2, 20.9, 17.5.

To a stirred solution of 2-(p-tolyl)propyl carbonochloridate (30) (300 mg, 1.41 mmol) in acetone/water (1:1) (5 mL) at 0 °C was added NaN$_3$ (135 mg, 1.5 mmol) and left stirred at room temperature. After the completion of reaction (as observed from TLC, in about 45 min), reaction mixture was concentrated under vacuum, followed by extraction with CH$_2$Cl$_2$ (3 x 10 mL). The combined organic layers were washed with brine, dried over Na$_2$SO$_4$ and evaporated under reduced pressure. The residue was flash chromatographed on silica gel which furnished 2-(p-tolyl)propyl carbonazidate (6) as a colorless oil in
96% yield. \( R_f = 0.78 \) (5% EtOAc in hexane); \(^1\)H NMR (400 MHz, CDCl\(_3\)): \( \delta \) \(^1\)H NMR (400 MHz, CDCl\(_3\)): \( \delta \) 7.22-7.20 (m, 4H), 4.42-4.38 (m, 1H), 4.33-4.29 (m, 1H), 3.23-3.18 (m, 1H), 2.42 (s, 3H), 1.41 (d, 3H, \( J = 7.2 \) Hz); \(^{13}\)C NMR (100 MHz, CDCl\(_3\)): \( \delta \) 157.1, 138.8, 136.2, 129.0, 126.8, 72.9, 38.1, 20.7, 17.4; LC-MS (ESI) calculated for \( \text{C}_{11}\text{H}_{14}\text{N}_3\text{O}_2 \) [M+H]\(^+\) \( m/z \): 220.2, Observed: 220.3.

**Synthesis of 2-(4-(trifluoromethyl)phenyl)propyl carbonazidate (7)**

![Synthesis of 2-(4-(trifluoromethyl)phenyl)propyl carbonazidate (7)](image)

To a stirred solution of 2-(4-((difluoro-13-methyl)-12-fluoranyl)phenyl)propan-1-ol (31)\(^8\) (400 mg, 1.96 mmol) in dry THF (3.0 mL) at 0 °C, \( \text{COCl}_2 \) (20% in toluene, 3 mmol) was added slowly and stirred for 1-2 h at room temperature. After the completion of reaction (as observed from TLC), nitrogen was bubbled through the reaction for 1 h to remove excess phosgene. The reaction mixture was then concentrated and the obtained residue was used directly in the next step which was converted into 2-(4-(trifluoromethyl)phenyl)propyl carbonazidate (7) by procedure as described above as given for 2-(p-tolyl)propyl carbonazidate (6) in 81% yield (after two steps) as a colorless oil. \( R_f = 0.79 \) (2% EtOAc in hexane); \(^1\)H NMR (400 MHz, CDCl\(_3\)): \( \delta \) 7.58 (d, 2H, \( J = 7.6 \) Hz), 7.34 (d, 2H, \( J = 7.5 \) Hz), 4.35-4.25 (m, 2H), 3.25-3.20 (m, 1H), 1.41 (d, 3H, \( J = 7.1 \) Hz); \(^{13}\)C NMR (100 MHz, CDCl\(_3\)): \( \delta \) 157.3, 146.3, 127.6, 126.2, 125.5, 125.4, 123.9, 72.4, 38.7, 17.4; LC-MS (ESI) calculated for \( \text{C}_{11}\text{H}_{15}\text{F}_3\text{N}_3\text{O}_2 \) [M+H]\(^+\) \( m/z \): 274.2, Observed: 274.1.

**Synthesis of 2-(4-(tert-butyl)phenyl)propyl carbonazidate (8)**

![Synthesis of 2-(4-(tert-butyl)phenyl)propyl carbonazidate (8)](image)

Compound 2-(4-(tert-butyl)phenyl)propan-1-ol (32)\(^9\) was converted into 2-(4-(tert-butyl)phenyl)propyl carbonochloridate (33) by following the same procedure as for 2-(p-tolyl)propyl carbonochloridate (30)
and isolated in 86% yield as colorless oil. $R_f = 0.83$ (5% EtOAc in hexane). $^1$H NMR (400 MHz, CDCl$_3$): $\delta$ 7.41 (d, 2H, $J = 7.5$ Hz), 7.20 (d, 2H, $J = 7.6$ Hz), 4.49-4.33 (m, 2H), 3.22-3.19 (m, 1H), 1.40 (s, 9H), 1.38 (d, 3H, $J = 7.1$ Hz); $^{13}$C NMR (100 MHz, CDCl$_3$): $\delta$ 150.6, 149.9, 138.3, 126.9, 125.6, 76.6, 38.2, 34.4, 31.3, 17.6.

Compound 2-(4-(tert-butyl)phenyl)propyl carbonochloridate (33) was converted into 2-(4-(tert-butyl)phenyl)propyl carbonazidate (8) by the same procedure as described for 2-(p-tolyl)propyl carbonazidate (7) and isolated in 94% yield as colorless oil. $R_f = 0.80$ (5% EtOAc in hexane); $^1$H NMR (400 MHz, CDCl$_3$): $\delta$ 7.38 (d, 2H, $J = 7.5$ Hz), 7.18 (d, 2H, $J = 7.4$ Hz), 4.35-4.25 (m, 2H), 3.17-3.15 (m, 1H), 1.34 (s, 9H), 1.34 (d, 3H, $J = 7.2$ Hz); $^{13}$C NMR (100 MHz, CDCl$_3$): $\delta$ 157.3, 149.7, 138.9, 126.8, 125.4, 73.3, 38.2, 34.3, 31.3, 17.6. LC-MS (ESI) calculated for C$_{14}$H$_{20}$N$_3$O$_2$[M+H]$^+$ m/z: 262.3, Observed: 262.3.

**Synthesis of 2-(m-tolyl)propyl carbonazidate (9)**

![Synthesis of 2-(m-tolyl)propyl carbonazidate (9)](image)

Compound 2-(m-tolyl)propan-1-ol (34)$^{10}$ was converted into 2-(m-tolyl)propyl carbonochloridate (35) by following the same procedure as described for 2-(p-tolyl)propyl carbonochloridate (30) and isolated in 86% yield as colorless oil. $R_f = 0.85$ (5% EtOAc in hexane); $^1$H NMR (400 MHz, CDCl$_3$): $\delta$ 7.33-7.29 (m, 1H), 7.17-7.10 (m, 3H), 4.51-4.37 (m, 2H), 3.26-3.21 (m, 1H), 2.44 (s, 3H), 1.41 (d, 3H, $J = 7.1$ Hz); $^{13}$C NMR (100 MHz, CDCl$_3$): $\delta$ 150.4, 141.3, 138.2, 128.5, 127.9, 127.8, 124.1, 76.4, 38.5, 21.3, 17.5.

Compound 2-(m-tolyl)propyl carbonochloridate (35) was converted into 2-(m-tolyl)propyl carbonazidate (9) by the same procedure as described for 2-(p-tolyl)propyl carbonazidate (7) and isolated in 93% yield as colorless oil. $R_f = 0.80$ (5% EtOAc in hexane); $^1$H NMR (400 MHz, CDCl$_3$): $\delta$ 7.28-7.24 (m, 1H), 7.11-7.06 (m, 3H), 4.39-4.25 (m, 2H), 3.18-3.13 (m, 1H), 2.39 (s, 3H), 1.36 (d, 3H, $J = 7.1$ Hz); $^{13}$C NMR (100 MHz, CDCl$_3$): $\delta$ 157.2, 141.9, 138.0, 128.4, 127.9, 127.6, 124.1, 73.1, 38.6, 21.3, 17.6. LC-MS (ESI) calculated for C$_{11}$H$_{14}$N$_3$O$_2$[M+H]$^+$ m/z: 220.2, Observed: 220.3.
Synthesis of 2-(3,5-dimethylphenyl)propyl carbonazidate (10)

Compound 2-(3,5-dimethylphenyl)propan-1-ol (36)\(^8\) was converted into 2-(3,5-dimethylphenyl)propyl carbonochloridate (37) by following the same procedure as for 2-(p-tolyl)propyl carbonochloridate (30) and isolated in 84% yield as colorless oil. \(R_f = 0.87\) (5% EtOAc in hexane); \(^1\)H NMR (400 MHz, CDCl\(_3\)):\(\delta\) 7.04 (s, 1H), 6.97 (s, 2H), 4.58-4.40 (m, 2H), 3.26-3.21 (m, 1H), 2.45 (s, 6H), 1.46 (d, 3H, \(J = 7.2\) Hz); \(^{13}\)C NMR (100 MHz, CDCl\(_3\)):\(\delta\) 150.4, 141.3, 138.0, 128.7, 124.9, 76.5, 38.5, 21.1, 17.5.

Compound 2-(3,5-dimethylphenyl)propyl carbonochloridate (37) was converted into 2-(3,5-dimethylphenyl)propyl carbonazidate (10) by using the same procedure as described for 2-(p-tolyl)propyl carbonazidate (7) and isolated in 95% yield as colorless oil. \(R_f = 0.83\) (5% EtOAc in hexane); \(^1\)H NMR (400 MHz, CDCl\(_3\)):\(\delta\) 6.93 (s, 1H), 6.87 (s, 2H), 4.37-4.23 (m, 2H), 3.14-3.08 (m, 1H), 2.34 (s, 6H), 1.34 (d, 3H, \(J = 7.2\) Hz); \(^{13}\)C NMR (100 MHz, CDCl\(_3\)):\(\delta\) 157.3, 141.9, 138.0, 124.9, 72.2, 38.6, 21.2, 17.7. LC-MS (ESI) calculated for C\(_{12}\)H\(_{16}\)N\(_3\)O\(_2\) \([\text{M+H}]^+\) \(m/z\): 234.2, Observed: 234.2.

Phenethyl carbonazidate (11)

\(^1\)H NMR (400 MHz, CDCl\(_3\)):\(\delta\) 7.35-7.22 (m, 5H), 4.43 (t, 2H, \(J = 7.5\) Hz), 3.01 (t, 2H, \(J = 7.4\) Hz); \(^{13}\)C NMR (100 MHz, CDCl\(_3\)):\(\delta\) 157.3, 136.7, 128.8, 128.6, 126.8, 68.8, 34.8; LC-MS (ESI) calculated for C\(_9\)H\(_{10}\)N\(_3\)O\(_2\) \([\text{M+H}]^+\) \(m/z\): 192.1, Observed: 192.1.
Synthesis of (E)-4-phenylbut-3-en-1-yl carbonazidate (12)

Compound (E)-4-phenylbut-3-en-1-ol (38)\(^{11}\) was converted into (E)-4-phenylbut-3-en-1-yl carbonochloridate (39) by following the same procedure as for 2-(p-tolyl)propyl carbonochloridate (30) and isolated in 84% yield as colorless oil. \(R_f = 0.74\) (5% EtOAc in hexane); \(^1\)H NMR (400 MHz, CDCl\(_3\)): \(\delta\) 7.39-7.27 (m, 5H), 6.53 (d, 1H, \(J = 14.4\) Hz), 6.19-6.12 (m, 1H), 4.43 (t, 2H, \(J = 6.9\) Hz) 2.66-2.65 (m, 2H); \(^{13}\)C NMR (100 MHz, CDCl\(_3\)): \(\delta\) 150.6, 136.8, 133.4, 128.3, 127.5, 126.1, 123.0, 71.0, 31.8.

Compound (E)-4-phenylbut-3-en-1-yl carbonochloridate (39) was converted into (E)-4-phenylbut-3-en-1-yl carbonazidate (12) by using the same procedure as described for 2-(p-tolyl)propyl carbonazidate (7) and isolated in 94% yield as colorless oil. \(R_f = 0.72\) (5% EtOAc in hexane); \(^1\)H NMR (400 MHz, CDCl\(_3\)): \(\delta\) 7.39-7.19 (m, 5H), 6.51 (d, 1H, \(J = 14.6\) Hz), 6.20-6.13 (m, 1H), 4.33 (t, 2H, \(J = 7.2\) Hz) 2.64-2.59 (m, 2H); \(^{13}\)C NMR (100 MHz, CDCl\(_3\)): \(\delta\) 157.3, 136.8, 132.9, 128.4, 127.3, 126.0, 124.2, 67.5, 32.0. LC-MS (ESI) calculated for C\(_{11}\)H\(_{12}\)N\(_3\)O\(_2\)[M+H]\(^+\) \(m/z\): 218.2, Observed: 218.2.

Synthesis of 2,3-dihydro-1H-inden-2-yl carbonazidate (13)

2-indanol (40) was converted into 2,3-dihydro-1H-inden-2-yl carbonochloridate (41) by following the same procedure as for 2-(p-tolyl)propyl carbonochloridate (30) and isolated in 82% yield as colorless oil. \(R_f = 0.79\) (5% EtOAc in hexane); \(^1\)H NMR (400 MHz, CDCl\(_3\)): \(\delta\) 7.30-7.29 (m, 4H), 5.65 (m, 1H), 3.43-3.38 (m, 2H), 3.25-3.21 (m, 2H); \(^{13}\)C NMR (100 MHz, CDCl\(_3\)): \(\delta\) 150.3, 139.1, 127.0, 124.6, 83.8, 39.1.

Compound 2,3-dihydro-1H-inden-2-yl carbonochloridate (41) was converted into 2,3-dihydro-1H-inden-2-yl carbonazidate (13) by using the same procedure as described for 2-(p-tolyl)propyl carbonazidate (7) and isolated in 94% yield as colorless oil. \(R_f = 0.75\) (5% EtOAc in hexane); \(^1\)H NMR (400 MHz, CDCl\(_3\)): \(\delta\) 7.28-7.27 (m, 4H), 5.57 (m, 1H), 3.41-3.35 (m, 2H), 3.18-3.14 (m, 2H); \(^{13}\)C NMR (100 MHz, CDCl\(_3\)): \(\delta\)
Synthesis of 1-phenylpropyl carbonazidate (14)

1-phenylpropan-1-ol (42) (3.5 mmol) was slowly added to a solution of 1,1’-carbonyldiimidazole (600 mg, 3.84 mmol) in THF (35 mL) at 0 °C and the resulting mixture was stirred at room temperature for 2 h. The mixture was washed with saturated aqueous NH₄Cl (15 mL) and brine (15 mL), then dried over Na₂SO₄. The solvent was removed under reduced pressure. The product obtained was dissolved in ethanol (35 mL), hydrazine hydrate (750 mg, 10 mmol) was added and the resulting mixture was stirred at room temperature for 2h. After the completion of reaction (as observed from TLC), the solvent was removed under reduced pressure, and the product obtained was used without any further purification in next step. The crude product hydrazinecarboxylate (6.5 mmol) was dissolved in a mixture of acetic acid (5 mL) and water (3 mL), and the solution was cooled to 0 °C, stirred and treated dropwise with NaNO₂ (462 mg, 6.7 mmol) while maintaining the temperature below 5 °C. After the addition, mixture was stirred for 15 min at below 5 °C and further for an hour at room temperature. After the completion of reaction, mixture was poured in water followed by extraction with ether (3 x 40 mL). The combined organic layers were washed with brine, dried over Na₂SO₄ and evaporated under reduced pressure which furnished 1-phenylpropyl carbonazidate (14) as colorless oil in 72% yield. Rᵢ = 0.85 (5% EtOAc in hexane), ¹H NMR (400 MHz, CDCl₃): δ 7.39-7.31 (m, 5H), 5.63-5.59 (m, 1H), 2.06-1.97 (m, 1H), 1.93-1.84 (m, 1H), 0.94-0.91 (m, 3H); ¹³C NMR (100 MHz, CDCl₃): δ 157.0, 138.9,128.5, 128.4, 126.5, 82.3, 29.0, 9.7. LC-MS (ESI) calculated for C₁₀H₁₀N₃O₂[M+H]⁺ m/z: 206.2, Observed: 206.2.
(1R,2S,5R)-2-isopropyl-5-methylcyclohexyl carbonazidate (23)

\[
\begin{align*}
\text{1H NMR (400 MHz, CDCl}_3\text{): } & \delta 4.65-4.63 (m, 1H), 2.07 (m, 1H), 1.90-1.89 (m, 1H), 1.68 (m, 2H), 1.46-1.40 (m, 2H), 1.08-1.02 (m, 2H), 0.92-0.89 (m, 7H), 0.80 (d, 3H, } J = 7.2 \text{ Hz). } \text{13C NMR (100 MHz, CDCl}_3\text{): } \delta 157.1, 79.4, 46.8, 40.5, 33.9, 31.4, 26.2, 23.3, 21.9, 20.6, 16.3. \text{ LC-MS (ESI) calculated for C}_{11}\text{H}_{20}\text{N}_{3}\text{O}_{2}[\text{M+H}]^+ \text{ m/z : 226.2, Observed: 226.2.} 
\end{align*}
\]

(1S,2R,4S)-1,7,7-trimethylbicyclo[2.2.1]heptan-2-yl carbonazidate (24)

\[
\text{1H NMR (400 MHz, CDCl}_3\text{): } \delta 4.88-4.85 (m, 1H), 2.38-2.34 (m, 1H), 1.88-1.82 (m, 1H), 1.73-1.67 (m, 2H), 1.31-1.19 (m, 2H), 1.08-1.04 (m, 1H), 0.88 (s, 3H), 0.87 (s, 6H). \text{ 13C NMR (100 MHz, CDCl}_3\text{): } \delta 157.6, 84.7, 48.9, 47.9, 44.6, 36.2, 27.7, 26.7, 19.5, 18.7, 13.3. \text{ LC-MS (ESI) calculated for C}_{11}\text{H}_{18}\text{N}_{3}\text{O}_{2}[\text{M+H}]^+ \text{ m/z : 224.2, Observed: 224.3.} 
\]

Synthesis of (Z)-4-phenylbut-3-en-1-yl carbonazidate (Z-12)

Compound(Z)-4-phenylbut-3-en-1-ol (43)\textsuperscript{12} was converted into (Z)-4-phenylbut-3-en-1-yl carbonochloridate (44) by following the same procedure as for 2-(p-tolyl)propyl carbonochloridate (30) and isolated in 86% yield as colorless oil. R\textsubscript{f} = 0.75 (5% EtOAc in hexane); 1H NMR (400 MHz, CDCl\textsubscript{3}): \delta 7.42-7.29 (m, 5H), 6.66 (d, 1H, } J = 7.4 \text{ Hz), 5.70-5.63 (m, 1H), 4.41 (t, 2H, } J = 7.3 \text{ Hz)2.81-2.76(m, 2H); } 13\text{C NMR (100 MHz, CDCl}_3\text{): } \delta 150.5, 136.6, 132.4, 128.5, 128.2, 127.0, 125.4, 71.2, 27.6. 
\]

S21
Compound \((Z)-4\text{-phenylbut-3-en-1-yl carbonochloridate (44)}\) was converted into \((Z)-4\text{-phenylbut-3-en-1-yl carbonazidate (Z-12)}\) by using the same procedure as described for \(2\text{-}(p\text{-tolyl})propyl carbonazidate (7)\) in 92% yield as colorless oil. \(R_f = 0.73\) (5% EtOAc in hexane); \(^1\text{H NMR (400 MHz, CDCl}_3\): \(\delta 7.36-7.25\) (m, 5H), 6.58 (d, 1H, \(J = 7.4\) Hz), 5.64-5.60 (m, 1H), 4.29 (t, 2H, \(J = 7.3\) Hz) 2.75-2.70 (m, 2H). \(^{13}\text{C NMR (100 MHz, CDCl}_3\): \(\delta 157.5, 136.8, 132.1, 128.6, 128.3, 127.0, 126.1, 67.8, 27.8. LC-MS (ESI) calculated for C\(_{11}\)H\(_{12}\)N\(_3\)O\(_2\)[M+H]+ m/z: 218.2, Observed: 218.3.

C. Synthesis of deuterated carbonazidate substrates

**Synthesis of 2-(p-tolyl)propyl-2-d carbonazidate (D-6)**

To a stirred solution of 2-(p-tolyl)propanoic acid (45) (492 mg, 3 mmol) in dry THF at -78 °C was added n-BuLi (2.05 mmol, 1.6 M in hexane) dropwise. The reaction mixture was left stirred for 1 h at -78 °C, and was then gradually brought to 0 °C, followed by quenching with D\(_2\)O. The reaction mixture was acidified with 6N HCl and with extracted with diethyl ether (3 x 20 mL). The combined organic layers were washed with brine, dried over Na\(_2\)SO\(_4\) and evaporated under reduced pressure to give 2-(p-tolyl)propanoic-2-d acid (46) as a white solid in 91% yield and was used without any purification in the next step. \(R_f = 0.39\) (5% MeOH in CH\(_2\)Cl\(_2\)). \(^1\text{H NMR (400 MHz, CDCl}_3\): \(\delta 11.5\) (s, br, 1H), 7.29-7.20 (m, 4H), 2.39 (s, 3H), 1.55 (s, 3H). \(^{13}\text{C NMR (100 MHz, CDCl}_3\): \(\delta 181.2, 136.9, 136.6, 129.9, 127.4, 44.5, 20.9, 17.9.}

Compound (p-tolyl)propanoic-2-d acid (46) was then reduced with LiAlH\(_4\) to give the intermediate alcohol. The alcohol obtained was treated with COCl\(_2\) via aforementioned procedure which furnished 2-(p-tolyl)propyl-2-d carbonochloridate (47) in 84% yield (over two steps) as colorless oil. \(R_f = 0.78\) (5%
EtOAc in hexane).\(^1\)H NMR (400 MHz, CDCl\(_3\)): \(\delta\) 7.20-7.15 (m, 4H), 4.45-4.33 (m, 2H), 2.38 (s, 3H), 1.37 (s, 3H); \(^1\)C NMR (100 MHz, CDCl\(_3\)): \(\delta\) 150.6, 138.4, 136.7, 129.4, 127.0, 76.5, 37.8, 20.9, 17.5.

Compound 2-(p-tolyl)propyl-2-d carbonochloridate (47) was then converted to 2-(p-tolyl)propyl-2-d carbonazidate (D-6) by procedure as described above for 2-(p-tolyl)propyl carbonazidate (7) in 93% yield as colorless oil. \(R_f= 0.73\) (5% EtOAc in Hexane); \(^1\)H NMR (400 MHz, CDCl\(_3\)): \(\delta\) 7.16-7.13 (m, 4H), 4.35-4.23 (m, 2H), 2.36 (s, 3H), 1.33 (s, 3H). \(^1\)C NMR (100 MHz, CDCl\(_3\)): \(\delta\) 157.3, 138.9, 136.4, 129.2, 127.0, 73.1, 37.9, 20.9, 17.6. LC-MS (ESI) calculated for C\(_{11}\)H\(_{13}\)DN\(_3\)O\(_2\) [M+H]\(^+\) m/z 221.2, Observed: 221.2.

**Synthesis of 2-phenylethyl-2,2-d2 carbonazidate (D\(_2\)–11)**

A mixture of phenylacetic acid (48) (2.50 g; 18.36 mmol), anhydrous potassium carbonate (10.30 g; 73.4 mmol) and deuterium oxide (15 mL) was refluxed overnight. After completion of reaction (as determined by GC-MS) the reaction mixture was cooled to about 0 °C, acidified to pH 2 with 6 N hydrochloric acid, and then extracted with diethyl ether (3 x 50 mL). The combined organic layers were washed with brine, dried over Na\(_2\)SO\(_4\) and evaporated under reduced pressure to give 2-phenylacetic-2,2-d2 acid (49) as a white solid in 96% yield and was used without any purification in the next step. \(R_f= 0.38\) (5% MeOH in CH\(_2\)Cl\(_2\)).\(^1\)H NMR (400 MHz, CDCl\(_3\)): \(\delta\) 10.9 (s, br, 1H), 7.37-7.29 (m, 5H). \(^1\)C NMR (100 MHz, CDCl\(_3\)): \(\delta\) 178.2, 133.1, 129.3, 128.6, 127.3, 40.7.

To a stirred solution of 2-phenylacetic-2,2-d2 acid (49) (1.0 g, 7.24 mmol) in dry THF (30 mL) at 0 °C was added LiAlH\(_4\) (275 mg, 7.24 mmol) and left stirred at room temperature. After the completion of reaction (as observed from TLC, in about 45 min), reaction mixture was quenched with water at 0 °C, followed by extraction with ethyl acetate (3 x 40 mL). The combined organic layers were washed with brine, dried over Na\(_2\)SO\(_4\) and evaporated under reduced pressure which furnished the intermediate alcohol as colorless oil in 90% yield and was proceeded further in the next step without any purification. The obtained alcohol was then converted to 2-phenylethyl-2,2-d2 carbonochloridate (50) as described above for 2-(p-tolyl)propyl carbonazidate (30) in 88% yield as colorless oil. \(R_f= 0.75\) (5% EtOAc in Hexane).\(^1\)H NMR (400 MHz, CDCl\(_3\)): \(\delta\) 7.41-7.26 (m, 5H), 4.53 (s, 1H). \(^1\)C NMR (100 MHz, CDCl\(_3\)): \(\delta\) 150.4, 136.0, 128.8, 128.6, 126.9, 71.9, 33.8.
Compound 2-phenylethyl-2,2-d2 carbonochloridate (50) was converted to 2-phenylethyl-2,2-d2 carbonazidate (D2-11) by procedure as described above for 2-(p-tolyl)propyl carbonazidate (7) in 95% as colorless oil. Rf = 0.70 (5% EtOAc in Hexane); ¹H NMR (400 MHz, CDCl3): δ 7.37-7.24 (m, 5H), 4.43 (s, 2H). ¹³C NMR (100 MHz, CDCl3): δ 157.2, 136.5, 128.7, 128.4, 126.7, 68.5, 34.0. LC-MS (ESI) calculated for C₉H₇D₂N₃O₂ [M+H]⁺ m/z: 194.2, Observed: 194.2.

Synthesis of 2-phenylethyl-2-d carbonazidate (D1-11)

To a stirred solution of 2-bromo-2-phenylacetic acid (51) (639 mg, 3 mmol) in dry THF at -78 °C was added n-BuLi (2.05 mmol, 1.6 M in hexane) dropwise. The reaction mixture was left stirred for 1 h at -78 °C, and was then gradually brought to 0 °C, followed by quenching with D₂O. The reaction mixture was acidified with 6N HCl and with extracted with diethyl ether (3 x 20 mL). The combined organic layers were washed with brine, dried over Na₂SO₄ and evaporated under reduced pressure to give 2-phenylacetic-2-d acid (52) as a white solid in 92% yield, which was used without any purification in the next step. Rf = 0.34 (5% MeOH in CH₂Cl₂). ¹H NMR (400 MHz, CDCl3): δ 11.5 (s, br, 1H), 7.33-7.26 (m, 5H); 3.63 (s, 1H). ¹³C NMR (100 MHz, CDCl₃): δ 177.7, 133.2, 129.3, 128.6, 127.4, 40.7.

Compound 2-phenylacetic-2-d acid (52) was then reduced by LiAlH₄ followed by treatment with COCl₂ by following the aforementioned procedure which provided 2-phenylethyl-2-d carbonochloridate (53) in 82% yield (over two steps) as colorless oil. Rf = 0.82 (5% EtOAc in hexane). ¹H NMR (400 MHz, CDCl₃): δ 7.35-7.21 (m, 5H), 4.5 (d, 2H, J = 7.7 Hz), 3.03-3.02 (m, 1H). ¹³C NMR (100 MHz, CDCl₃): δ 150.6, 136.1, 128.9, 128.7, 127.1, 72.1, 34.4.

Compound 2-phenylethyl-2-d carbonochloridate (53) was then converted to 2-phenylethyl-2-d carbonazidate (D1-11) by using the same procedure as described above for 2-(p-tolyl)propyl carbonazidate (7) in 96% yield as colorless oil. Rf = 0.70 (5% EtOAc in Hexane). ¹H NMR (400 MHz, CDCl₃): δ 7.35-7.24 (m, 5H), 4.43(d, 2H, J = 7.4 Hz). ¹³C NMR (100 MHz, CDCl₃): δ 157.2, 136.6, 128.9, 128.5, 126.7, 68.7, 34.4. LC-MS (ESI) calculated for C₉H₈D₂N₃O₂ [M+H]⁺ m/z: 193.2, Observed: 193.2.
D. Synthesis of carbamate standards

To a stirred solution of primary alcohol (5 mmol) and sodium isocyanate (10 mmol) in 10 mL of dry CH$_2$Cl$_2$ was added TFA (10.5 mmol) dissolved in 5 mL of dry CH$_2$Cl$_2$ at room temperature. After the completion of reaction (approx 5 h at room temperature), water (5 mL) was added, and extracted with CH$_2$Cl$_2$ (3x10 mL). The combined organic layers were washed with brine, dried over Na$_2$SO$_4$ and evaporated under reduced pressure to give the corresponding carbamate product which was then purified by flash column chromatography (85–91% yield). Spectral data for phenethyl carbamate and (1S,2S,5S)-2-isopropyl-5-methylcyclohexyl carbamate, 2,3-dihydro-1H-inden-2-yl carbamate matched the reported ones.$^{13}$

2-phenylpropyl carbamate (54)

![2-phenylpropyl carbamate](image)

Yield (86%), $R_f$ = 0.38 (20% EtOAc in hexane); $^1$H NMR (400 MHz, CDCl$_3$): δ 7.34-7.30 (m, 2H), 7.24-7.23 (m, 3H), 4.99 (br, s, 2H), 4.17-4.15 (m, 2H), 3.14-3.05 (m, 1H), 1.28 (d, 3H, $J = 7.1$ Hz); $^{13}$C NMR (100 MHz, CDCl$_3$): δ 157.2, 143.2, 128.4, 127.2, 126.5, 69.7, 39.0, 17.9. GC-MS m/z (% relative intensity): 118(100), 105(39.4), 91(12.2).

2-(p-tolyl)propyl carbamate (55)

![2-(p-tolyl)propyl carbamate](image)

Yield (88%), $R_f$ = 0.40 (30% EtOAc in hexane); $^1$H NMR (400 MHz, CDCl$_3$): δ 7.16 (m, 4H), 5.10 (br, s, 2H), 4.18-4.16 (m, 2H), 3.11-3.07 (m, 1H), 2.36 (s, 3H), 1.31 (d, 3H, $J = 4.4$ Hz); $^{13}$C NMR (100 MHz, CDCl$_3$): δ 157.1, 140.2, 136.1, 129.1, 127.1, 69.9, 38.7, 20.9, 18.1. GC-MS m/z (% relative intensity): 150(2.3), 132(100), 119(66.3), 91(31.4).
2-(4-(trifluoromethyl)phenyl)propyl carbamate (56)

\[
\text{O} \quad \text{O} \quad \text{NH}_2 \quad \text{CF}_3
\]

Yield (89%), \( R_f = 0.42 \) (30% EtOAc in hexane); \(^1\)H NMR (400 MHz, CDCl\(_3\)): \( \delta \) 7.57-7.56 (m, 2H), 7.35-7.33 (m, 2H), 4.93 (br, s, 2H), 4.17-4.13 (m, 2H), 3.18-3.14 (m, 1H), 1.29 (d, 3H, \( J = 7.3 \) Hz); \(^{13}\)C NMR (100 MHz, CDCl\(_3\)): \( \delta \) 157.0, 147.5, 128.8, 127.7, 125.4, 123.9, 69.3, 39.1, 17.8. GC-MS \( m/z \) (% relative intensity): 186(100), 73(11.1), 167(7.9), 159(12.6), 154(20.1), 153(13.4), 133(14.3), 117(25.7).

2-(4-(tert-butyl)phenyl)propyl carbamate (57)

\[
\text{O} \quad \text{O} \quad \text{NH}_2 \quad \text{CH}_3
\]

Yield (85%), \( R_f = 0.41 \) (30% EtOAc in hexane); \(^1\)H NMR (400 MHz, CDCl\(_3\)): \( \delta \) 7.36-7.34 (m, 2H), 7.19-7.17 (m, 2H), 5.01 (br, s, 2H), 4.17-4.15 (m, 2H), 3.11-3.06 (m, 1H), 1.34 (s, 9H), 1.30 (d, 3H, \( J = 7.1 \) Hz); \(^{13}\)C NMR (100 MHz, CDCl\(_3\)): \( \delta \) 157.3, 149.2, 140.1, 126.8, 125.2, 69.9, 38.5, 34.3, 31.3, 17.9; GC-MS \( m/z \) (% relative intensity): 174(36.2), 159(100), 146(81.3), 131(15.1), 105(2.1), 91(3.9).

2-(m-tolyl)propyl carbamate (58)

\[
\text{O} \quad \text{O} \quad \text{NH}_2 \quad \text{CH}_3
\]

Yield (91%), \( R_f = 0.39 \) (30% EtOAc in hexane); \(^1\)H NMR (400 MHz, CDCl\(_3\)): \( \delta \) 7.25-7.21 (m, 1H), 7.07-7.05 (m, 2H), 5.11 (br, s, 2H), 4.18-4.16 (m, 2H), 3.10-3.05 (m, 1H), 2.37 (s, 3H), 1.30 (d, 3H, \( J = 4.3 \) Hz); \(^{13}\)C NMR (100 MHz, CDCl\(_3\)): \( \delta \) 157.3, 143.1, 137.8, 128.2, 127.9, 127.2, 124.1, 69.7, 38.9, 21.3, 18.0; GC-MS \( m/z \) (% relative intensity): 150(2.3), 132(100), 119(66.3), 91(31.4).
2-(3,5-dimethylphenyl)propyl carbamate (59)

\[
\begin{align*}
\text{O} & \quad \text{O} \\
\text{NH}_2 & \quad \text{O} \\
\end{align*}
\]

Yield (87%), \(R_f = 0.36\) (30% EtOAc in hexane); \(^1\)H NMR (400 MHz, CDCl\(_3\)): \(\delta\) 6.87-6.83 (m, 3H), 4.63 (br, s, 2H), 4.14-4.13 (m, 2H), 3.03-2.98 (m, 1H), 2.29 (s, 6H), 1.26 (d, 3H, \(J = 7.3\) Hz); \(^{13}\)C NMR (100 MHz, CDCl\(_3\)): \(\delta\) 156.9, 143.2, 137.9, 128.3, 125.0, 70.0, 39.0, 21.3, 18.2; GC-MS m/z (% relative intensity): 147(13.2), 146(100), 133(38.9), 119(10.6), 117(10.4), 106(19.3), 91(15.7).

(Z)-3-phenylallyl carbamate (Z-27)

\[
\begin{align*}
\text{O} & \quad \text{O} \\
\text{H}_2\text{N} & \quad \text{O} \\
\end{align*}
\]

Yield (88%), \(R_f = 0.45\) (30% EtOAc in hexane); \(^1\)H NMR (400 MHz, CDCl\(_3\)): \(\delta\) 7.35-7.21 (m, 5H), 6.53 (d, 2H, \(J = 12.2\) Hz), 5.69-5.62 (m, 2H), 4.77 (s, 2H), 4.17-4.15 (m, 2H), 2.69-2.64 (m, 2H); \(^{13}\)C NMR (100 MHz, CDCl\(_3\)): \(\delta\) 156.9, 137.1, 131.3, 128.6, 128.2, 127.4, 126.8, 64.5, 28.4; GC-MS m/z (% relative intensity): 130(100), 129(74.6), 155(39.2), 91(9.3).

(E)-4-phenylbut-3-en-1-yl carbamate (E-27)

\[
\begin{align*}
\text{O} & \quad \text{O} \\
\text{NH}_2 & \quad \text{O} \\
\end{align*}
\]

Yield (90%), \(R_f = 0.45\) (20% EtOAc in hexane); \(^1\)H NMR (400 MHz, CDCl\(_3\)): \(\delta\) 7.35-7.33 (m, 5H), 6.47 (d, 2H, \(J = 15.6\) Hz), 6.21-6.14 (m, 2H), 4.76 (s, 2H), 4.20-4.17 (m, 2H), 2.64-2.51 (m, 2H); \(^{13}\)C NMR (100 MHz, CDCl\(_3\)): \(\delta\) 156.9, 137.3, 132.3, 128.5, 127.2, 126.0, 125.7, 64.3, 32.6; GC-MS m/z (% relative intensity): 130(100), 129(74.6), 155(39.2), 91(9.3).
E. Synthesis of oxazolidinone standards

All the standard oxazolidinones, except 26 were synthesized by following a reported procedure\textsuperscript{13} as follows: To a stirred solution of carbamate (0.31 mmol) in 2 mL of CH\textsubscript{2}Cl\textsubscript{2} were added successively MgO (29.25 mg, 0.72 mmol, 2.3 equiv), Phl(OAc)\textsubscript{2} (122 mg, 0.25 mmol, 1.4 equiv) and Rh(II) catalyst (16 \mu mol, 0.05 equiv). The mixture was stirred vigorously and heated at 40 °C for 12 hrs. After cooling to 25 °C, the reaction was diluted with 10 mL of CH\textsubscript{2}Cl\textsubscript{2} and filtered through a pad of Celite (30 x 20 mm). The filter cake was rinsed with 2 x 10 mL of CH\textsubscript{2}Cl\textsubscript{2}. The combined filtrates were evaporated under reduced pressure and the isolated residue purified by chromatography on silica gel. Spectral data of 4-phenyloxazolidin-2-one (20), 3,3a,8,8a-tetrahydro-2H-indeno[1,2-d]oxazol-2-one (22) and (E)-4-styryloxazolidin-2-one (21) were found to be in good agreement with the reported ones.\textsuperscript{13-14}

4-methyl-4-phenyloxazolidin-2-one (5)

![4-methyl-4-phenyloxazolidin-2-one](image)

Yield (75%), \( R_f = 0.41 \) (30% EtOAc in hexane); \(^1\)H NMR (400 MHz, CDCl\textsubscript{3}): \( \delta 7.38-7.30 \) (m, 5H), 6.73 (s, 1H), 4.38 (d, 1H, \( J = 7.2 \) Hz), 4.34 (d, 1H, \( J = 7.2 \) Hz), 1.74 (s, 3H); \(^{13}\)C NMR (100 MHz, CDCl\textsubscript{3}): \( \delta 159.4, 143.5, 128.9, 127.9, 124.5, 78.0, 60.5, 27.9 \); GC-MS \( m/z \) (% relative intensity): 177(1.2), 163(10.4), 162(100), 146(1.9), 119(28.2), 104(39.3), 91(46.1).

4-methyl-4-(p-tolyl)oxazolidin-2-one (15)

![4-methyl-4-(p-tolyl)oxazolidin-2-one](image)

Yield (78%), \( R_f = 0.37 \) (30% EtOAc in hexane); \(^1\)H NMR (400 MHz, CDCl\textsubscript{3}): \( \delta 7.26-7.19 \) (m, 4H), 6.76 (s, 1H), 4.36 (d, 1H, \( J = 7.1 \) Hz), 4.34 (d, 1H, \( J = 7.1 \) Hz), 2.35 (s, 3H), 1.73 (s, 3H); \(^{13}\)C NMR (100 MHz, CDCl\textsubscript{3}): \( \delta 159.5, 140.5, 137.6, 129.5, 124.5, 78.1, 60.3, 27.8, 20.9 \); GC-MS \( m/z \) (% relative intensity): 191(8.6), 176(100), 146(10), 133(43.4), 118(42.6), 105(49.7), 91(14.3).
4-methyl-4-(4-(trifluoromethyl)phenyl)oxazolidin-2-one (16)

Yield (79%), R<sub>f</sub> = 0.32 (30% EtOAc in hexane); ¹H NMR (400 MHz, CDCl₃): δ 7.66 (d, 1H, J = 7.1 Hz), 7.50 (d, 1H, J = 7.2 Hz), 7.16 (s, 1H), 4.43 (d, 1H, J = 7.1 Hz), 4.35 (d, 1H, J = 7.1 Hz), 1.77 (s, 3H); ¹³C NMR (100 MHz, CDCl₃): δ 159.4, 147.5, 130.1, 126.0(2C), 125.1, 124.2, 77.6, 60.5, 27.9; GC-MS m/z (% relative intensity): 231(11.4), 230(100), 226(3.5), 187(28.2), 172(54.8), 159(74.1), 145(14.2).

4-(4-(tert-butyl)phenyl)-4-methyloxazolidin-2-one (17)

Yield (77%), R<sub>f</sub> = 0.30 (30% EtOAc in hexane); ¹H NMR (400 MHz, CDCl₃): δ 7.40 (d, 1H, J = 7.1 Hz), 6.22 (s, 1H), 4.34 (m, 2H), 1.74 (s, 3H), 1.31 (s, 9H); ¹³C NMR (100 MHz, CDCl₃): δ 159.2, 150.9, 140.3, 125.8, 124.4, 78.2, 60.1, 34.5, 31.2, 27.5; GC-MS m/z (% relative intensity): 233(5.2), 218(100), 203(4.9), 175(3.1), 160(20.6), 147(22.5), 133(20.8), 105(6.3), 91(5.4).

4-methyl-4-(m-tolyl)oxazolidin-2-one (18)

Yield (80%), R<sub>f</sub> = 0.36 (30% EtOAc in hexane); ¹H NMR (400 MHz, CDCl₃): δ 7.27-7.24 (m, 1H), 7.02 (s, 1H), 4.36 (d, 1H, J = 7.1 Hz), 4.33 (d, 1H, J = 7.1 Hz), 2.35 (s, 3H), 1.71 (s, 3H); ¹³C NMR (100 MHz, CDCl₃): δ 159.6, 143.6, 138.6, 128.8, 128.5, 125.2, 121.5, 77.9, 60.5, 27.9, 21.5; GC-MS m/z (% relative intensity): 191(3.8), 176(100), 146(6.4), 133(31.7), 118(46.9), 105(88.3), 91(35.3), 77(9.7).
4-(3,5-dimethylphenyl)-4-methyloxazolidin-2-one (19)

Yield (83%), R_f = 0.39 (30% EtOAc in hexane); \(^1\)H NMR (400 MHz, CDCl\(_3\)): \(\delta\) 6.95-6.93 (m, 3H), 6.82 (s, 1H), 4.35(d, 1H, \(J = 7.1\)Hz), 4.32(d, 1H, \(J = 7.1\)Hz), 2.31(s, 6H), 1.70 (s, 3H); \(^13\)C NMR (100 MHz, CDCl\(_3\)): \(\delta\) 159.5, 143.5, 138.5, 129.3, 122.3, 78.0, 60.4, 27.9, 21.4; GC-MS m/z (% relative intensity): 205(8.7), 190(100), 160(7.2), 147(38.4), 132(33), 119(84), 105(15.6), 91(27.8).

4-phenyloxazolidin-2-one (20)

Yield (70%), R_f = 0.40 (30% EtOAc in hexane); \(^1\)H NMR (400 MHz, CDCl\(_3\)): \(\delta\) 7.40-7.25 (m, 5H), 6.20 (s, 1H), 4.96-4.92 (t, 1H, \(J = 7.1\) Hz), 4.18-4.14 (dd, 1H, \(J_1 = 7.2, J_2 = 8.4\) Hz); \(^13\)C NMR (100 MHz, CDCl\(_3\)): \(\delta\) 159.8, 139.5, 129.6, 128.7, 126.0, 72.5, 56.2; GC-MS m/z (% relative intensity): 163(50.4), 133(80.1), 105(85.2), 104(100), 91(26.5), 78(17.2).

(E)-4-styryloxazolidin-2-one (21)

Yield (67%), R_f = 0.43 (30% EtOAc in hexane); \(^1\)H NMR (400 MHz, CDCl\(_3\)): \(\delta\) 7.36-7.26 (m, 5H), 6.60 (d, 1H, \(J = 14.1\) Hz), 6.15-6.10 (m, 1H), 5.82 (s, 1H), 4.61-4.57 (m, 2H), 4.14 (m, 1H); \(^13\)C NMR (100 MHz, CDCl\(_3\)): \(\delta\) 159.5, 135.3, 133.9, 128.7, 128.5, 126.3, 70.2, 55.1; GC-MS m/z (% relative intensity): 190(3.3), 189(24.5), 159(3.2), 144(37.3), 130(100), 115(21.8), 104(20.6), 91(15).
3,3a,8,8a-tetrahydro-2H-indeno[1,2-d]oxazol-2-one (22)

![Indeno[1,2-d]oxazol-2-one](image)

Yield (82%), \( R_f = 0.42 \) (30% EtOAc in hexane); \(^1\)H NMR (400 MHz, CDCl\(_3\)): \( \delta \) 7.28-7.22 (m, 5H), 6.91 (s, 1H), 5.41-5.38 (m, 1H), 5.16 (d, 1H, \( J = 7.2 \) Hz), 3.42-3.29 (m, 2H); \(^1^3\)C NMR (100 MHz, CDCl\(_3\)): \( \delta \) 159.7, 140.2, 139.7, 129.3, 127.9, 125.5, 124.8, 80.6, 61.2, 38.8; GC-MS \( m/z \) (% relative intensity): 175(100), 146(25.3), 131(95.6), 104(85.2), 78(24.7).

(3aS,4R,7S,7aS)-7-isopropyl-4-methylhexahydrobenzo[d]oxazol-2(3H)-one (25)

![Hexahydrobenzo[d]oxazol-2(3H)-one](image)

Yield (24%), \( R_f = 0.26 \) (30% EtOAc in hexane); \(^1\)H NMR (400 MHz, CDCl\(_3\)): \( \delta \) 5.31 (s, 1H), 3.80 (t, 1H, \( J = 11.2 \) Hz), 3.02 (t, 1H, \( J = 11.1 \) Hz), 1.88-1.69 (m, 4H), 1.59-1.22 (m, 1H), 0.99 (m, 11H); \(^1^3\)C NMR (100 MHz, CDCl\(_3\)): \( \delta \) 160.9, 85.1, 66.7, 45.4, 35.5, 32.5, 28.9, 25.7, 19.6, 18.5, 18.4; GC-MS \( m/z \) (% relative intensity): 154(100), 140(137.4), 110(46.5), 93(24.2), 69(41.7), 55(12.4).

(3aR,4R,7S,7aS)-7,8,8-trimethylhexahydro-4,7-methanobenzo[d]oxazol-2(3H)-one (26) was synthesized by pyrolysis of carbonazidate 24 in tetrachloroethane at 130 °C for 1h followed by purification on flash column chromatography.\(^7\)

![Hexahydro-4,7-methanobenzo[d]oxazol-2(3H)-one](image)

Yield (31%), \( R_f = 0.27 \) (30% EtOAc in hexane); \(^1\)H NMR (400 MHz, CDCl\(_3\)): \( \delta \) 6.04 (s, 1H), 4.59 (d, 1H, \( J = 7.2 \) Hz), 4.18-4.14 (m, 1H), 1.87-1.85 (m, 1H), 1.73-1.68 (m, 1H), 1.61-1.55 (m, 2H), 1.35-1.29 (m, 1H), 0.94 (s, 6H), 0.90 (s, 3H); \(^1^3\)C NMR (100 MHz, CDCl\(_3\)): \( \delta \) 160.6, 85.8, 54.9, 49.2, 48.5, 26.5, 20.1,
19.8, 17.9, 14.1; GC-MS m/z (% relative intensity): 195(5.1), 164(4.9), 134(7.4), 125(7.3), 119(8.5), 109(39.2), 95(100), 83(11.9).

(Z)-4-styryloxazolidin-2-one (Z-21)

Yield (65%), Rf = 0.44 (30% EtOAc in hexane); ¹H NMR (400 MHz, CDCl₃): δ 7.37-7.11 (m, 5H), 6.72 (d, 1H, J = 12.1 Hz), 6.30 (s, 1H), 5.71-5.66 (m, 1H), 4.85-4.79 (m, 1H), 4.58-4.54 (m, 1H), 4.14-4.10 (m, 1H); ¹³C NMR (100 MHz, CDCl₃): δ 159.8, 135.3, 134.1, 129.3, 128.5, 128.3, 127.8, 70.3, 50.2; GC-MS m/z (% relative intensity): 190(3.3), 189(24.5), 159(3.2), 144(37.3), 130(100), 115(21.8), 104(20.6), 91(15).
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