Electronic Supplementary Information

Metal-free Cascade construction of C-C bond by activation of inert C(sp3)-H bond

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General Information

The regents were used as purchased from chemical suppliers. All reactions were carried out under N$_2$ atmosphere using Schlenk technology. The initial reactants were prepared according to literature. Thin Layer Chromatography (TLC) was used to follow the progress of reactions. $^1$H NMR and $^{13}$C NMR spectra were obtained using 400 MHz spectrometer at room temperature, with TMS as internal standard. Chemical shifts (δ) are determined in ppm downfield from tetramethylsilane. Abbreviations for signal couplings are: s, singlet; d, doublet; t, triplet; q, quartet; m, multiplet.

Mechanism studies

Kinetic Isotope Effect experimental procedure

$N$-phenyl-$N$-(phenylsulfonyl)methacrylamide (0.2 mmol, 1 equiv), dicumyl peroxide (DCP, 0.6 mmol, 3 equiv), cyclohexane (0.5 mL), cyclohexane-d$_{12}$ (0.5 mL) and a stir bar were added into a sealed tube. The sealed tube was degassed by alternating vacuum evacuation and N$_2$ backfill three times. Then the sealed tube was heated at 140 °C for 12 h. And the mixture was concentrated in vacuum and the residue was purified using TLC on silica gel (GF254) to give the corresponding product 2. The KIE value was calculated according to $^1$H NMR spectra of the mixture of products a and b.

\[
k_{H}/k_D = 3.8
\]

Scheme 2. Mechanism studies
General information of activation of inert C(sp³)-H bond

N-phenyl-N-(phenylsulfonyl)methacrylamide (0.2 mmol, 1 equiv), dicumyl peroxide (DCP, 0.6 mmol, 3 equiv), cycloane (1 mL) and a stir bar were added into a sealed tube. The sealed tube was degassed by alternating vacuum evacuation and N₂ backfill three times. Then the tube was heated at
140 °C for 12 h. And the mixture was concentrated in vacuum and the residue was purified using TLC on silica gel to give the corresponding product 2.

References


Characterization of products 2

3-cyclohexyl-2-methyl-N-phenyl-2-(p-tolyl)propanamide (2a)

![2a]

yellow-green oil, 1H NMR (400 MHz, CDCl3) δ 7.36-7.22 (m, 6H), 7.18 (d, J = 8.1 Hz, 2H), 7.07-7.01 (m, 1H), 6.82 (s, 1H), 2.36 (s, 3H), 2.07-1.92 (m, 2H), 1.71-1.66 (m, 1H), 1.62 (s, 3H), 1.57-1.50 (m, 2H), 1.46-1.27 (m, 3H), 1.23-0.96 (m, 5H). 13C NMR (100 MHz, CDCl3): δ 175.6, 141.2, 138.0, 136.9, 129.5, 128.9, 124.0, 119.7, 51.2, 46.0, 35.3, 35.3, 34.1, 26.5, 26.4, 26.2, 24.4, 21.0. HRMS (ESI) calcd. for C23H30NO (M+H+): 336.2322, found: 336.2322.

3-cyclohexyl-2-methyl-N,2-diphenylpropanamide (2b)

![2b]

yellow-green oil, 1H NMR (400 MHz, CDCl3) δ 7.45-7.27 (m, 8H), 7.24 (s, 1H), 7.087-7.02 (m, 1H), 6.79 (s, 1H), 2.08-1.95 (m, 2H), 1.71-1.66 (m, 1H), 1.65 (s, 3H), 1.57-1.50 (m, 2H), 1.42-1.29 (m, 3H), 1.23-1.00 (m, 5H), 0.90-0.85 (m, 1H). 13C NMR (100 MHz, CDCl3) δ 175.4, 144.3, 138.0, 128.9, 128.8, 127.3, 126.9, 124.1, 119.7, 51.6, 46.0, 35.3, 35.2, 34.1, 26.44, 3.41, 26.2, 24.3. HRMS(ESI) calcd. for C22H28NO (M+H+): 322.2165, found: 322.2168.

2-(4-(tert-butyl)phenyl)-3-cyclohexyl-2-methyl-N-phenylpropanamide (2c)

![2c]

yellow-green oil, 1H NMR (400 MHz, CDCl3) δ 7.39-7.31 (m, 6H), 7.26 (m, 3H), 7.09-7.00 (m, 1H), 6.86 (s, 1H), 2.06-1.91 (m, 2H), 1.71-1.65 (m, 2H), 1.62 (s, 3H), 1.58-1.51 (m, 2H), 1.49-1.36 (m, 2H), 1.32 (s, 9H), 1.21-0.99 (m, 4H), 0.96-0.87 (m, 1H). 13C NMR (100 MHz, CDCl3): δ 175.5, 150.1, 141.3, 138.0, 128.9, 126.5, 125.7, 124.0, 119.8, 51.2, 46.1, 35.4, 35.2, 34.4, 34.1, 31.3, 26.5, 26.4, 26.2, 24.5. HRMS (ESI) calcd. for C28H40NO (M+H+): 406.3104, found: 406.3104.
3-cyclohexyl-N-(3,5-dimethoxyphenyl)-2-methyl-2-(p-tolyl)propanamide (2d)

![Structure of 2d]

yellow-green oil, $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 8.08 (d, $J = 3.0$ Hz, 1H), 7.69 (s, 1H), 7.35-7.29 (d, $J = 8.3$ Hz, 2H), 7.17 (d, $J = 8.0$ Hz, 2H), 6.68 (d, $J = 8.9$ Hz, 1H), 6.55-6.42 (m, 1H), 3.77 (s, 3H), 3.57 (s, 3H), 2.35 (s, 3H), 2.10-1.94 (m, 2H), 1.72-1.67 (m, 1H), 1.65 (s, 3H), 1.57-1.51 (m, 2H), 1.42 (m, 1H), 1.36-1.28 (m, 1H), 1.23-0.99 (m, 5H), 0.93-0.84 (m, 1H). $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$ 175.6, 154.0, 142.2, 141.2, 136.6, 129.3, 128.8, 126.8, 111.3, 108.6, 105.2, 56.5, 55.8, 51.5, 45.8, 35.3, 35.1, 34.1, 26.4, 26.4, 26.2, 24.0, 21.0. HRMS (ESI) calcd. for C$_{25}$H$_{34}$NO$_3$ (M+H$^+$): 396.2533, found: 396.2536.

3-cyclohexyl-N-(4-methoxyphenyl)-2-methyl-2-(p-tolyl)propanamide (2e)

![Structure of 2e]

yellow-green oil, $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.29 (d, $J = 8.0$ Hz, 2H), 7.26-7.21 (m, 2H), 7.17 (d, $J = 8.0$ Hz, 2H), 6.87-6.76 (m, 2H), 6.74 (s, 1H), 3.76 (s, 3H), 2.35 (s, 3H), 1.99 (s, 3H), 1.72-1.66 (m, 1H), 1.62 (s, 3H), 1.57-1.50 (m, 2H), 1.42-1.28 (m, 2H), 1.24-0.97 (m, 5H), 0.92-0.85 (m, 1H). $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$ 175.5, 156.24, 141.6, 136.8, 131.2, 129.5, 126.9, 121.6, 114.0, 55.5, 51.0, 46.0, 35.3, 35.3, 34.1, 26.5, 26.4, 26.21, 24.5, 21.0. HRMS (ESI) calcd. for C$_{24}$H$_{32}$NO$_2$ (M+H$^+$): 366.2428, found: 366.2425.

3-cyclohexyl-N-(3-methoxyphenyl)-2-methyl-2-(p-tolyl)propanamide (2f)

![Structure of 2f]

yellow-green oil, $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.31-7.26 (m, 2H), 7.22 (t, $J = 2.2$ Hz, 1H), 7.18 (d, $J = 8.0$ Hz, 2H), 7.12 (t, $J = 8.1$ Hz, 1H), 6.82 (s, 1H), 6.76-6.67 (m, 1H), 6.67-6.55 (m, 1H), 3.78 (s, 3H), 2.36 (s, 3H), 2.06-1.92 (m, 2H), 1.71-1.63 (m, 2H), 1.62 (s, 3H), 1.57-1.49 (m, 2H), 1.44-1.27 (m, 3H), 1.20-0.99 (m, 4H). $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$ 175.7, 160.1, 141.0, 139.3, 136.9, 129.6, 129.5, 126.8, 111.6, 110.1, 105.1, 55.3, 51.3, 45.9, 35.3, 35.3, 34.0, 26.4, 26.4, 26.2, 24.4, 21.0. HRMS (ESI) calcd. for C$_{23}$H$_{32}$NO$_2$ (M+H$^+$): 366.2428, found: 366.2428.
ethyl 3-(3-cyclohexyl-2-methyl-2-(p-tolyl)propanamido)benzoate (2g)

yellow-green oil, $^1$H NMR (400 MHz, CDCl$_3$) δ 7.86-7.79 (m, 1H), 7.76-7.69 (m, 2H), 7.35 (t, J = 7.9 Hz, 1H), 7.31-7.27 (m, 2H), 7.19 (d, J = 8.1 Hz, 2H), 6.92 (s, 1H), 4.35 (q, J = 7.1 Hz, 2H), 2.37 (s, 3H), 2.07-1.93 (m, 2H), 1.69-1.65 (m, 1H), 1.63 (s, 3H), 1.61-1.49 (m, 3H), 1.42-1.30 (m, 5H), 1.22-0.99 (m, 4H), 0.92-0.84 (m, 1H). $^{13}$C NMR (100 MHz, CDCl$_3$) δ 175.9, 166.3, 140.8, 138.2, 137.1, 131.1, 129.6, 129.0, 126.8, 125.0, 124.1, 120.3, 61.1, 51.3, 45.9, 35.3, 35.2, 34.0, 26.4, 26.2, 24.3, 21.0, 14.3. HRMS (ESI) calcd. For C$_{26}$H$_{34}$NO$_3$ (M+H$^+$): 408.2533, found: 408.2533.

3-cyclohexyl-N-(4-fluorophenyl)-2-methyl-2-(p-tolyl)propanamide (2h)

yellow-green oil, $^1$H NMR (400 MHz, CDCl$_3$) δ 7.39-7.26 (m, 4H), 7.18 (d, J = 8.1 Hz, 2H), 6.97-6.92 (m, 2H), 6.79 (s, 1H), 2.36 (s, 3H), 2.05-1.92 (m, 2H), 1.69-1.64 (m, 1H), 1.62 (s, 3H), 1.57-1.52 (m, 2H), 1.42-1.29 (m, 3H), 1.22-0.99 (m, 4H), 0.92-0.85 (m, 1H). $^{13}$C NMR (100 MHz, CDCl$_3$) δ 175.7, 141.1, 137.0, 129.6, 126.8, 121.6, 121.5, 115.6, 115.4, 51.1, 45.9, 35.3, 35.2, 34.0, 30.3, 26.4, 26.2, 24.4, 21.0. HRMS (ESI) calcd. for C$_{23}$H$_{29}$FNO (M+H$^+$): 376.2047, found: 376.2048.

N-(4-chlorophenyl)-3-cyclohexyl-2-methyl-2-(p-tolyl)propanamide (2i)

yellow-green oil, $^1$H NMR (400 MHz, CDCl$_3$) δ 7.31-7.26 (m, 4H), 7.24-7.15 (m, 4H), 6.81 (s, 1H), 2.36 (s, 3H), 2.04-1.91 (m, 2H), 1.68-1.63 (m, 1H), 1.61 (s), 1.57-1.49 (m, 2H), 1.42-1.30 (m, 2H), 1.24-0.80 (m, 6H). $^{13}$C NMR (100MHz, CDCl$_3$) δ 175.72, 140.9, 137.0, 136.6, 129.6, 129.0, 128.9, 126.8, 120.9, 51.3, 45.9, 35.3, 35.2, 34.0, 26.4, 26.2, 24.4, 21.0. HRMS (ESI) calcd. for C$_{23}$H$_{29}$ClNO (M+H$^+$): 370.1932, found: 370.1933.

N-(4-bromophenyl)-3-cyclohexyl-2-methyl-2-(p-tolyl)propanamide (2j)
yellow-green oil, $^1$H NMR (400 MHz, CDCl$_3$) δ 7.38-7.33 (m, 2H), 7.30-7.26 (m, 2H), 7.26-7.21 (m, 2H), 7.18 (d, $J = 8.0$ Hz, 2H), 6.81 (s, 1H), 2.36 (s, 3H), 2.05-1.91 (m, 2H), 1.68-1.63 (m, 1H), 1.61 (s, 3H), 1.57-1.50 (m, 2H), 1.41-1.29 (m, 2H), 1.24-0.82 (m, 6H), $^{13}$C NMR (100 MHz, CDCl$_3$) δ 175.7, 140.9, 137.1, 131.8, 129.6, 126.8, 121.2, 116.5, 51.3, 45.9, 35.3, 35.2, 34.0, 26.4, 26.4, 26.2, 24.4, 21.0. HRMS (ESI) calcd. for C$_{23}$H$_{29}$BrNO (M+H$^+$): 414.1427, found: 414.1425.

3-cyclooctyl-($N$-(3,5-dimethoxyphenyl)-2-methyl-2-($p$-tolyl)propanamide (2o)

yellow-green oil, $^1$H NMR (400 MHz, CDCl$_3$) δ 8.08 (d, $J = 8.0$ Hz, 1H), 7.67 (s, 1H), 7.33-7.28 (m, 2H), 7.18 (d, $J = 8.0$ Hz, 2H), 6.68 (d, $J = 8.9$ Hz, 1H), 6.53-6.46 (m, 1H), 3.50 (s, 3H), 2.35 (s, 3H), 2.15-1.98 (m, 2H), 1.64 (s, 3H), 1.64-1.62 (m, 1H), 1.59-1.34 (m, 13H), 1.24-1.19 (m, 1H), $^{13}$C NMR (100 MHz, CDCl$_3$) δ 175.6, 154.0, 142.2, 141.1, 136.6, 129.3, 128.9, 126.9, 111.4, 108.6, 105.2, 56.5, 55.8, 51.9, 46.3, 34.1, 33.9, 33.4, 27.3, 26.3, 25.2, 25.0, 23.9, 21.0. HRMS (ESI) calcd. for C$_{27}$H$_{38}$NO$_3$ (M+H$^+$): 424.2846, found: 424.2843.

3-cyclopentyl-($N$-(3,5-dimethoxyphenyl)-2-methyl-2-($p$-tolyl)propanamide (2p)

yellow-green oil, $^1$H NMR (400 MHz, CDCl$_3$) δ 8.09 (d, $J = 8.0$ Hz, 1H), 7.69 (s, 1H), 7.34-7.29 (m, 2H), 7.18 (d, $J = 8.0$ Hz, 2H), 6.71-6.65 (d, $J = 9.0$ Hz 1H), 6.53-6.47 (m, 1H), 3.77 (s, 3H), 3.57 (s, 3H), 2.35 (s, 3H), 2.27-2.16 (m, 2H), 1.81-1.69 (m, 2H), 1.66 (s, 3H), 1.59-1.50 (m, 3H), 1.43-1.33 (m, 2H), 1.19-1.10 (m, 1H), 1.04-0.96 (m, 1H), $^{13}$C NMR (100 MHz, CDCl$_3$) δ 175.7, 154.0, 142.2, 141.1, 136.6, 129.3, 128.9, 126.9, 111.4, 108.6, 105.15, 56.6, 55.8, 51.8, 44.8, 36.7, 34.7, 34.5, 25.0, 24.9, 24.2, 21.0. HRMS (ESI) calcd. for C$_{24}$H$_{32}$NO$_3$ (M+H$^+$): 382.2377, found: 382.3376.

3-cyclooctyl-($N$-(4-methoxyphenyl)-2-methyl-2-($p$-tolyl)propanamide (2q)
yellow-green oil, $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.31-7.27 (m, 2H), 7.26-7.21 (m, 2H), 7.18 (d, $J$ = 8.0 Hz, 2H), 6.83-6.76 (m, 2H), 6.73 (s, 1H), 3.76 (s, 3H), 2.35 (s, 3H), 2.10-1.95 (m, 2H), 1.62 (s, 3H), 1.59-1.28 (m, 14H), 1.23 (m, 1H). $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$ 175.6, 156.2, 141.2, 136.8, 131.2, 129.5, 127.0, 121.6, 114.0, 55.5, 51.4, 46.5, 34.1, 34.1, 33.3, 27.3, 27.3, 26.3, 25.2, 25.0, 24.4, 21.0. HRMS (ESI) calcd. for C$_{26}$H$_{36}$NO$_2$ (M+H$^+$): 394.2741, found: 394.2743.

3-cyclopentyl-N-(4-methoxyphenyl)-2-methyl-2-(p-tolyl)propanamide (2r)

yellow-green oil, $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.32-7.26 (m, 3H), 7.25-7.23 (m, 1H), 7.18 (d, $J$ = 8.0 Hz, 2H), 6.83-6.76 (m, 2H), 6.73 (s, 1H), 3.76 (s, 3H), 2.36 (s, 3H), 2.25-2.13 (m, 2H), 1.82-1.68 (m, 2H), 1.63 (s, 3H), 1.58-1.47 (m, 3H), 1.42-1.32 (m, 2H), 1.17-1.09 (m, 1H), 1.02-0.93 (m, 1H). $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$ 175.6, 156.2, 141.3, 136.8, 131.2, 129.5, 127.0, 121.5, 114.0, 55.5, 51.3, 45.0, 36.7, 34.6, 25.0, 24.9, 24.6, 21.0. HRMS (ESI) calcd. for C$_{23}$H$_{30}$NO$_2$ (M+H$^+$): 352.2271, found: 352.2269.

N-(4-chlorophenyl)-3-cyclopentyl-2-methyl-2-(p-tolyl)propanamide (2s)

yellow-green oil, $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.31 (t, $J$ = 2.0 Hz, 1H), 7.29 (s, 2H), 7.27 (t, $J$ = 1.6 Hz, 1H), 7.23-7.16 (m, 4H), 6.81 (s, 1H), 2.36 (s, 3H), 2.18 (m, 2H), 1.79-1.66 (m, 3H), 1.62 (s, 3H), 1.55-1.49 (m, 2H), 1.43-1.30 (m, 2H), 1.16-1.07 (m, 1H), 1.02-0.91 (m, 1H). $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$ 175.8, 140.8, 137.1, 136.6, 129.6, 128.9, 128.9, 126.9, 120.9, 51.5, 44.9, 36.6, 34.6, 34.5, 25.0, 24.9, 24.5, 21.0. HRMS (ESI) calcd. for C$_{22}$H$_{26}$ClNNaO (M+Na$^+$): 378.1595, found: 378.1598.

3-cyclopentyl-2-methyl-N,2-di-p-tolylpropanamide (2t):
yellow-green oil, $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.33-7.26 (m, 2H), 7.25-7.20 (m, 2H), 7.18 (d, $J = 8.0$ Hz, 2H), 7.06 (d, $J = 8.3$ Hz, 2H), 6.76 (s, 1H), 2.36 (s, 3H), 2.27 (s, 3H), 2.25-2.12 (m, 2H), 1.80-1.68 (m, 2H), 1.62 (s, 3H), 1.58-1.46 (m, 3H), 1.42-1.32 (m, 2H), 1.18-1.10 (m, 1H), 1.03-0.92 (m, 1H). $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$ 175.6, 141.2, 136.9, 135.5, 133.6, 129.5, 129.3, 127.0, 119.7, 51.4, 45.0, 36.7, 34.6, 34.5, 25.0, 24.9, 24.6, 21.0, 20.8. HRMS (ESI) calcd. for C$_{23}$H$_{30}$NO (M+H$^+$): 336.2322, found: 336.2321.

3-cyclooctyl-2-methyl-N-phenyl-2-(p-tolyl)propanamide (2u)

yellow-green oil, $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.36-7.32 (m, 2H), 7.32-7.26 (m, 3H), 7.25-7.22 (m, 1H), 7.18 (d, $J = 8.0$ Hz, 2H), 7.07-7.02 (m, 1H), 6.82 (s, 1H), 2.36 (s, 3H), 2.11-1.95 (m, 2H), 1.64 (s, 1H), 1.62 (s, 3H), 1.60-1.34 (m, 12H), 1.29-1.27 (m, 1H), 1.24-1.13 (m, 2H). $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$ 175.7, 141.1, 138.0, 136.9, 129.5, 128.9, 127.0, 124.0, 119.7, 51.6, 46.5, 34.1, 33.3, 27.3, 27.3, 26.23, 25.2, 25.0, 24.3, 21.0. HRMS (ESI) calcd for C$_{25}$H$_{34}$NO (M+H$^+$): 364.2635, found: 364.2636.

3-cyclopentyl-2-methyl-N-phenyl-2-(p-tolyl)propanamide (2v)

yellow-green oil, $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.36-7.33 (m, 2H), 7.31-7.27 (m, 2H), 7.25-7.23 (m, 1H), 7.19 (d, $J = 8.1$ Hz, 2H), 7.06-7.02 (m, 1H), 6.82 (s, 1H), 2.36 (s, 3H), 2.26-2.13 (m, 2H), 1.81-1.71 (m, 2H), 1.64 (s, 3H), 1.57-1.47 (m, 3H), 1.45-1.35 (m, 2H), 1.17-1.09 (m, 1H), 1.02-0.93 (m, 1H). $^{13}$C NMR (100 MHz, CDCl$_3$): $\delta$ 175.8, 141.1, 138.1, 136.9, 129.6, 128.9, 127.0, 124.0, 119.6, 51.5, 44.9, 36.7, 34.6, 34.6, 25.0, 24.9, 24.6, 21.0. HRMS (ESI) calcd for C$_{22}$H$_{28}$NO (M+H$^+$): 322.2165, found: 322.2163.

3-cyclooctyl-2-(4-fluorophenyl)-2-methyl-N-phenylpropanamide (2w)
yellow-green oil, $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.42-7.31 (m, 4H), 7.30-7.23 (m, 2H), 7.12-7.02 (m, 2H), 6.77 (s, 1H), 2.11-1.94 (m, 2H), 1.64 (s, 3H), 1.59-1.31 (m, 12H), 1.04-0.80 (m, 2H). $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$ 175.1, 128.9, 128.7, 124.2, 119.7, 115.8, 115.5, 51.5, 46.8, 34.2, 34.1, 33.3, 27.2, 27.2, 26.3, 25.2, 25.1, 24.3. HRMS (ESI) calcd for C$_{24}$H$_{30}$FNNaO (M+Na$^+$): 390.2204, found: 390.2206.

2-(4-(tert-butyl)phenyl)-3-cyclooctyl-2-methyl-N-phenylpropanamide (2x)

yellow-green oil, $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.41-7.30 (m, 6H), 7.29-7.24 (m, 2H), 7.08-7.03 (m, 1H), 6.85 (s, 1H), 2.09-1.95 (m, 2H), 1.63 (s, 3H), 1.60 (s, 3H), 1.56-1.34 (m, 11H), 1.33 (s, 9H), 1.30 - 1.27 (m, 1H), 1.25-1.16 (m, 2H). $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$ 175.6, 150.1, 141.0, 138.1, 128.9, 126.7, 125.6, 124.0, 119.8, 51.6, 46.8, 34.5, 34.3, 34.2, 33.3, 31.3, 27.3, 27.2, 26.3, 25.2, 25.1, 24.4. HRMS (ESI) calcd for C$_{28}$H$_{40}$NO (M+H$^+$): 406.3104, found: 406.3104.

Copies of $^1$H NMR, $^{13}$C NMR

3-cyclohexyl-2-methyl-N-phenyl-2-(p-tolyl)propanamide (2a)
3-cyclohexyl-2-methyl-N,2-diphenylpropanamide (2b)
2-(4-(tert-butyl)phenyl)-3-cyclohexyl-2-methyl-N-phenylpropanamide (2c)

2-(4-(tert-butyl)phenyl)-3-cyclohexyl-2-methyl-N-phenylpropanamide (2c)
3-cyclohexyl-N-(3,5-dimethoxyphenyl)-2-methyl-2-(p-tolyl)propanamide (2d)
3-cyclohexyl-N-(4-methoxyphenyl)-2-methyl-2-(p-tolyl)propanamide (2e)
3-cyclohexyl-N-(3-methoxyphenyl)-2-methyl-2-(p-tolyl)propanamide (2f)
ethyl 3-(3-cyclohexyl-2-methyl-2-(p-tolyl)propanamido)benzoate (2g)
3-cyclohexyl-N-(4-fluorophenyl)-2-methyl-2-(p-tolyl)propanamide (2h)
**N-(4-chlorophenyl)-3-cyclohexyl-2-methyl-2-(p-tolyl)propanamide (2i)**

![Chemical Structure Image]

**Formula:** C24H25ClFNO2

**Physical Properties:**
- mp: 142.6 - 143.6 °C
- IR (KBr): 3083, 3002, 2904, 2876, 1648, 1463, 1372, 1284, 1174, 1089, 979, 835, 770, 691, 609 cm⁻¹

**NMR Spectra:**
- 1H NMR (DMSO-d6):
  - δ (ppm)
  - 2.00 (s, 3H)
  - 7.31 (d, J=8.2 Hz, 2H)
  - 7.25 (d, J=7.7 Hz, 2H)
  - 6.64 (d, J=7.7 Hz, 1H)
  - 5.81 (s, 1H)
  - 4.40 (q, J=7.7 Hz, 2H)
  - 3.55 (s, 2H)
  - 1.92 (s, 3H)

**Mass Spectral Data:**
- MS (ESI): m/z 435.1 (M+H)⁺
$N$-(4-bromophenyl)-3-cyclohexyl-2-methyl-2-(p-tolyl)propanamide (2j)
3-cyclooctyl-N-(3,5-dimethoxyphenyl)-2-methyl-2-(p-tolyl)propanamide (2o)
3-cyclopentyl-N-(3,5-dimethoxyphenyl)-2-methyl-2-(p-tolyl)propanamide (2p)
3-cyclooctyl-N-(4-methoxyphenyl)-2-methyl-2-(p-tolyl)propanamide (2q)
3-cyclopentyl-N-(4-methoxyphenyl)-2-methyl-2-(p-tolyl)propanamide (2r)
N-(4-chlorophenyl)-3-cyclopentyl-2-methyl-2-(p-tolyl)propanamide (2s)
3-cyclopentyl-2-methyl-N,2-di-p-toly1propanamide (2t)
3-cyclooctyl-2-methyl-N-phenyl-2-(p-tolyl)propanamide (2u)
3-cyclopentyl-2-methyl-N-phenyl-2-(p-tolyl)propanamide (2v)
3-cyclooctyl-2-(4-fluorophenyl)-2-methyl-N-phenylpropanamide (2w)
2-(4-(tert-butyl)phenyl)-3-cyclooctyl-2-methyl-N-phenylpropanamide (2x)