Supporting Information
for
Catalyst-free and solvent-free Michael addition of 1,3-dicarbonyl compounds to nitroalkenes by a grinding method

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General procedures and analytical data
Materials and general information

All reagents were obtained from commercial suppliers and were used without further purification unless otherwise noted. 1,3-cyclopentanedione was purified by flash column chromatography (silicagel, 300–400 mesh) prior to use. $^1$H NMR and $^{13}$C NMR spectra were recorded on a Bruker 400 MHz instrument by using CDCl$_3$ or DMSO-$d_6$ as a solvent with tetramethylsilane (TMS) as an internal standard at room temperature. Chemical shifts are given in $\delta$ relative to TMS; the coupling constants $J$ are given in Hz. HPLC was carried out by using a Shimadzu organizer consisting of a LC-2010A HT Integrator and a UV–vis detector. C18 column (150 mm × 46 mm) was used in the HPLC experiments with MeOH/H$_2$O 30:70, 0.5 mL/min and $\lambda_{\text{max}} = 265$ nm. HRMS were performed on Bruker Daltonics Bio TOF mass spectrometer. Column chromatography was performed on EM silica gel (200–300 mesh).

General procedure for the preparation of nitroalkenes

Aldehyde (0.05 mol), MeNO$_2$ (0.05 mol), and MeOH (10–20 mL) were added to a round-bottom flask and then stirred vigorously. NaOH solution (10.5 M, 10 mL) was added dropwise in an ice bath; a large amount of white or yellow solid precipitated, and stirring was continued for 15 min. Distilled H$_2$O was added until the solution became clear, then the solution was added dropwise to concentrated HCl (30 mL), and a yellow solid precipitated. The yellow solid was filtered and washed with H$_2$O, then evaporated in a vacuum drying oven. After recrystallization (EtOH), yellow needle-like crystals were obtained.

General procedure for the model reaction (optimizing conditions)

A quantity of $\beta$-nitrostyrene, 1,3-cyclopentanedione and grinding aid were added in a mortar, and after 10 min of continuous grinding, the mixture was left standing at rt for 10 min. Then, the reaction was quenched with MeOH. The reaction mixture was transferred to a centrifuge tube, shaken and centrifuged fully, and the yield was extracted by HPLC using the supernatant.

General procedure for the catalyst-free and solvent-free Michael addition

Nitroalkene (0.36 mmol), 1,3-dicarbonyl compound (0.30 mmol) and quartz sand (2.25 g) were added in a mortar, mixed thoroughly and ground well (intermittently) at rt, and then even placed overnight until reacted completely. The mixture was purified directly by flash column chromatography to give the product without any pretreatment. For the simpler purification procedure, the reaction mixture was transferred to a sand core funnel in which a thin layer of column-layer chromatographic silica gel was laid down in advance, and then the elution process was performed. First, redundant $\beta$-nitrostyrene was directly eluted with dichloromethane, and then the pure product was obtained by using dichloromethane/methanol 5:1 v/v as eluent.

No Michael product was detected in the reaction of $\beta$-nitrostyrene and cyclohexane-1,3-dione, and another product was only obtained by a tandem process (Scheme S1, 73% yield).
Scheme S1: The tandem reaction of β-nitrostyrene and cyclohexane-1,3-dione

Investigation of the reactivity of various nitroalkenes

The reactivity of various nitroalkenes with 1,3-cyclopentanedione was studied (Table S1). Compared with β-nitrostyrene (Table S1, entry 1), its derivatives showed lower reactivity (Table S1, entries 2–4,6–12) with the exception of 1-chloro-3-(2-nitrovinyl)benzene (Table S1, entry 5), and especially low in the cases of (2-nitroprop-1-en-1-yl)benzene (Table S1, entry 12) and 1-nitro-2-(2-nitrovinyl)benzene (Table S1, entry 9), where steric effects or electronic effects were probably the main reasons.

Table S1: The reactivity of different nitroalkenes with 1,3-cyclopentanedione. a

<table>
<thead>
<tr>
<th>Entry</th>
<th>Acceptor</th>
<th>Conv. [%] b</th>
<th>Entry</th>
<th>Acceptor</th>
<th>Conv. [%] b</th>
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<td>( \text{Ph} )</td>
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<td>( \text{Ph} )</td>
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<tr>
<td>5</td>
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<td>12</td>
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<tr>
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<td>13</td>
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<td>( \text{Br} )</td>
<td>25</td>
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</table>

aConditions: acceptor (0.12 mmol), 1,3-cyclopentanedione (0.1 mmol), quartz sand (0.75 g), ground for 10 min and stood for 10 min. bConv. referring to the percentage conversion of 1,3-cyclopentanedione as determined by HPLC.
Analytical data of products

1,3-Cyclopentanedione (material)

\[
\text{O} \quad \text{O}
\]

\(^1\)H NMR (400 MHz, DMSO-\(d_6\)) δ 12.07 (s, 1 H), 5.09 (s, 1 H), 2.38 (s, 4 H); \(^{13}\)C NMR (100 MHz, DMSO-\(d_6\)) δ 105.46, 31.70.

2-(2-Nitro-1-phenylethyl)cyclopentane-1,3-dione (3a)

\[
\text{O} \quad \text{O} \quad \text{NO}_2
\]

\(^1\)H NMR (400 MHz, DMSO-\(d_6\)) δ 12.31 (s, 1 H), 7.34–7.19 (m, 5 H), 5.23–5.12 (m, 2 H), 4.47 (t, \(J = 8.2\) Hz, 1 H), 2.38 (s, 4 H); \(^{13}\)C NMR (100 MHz, DMSO-\(d_6\)) δ 140.19, 128.99, 128.08, 127.42, 114.66, 77.05, 38.53, 30.61; HRMS–ESI (\(m/z\)): [M + Na]^+ calcd for C\(_{13}\)H\(_{13}\)NO\(_4\), 270.0737; found, 270.0738.

2-(1-(4-Fluorophenyl)-2-nitroethyl)cyclopentane-1,3-dione (3b)

\[
\text{O} \quad \text{O} \quad \text{NO}_2
\]

\(^1\)H NMR (400 MHz, DMSO-\(d_6\)) δ 7.38–7.34 (m, 2 H), 7.12 (t, \(J = 8.8\) Hz, 2 H), 5.20–5.09 (m, 2 H), 4.46 (t, \(J = 8.2\) Hz, 1 H), 2.38 (s, 4 H); \(^{13}\)C NMR (100 MHz, DMSO-\(d_6\)) δ 144.92, 128.92, 128.29, 127.97, 126.02–125.86 (m), 123.31, 113.80, 114.45, 77.04, 37.80, 30.59; HRMS–ESI (\(m/z\)): [M + H]^+ calcd for C\(_{13}\)H\(_{12}\)FNO\(_4\), 266.0823; found: 266.0834.

2-(2-Nitro-1-(4-(trifluoromethyl)phenyl)ethyl)cyclopentane-1,3-dione (3c)

\[
\text{O} \quad \text{O} \quad \text{NO}_2
\]

\(^1\)H NMR (400 MHz, DMSO-\(d_6\)) δ 7.67 (d, \(J = 8.2\) Hz, 2 H), 7.56 (d, \(J = 8.2\) Hz, 2 H), 5.24 (d, \(J = 8.2\) Hz, 2 H), 4.57 (t, \(J = 8.1\) Hz, 1 H), 2.39 (s, 4 H); \(^{13}\)C NMR (100 MHz, DMSO-\(d_6\)) δ 144.92, 128.92, 128.29, 127.97, 126.02–125.86 (m), 123.31, 113.80, 76.41, 38.24, 30.64; HRMS–ESI (\(m/z\)): [M + H]^+ calcd for C\(_{14}\)H\(_{12}\)F\(_3\)NO\(_4\), 316.0791; found, 316.0802.

2-(1-(4-Chlorophenyl)-2-nitroethyl)cyclopentane-1,3-dione (3d)

\[
\text{O} \quad \text{O} \quad \text{NO}_2
\]

\(^1\)H NMR (400 MHz, DMSO-\(d_6\)) δ 7.35 (s, 4 H), 5.18–5.15 (m, 2 H), 4.46 (t, \(J = 8.2\) Hz, 1 H), 2.39 (s, 4 H); \(^{13}\)C NMR (100 MHz, DMSO-\(d_6\)) δ 139.14, 132.11, 129.97, 128.96, 114.19, 76.75, 37.88, 30.63; HRMS–ESI (\(m/z\)): [M + Na]^+ calcd for C\(_{13}\)H\(_{12}\)ClNO\(_4\), 304.0347; found, 304.0356.
2-(1-(3-Chlorophenyl)-2-nitroethyl)cyclopentane-1,3-dione (3e)

\[
\begin{align*}
\text{H NMR} & \ (400 \text{ MHz, DMSO-d}_6) \ \delta \ 7.39 \ (s, \ 1 \text{ H}), 7.36–7.28 \ (m, \ 3 \text{ H}), 5.20–5.17 \ (m, \ 2 \text{ H}), \\
& \ 4.47 \ (t, \ J = 8.1 \text{ Hz}, \ 1 \text{ H}), 2.40 \ (s, \ 4 \text{ H}); \ \text{C NMR} \ (100 \text{ MHz, DMSO-d}_6) \ \delta \ 142.58, 133.53, 130.92, 127.89, \\
& \ 127.52, 126.89, 113.99, 76.59, 38.12, 30.66; \ \text{HRMS–ESI} \ (m/z): \ [M + H]^+ \ \text{calcd for} \ C_{13}H_{12}ClNO_4, \ 282.0528; \ \text{found}, \ 282.0533.
\end{align*}
\]

2-(1-(4-Bromophenyl)-2-nitroethyl)cyclopentane-1,3-dione (3f)

\[
\begin{align*}
\text{H NMR} & \ (400 \text{ MHz, DMSO-d}_6) \ \delta \ 7.49 \ (d, \ J = 8.4 \text{ Hz}, \ 2 \text{ H}), 7.29 \ (d, \ J = 8.4 \text{ Hz}, \\
& \ 2 \text{ H}), 5.19–5.15 \ (m, \ 2 \text{ H}), 4.45 \ (t, \ J = 8.2 \text{ Hz}, \ 1 \text{ H}), 2.39 \ (s, \ 4 \text{ H}); \ \text{C NMR} \ (100 \text{ MHz, DMSO-d}_6) \ \delta \ 139.07, \\
& \ 131.39, 129.84, 120.11, 113.63, 76.16, 37.43, 30.14; \ \text{HRMS–ESI} \ (m/z): \ [M + Na]^+ \ \text{calcd for} \ C_{13}H_{12}BrNO_4, \ 347.9842; \ \text{found}, \ 347.9840.
\end{align*}
\]

2-(1-(2-Bromophenyl)-2-nitroethyl)cyclopentane-1,3-dione (3g)

\[
\begin{align*}
\text{H NMR} & \ (400 \text{ MHz, DMSO-d}_6) \ \delta \ 7.60 \ (d, \ J = 8.0 \text{ Hz}, \ 1 \text{ H}), 7.54 \ (d, \ J = 7.8 \text{ Hz}, \ 1 \text{ H}), \\
& \ 7.34 \ (t, \ J = 7.5 \text{ Hz}, \ 1 \text{ H}), 7.18 \ (t, \ J = 7.6 \text{ Hz}, \ 1 \text{ H}), 5.23–5.16 \ (m, \ 1 \text{ H}), 4.95–4.90 \ (m, \ 2 \text{ H}), 2.41 \ (s, \ 4 \text{ H}); \ \text{C NMR} \ (100 \text{ MHz, DMSO-d}_6) \ \delta \ 138.61, 133.30, 130.20, \\
& \ 129.59, 128.47, 124.07, 113.11, 75.82, 38.12, 30.69; \ \text{HRMS–ESI} \ (m/z): \ [M + H]^+ \ \text{calcd for} \ C_{13}H_{12}BrNO_4, \ 326.0022; \ \text{found}, \ 326.0023.
\end{align*}
\]

2-(2-Nitro-1-(4-nitrophenoxy)ethyl)cyclopentane-1,3-dione (3h)

\[
\begin{align*}
\text{H NMR} & \ (400 \text{ MHz, DMSO-d}_6) \ \delta \ 8.17 \ (d, \ J = 8.7 \text{ Hz}, \ 2 \text{ H}), 7.61 \ (d, \ J = 8.7 \text{ Hz}, \\
& \ 2 \text{ H}), 5.31–5.20 \ (m, \ 2 \text{ H}), 4.61 \ (t, \ J = 8.1 \text{ Hz}, \ 1 \text{ H}), 2.40 \ (s, \ 4 \text{ H}); \ \text{C NMR} \ (100 \text{ MHz, DMSO-d}_6) \ \delta \ 147.81, \\
& \ 146.98, 129.38, 124.19, 113.46, 76.10, 38.15, 30.66; \ \text{HRMS–ESI} \ (m/z): \ [M + H]^+ \ \text{calcd for} \ C_{13}H_{12}N_2O_6, \ 293.0768; \ \text{found}, \ 293.0774.
\end{align*}
\]
2-(2-Nitro-1-(2-nitrophenyl)ethyl)cyclopentane-1,3-dione (3i)

\[ \text{1H NMR (400 MHz, DMSO-}d_6\text{)} \delta 7.86 (d, J = 8.1 \text{ Hz, 1 H}), 7.75 (d, J = 7.7 \text{ Hz, 1 H}), 7.67 (t, J = 7.5 \text{ Hz, 1 H}), 7.49 (t, J = 7.6 \text{ Hz, 1 H}), 5.38–5.33 (m, 1 H), 5.13–5.08 (m, 1 H), 4.97–4.93 (m, 1 H), 2.37 (s, 4 H); \text{13C NMR (100 MHz, DMSO-}d_6\text{)} \delta 149.03, 133.21, 133.14, 130.09, 128.49, 124.16, 112.76, 75.24, 32.98, 30.10; \text{HRMS–ESI (m/z): [M + H]}^+ \text{calcd for C}_{13}H_{12}N_2O_6, 293.0768; \text{found, 293.0779.}

2-(2-Nitro-1-(p-tolyl)ethyl)cyclopentane-1,3-dione (3j)

\[ \text{1H NMR (400 MHz, DMSO-}d_6\text{)} \delta 6.97 (d, J = 7.9 \text{ Hz, 2 H}), 6.85 (d, J = 7.9 \text{ Hz, 2 H}), 4.95–4.85 (m, 2 H), 4.18 (t, J = 8.2 \text{ Hz, 1 H}), 2.14 (s, 4 H), 2.00 (s, 3 H); \text{13C NMR (100 MHz, DMSO-}d_6\text{)} \delta 137.16, 136.56, 129.52, 127.94, 114.80, 77.15, 38.18, 30.59, 21.02; \text{HRMS–ESI (m/z): [M + H]}^+ \text{calcd for C}_{14}H_{15}NO_4, 262.1074; \text{found, 262.1085.}

2-(1-(4-Methoxyphenyl)-2-nitroethyl)cyclopentane-1,3-dione (3k)

\[ \text{1H NMR (400 MHz, DMSO-}d_6\text{)} \delta 7.25 (d, J = 8.5 \text{ Hz, 2 H}), 6.85 (d, J = 8.5 \text{ Hz, 2 H}), 5.17–5.06 (m, 2 H), 4.41 (t, J = 8.2 \text{ Hz, 1 H}), 3.71 (s, 3 H), 2.38 (s, 4 H); \text{13C NMR (100 MHz, DMSO-}d_6\text{)} \delta 158.67, 132.13, 129.17, 114.94, 114.35, 77.35, 37.84, 30.60; \text{HRMS–ESI (m/z): [M + H]}^+ \text{calcd for C}_{13}H_{15}NO_5, 278.1023; \text{found, 278.1032.}

2-(2-Nitro-1-phenylpropyl)cyclopentane-1,3-dione (3l)

\[ \text{1H NMR (400 MHz, DMSO-}d_6\text{)} \delta 7.43–7.18 (m, 5 H), 5.81–5.70 (m, 1 H), 4.11–4.04 (m, 1 H), 2.39 (s, 0.71 H), 2.32 (s, 3.17), 1.45 (d, J = 6.5 \text{ Hz, 0.56 H}), 1.26 (d, J = 6.7 \text{ Hz, 2.49 H}); \text{13C NMR (100 MHz, DMSO-}d_6\text{)} \delta 140.61, 139.92, 129.14, 128.95, 128.87, 128.13, 127.57, 127.50, 115.35, 114.66, 85.34, 83.52, 45.59, 45.42, 30.48, 19.25, 19.05; \text{HRMS–ESI (m/z): [M + H]}^+ \text{calcd for C}_{14}H_{15}NO_5, 262.1074; \text{found, 262.1081.}
2-(1-(Furan-2-yl)-2-nitroethyl)cyclopentane-1,3-dione (3m)

\[ \text{O:} \] \( \text{NO}_2 \) 

\(^1\text{H}\) NMR (400 MHz, DMSO-\(d_6\)) \( \delta \) 7.52 (s, 1 H), 6.34 (t, \( J = 2 \) Hz, 1 H), 6.15 (d, \( J = 3.1 \) Hz, 1 H), 5.14–5.02 (m, 2 H), 4.61 (t, \( J = 7.9 \) Hz, 1 H), 2.41 (s, 4 H); \(^13\text{C}\) NMR (100 MHz, DMSO-\(d_6\)) \( \delta \) 151.81, 142.07, 111.52, 110.54, 106.34, 74.92, 31.74, 30.22; HRMS–ESI (\( m/z \)): \([\text{M} + \text{H}]^+\) calcd for C\(_{11}\)H\(_{11}\)NO\(_5\), 238.0710; found, 238.0714.

3-(2-Nitro-1-phenylethyl)furan-2,4(3H,5H)-dione (3n)

\[ \text{O:} \] \( \text{NO}_2 \) 

\(^1\text{H}\) NMR (400 MHz, DMSO-\(d_6\)) \( \delta \) 7.38–7.24 (m, 5 H), 5.23 (dd, \( J = 13.3 \), 8.9 Hz, 1 H), 5.14 (dd, \( J = 13.3 \), 7.5 Hz, 1 H), 4.64 (s, 2 H), 4.51 (t, \( J = 8.2 \) Hz, 1 H); \(^13\text{C}\) NMR (100 MHz, DMSO-\(d_6\)) \( \delta \) 176.43, 174.33, 139.41, 129.14, 128.02, 127.75, 97.56, 76.84, 67.16, 38.13; HRMS–ESI (\( m/z \)): \([\text{M} + \text{Na}]^+\) calcd for C\(_{12}\)H\(_{11}\)NO\(_5\), 272.0529; found, 272.0531.

2-(2-Nitro-1-phenylethyl)-1-phenylbutane-1,3-dione (3o)

\[ \text{O:} \] \( \text{NO}_2 \) 

\(^1\text{H}\) NMR (400 MHz, CDCl\(_3\)) \( \delta \) 8.03–7.14 (m, 10 H), 5.18 (t, \( J = 9.8 \) Hz, 1 H), 4.88–4.64 (m, 2 H), 4.56–4.40 (m, 1 H), 2.23 (s, 1.33 H), 1.94 (s, 1.48 H); \(^13\text{C}\) NMR (100 MHz, CDCl\(_3\)) \( \delta \) 201.67, 200.77, 194.06, 193.75, 136.53, 136.30, 136.17, 136.00, 134.49, 134.10, 129.28, 129.10, 129.03, 128.98, 128.56, 128.20, 128.15, 128.03, 78.18, 78.08, 65.36, 64.77, 43.44, 43.30, 29.78, 28.53; HRMS–ESI (\( m/z \)): \([\text{M} + \text{Na}]^+\) calcd for C\(_{18}\)H\(_{17}\)NO\(_4\), 334.1050; found, 334.1064.

Ethyl 2-benzoyl-4-nitro-3-phenylbutanoate (3p)

\[ \text{O:} \] \( \text{NO}_2 \) 

\(^1\text{H}\) NMR (400 MHz, CDCl\(_3\)) \( \delta \) 8.06–7.16 (m, 10 H), 4.98–4.90 (m, 2 H), 4.82–4.73 (m, 1 H), 4.52–4.41 (m, 1 H), 4.17 (q, \( J = 7.2 \), 7.2 Hz, 1 H), 3.89–3.83 (m, 1 H), 1.17 (t, \( J = 7.1 \) Hz, 1.41 H), 0.89 (t, \( J = 7.1 \) Hz, 1.74 H); \(^13\text{C}\) NMR (100 MHz, CDCl\(_3\)) \( \delta \) 192.78, 192.74, 167.73, 166.99, 136.77, 136.27, 136.04, 135.85, 134.25, 133.84, 128.96, 128.93, 128.91, 128.75, 128.57, 128.36, 128.30, 128.13, 127.99, 78.00, 62.24, 61.96, 57.04, 56.38, 43.13, 43.11, 13.89, 13.59; HRMS–ESI (\( m/z \)): \([\text{M} + \text{H}]^+\) calcd for C\(_{19}\)H\(_{19}\)NO\(_5\), 342.1336; found, 342.1339.
Ethyl 2-(4-methoxybenzoyl)-4-nitro-3-phenylbutanoate (3q)

\[
\text{O} \quad \text{O} \\
\text{NO}_2 \\
\text{OCH}_3
\]

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 8.05 (d, $J = 8.9$ Hz, 1.11 H), 7.87 (d, $J = 8.9$ Hz, 0.83 H), 7.31–7.19 (m, 5H), 6.92 (dd, $J = 26.4$, 8.9 Hz, 2 H), 4.96–4.87 (m, 2 H), 4.82–4.70 (m, 1 H), 4.50–4.40 (m, 1 H), 4.17 (q, $J = 6.0$, 7.2 Hz, 1 H), 3.90–3.84 (m, 4 H), 1.18 (t, $J = 7.1$ Hz, 1.26 H), 0.90 (t, $J = 7.1$ Hz, 1.82 H); $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$ 190.90, 190.84, 167.95, 167.21, 164.48, 164.15, 136.97, 136.41, 131.11, 128.92, 128.89, 128.30, 128.05, 127.94, 114.10, 113.97, 78.11, 78.08, 62.14, 61.86, 56.68, 55.99, 55.61, 55.55, 43.14, 13.94, 13.63; HRMS–ESI ($m/z$): [M + H]$^+$ calcd for C$_{20}$H$_{21}$NO$_6$, 372.1442; found, 372.1448.

2-(2-Nitro-1-phenylethyl)-1,3-diphenylpropane-1,3-dione (3r)

\[
\text{O} \quad \text{O} \\
\text{NO}_2 \\
\text{OCH}_3
\]

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.86 (dd, $J = 8.4$, 1.1 Hz, 2 H), 7.78 (dd, $J = 8.3$, 1.1 Hz, 2 H), 7.57–7.14 (m, 11 H), 5.84 (d, $J = 8.0$ Hz, 1 H), 5.00 (d, $J = 6.9$ Hz, 2 H), 4.63 (q, $J = 7.2$, 7.6 Hz, 1 H); $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$ 194.24, 193.62, 136.80, 136.22, 135.85, 134.06, 133.78, 128.97, 128.95, 128.83, 128.77, 128.60, 128.26, 128.15, 77.31, 59.89, 44.05; HRMS–ESI ($m/z$): [M + H]$^+$ calcd for C$_{23}$H$_{19}$NO$_4$, 374.1387; found, 374.1390.

3-(1-(Furan-2-yl)-2-nitroethyl)furan-2,4(3H,5H)-dione (3s)

\[
\text{O} \quad \text{O} \\
\text{NO}_2 \\
\text{OCH}_3
\]

$^1$H NMR (400 MHz, DMSO-$d_6$) $\delta$ 7.56 (d, $J = 1.3$ Hz, 1 H), 6.38 (dd, $J = 3.0$, 2.0 Hz, 1 H), 6.23 (d, $J = 3.3$ Hz, 1 H), 5.14–5.06 (m, 2 H), 4.66–4.62 (m, 3 H); $^{13}$C NMR (100 MHz, DMSO-$d_6$) $\delta$ 177.19, 173.81, 151.42, 142.85, 111.05, 107.10, 94.90, 75.07, 67.25, 31.98; HRMS–ESI ($m/z$): [M + Na]$^+$ calcd for C$_{10}$H$_9$NO$_6$, 262.0322; found, 262.0332.
Spectra

1,3-Cyclopentanedione (material)
2-(2-Nitro-1-phenylethyl)cyclopentane-1,3-dione (3a)
2-(1-(4-Fluorophenyl)-2-nitroethyl)cyclopentane-1,3-dione (3b)
2-(2-Nitro-1-(4-(trifluoromethyl)phenyl)ethyl)cyclopentane-1,3-dione (3c)
2-(1-(4-Chlorophenyl)-2-nitroethyl)cyclopentane-1,3-dione (3d)
2-(1-(3-Chlorophenyl)-2-nitroethy1)cyclopentane-1,3-dione (3e)
2-(1-(4-Bromophenyl)-2-nitroethyl)cyclopentane-1,3-dione (3f)
2-(1-(2-Bromophenyl)-2-nitroethyl)cyclopentane-1,3-dione (3g)
2-(2-Nitro-1-(4-nitrophenyl)ethyl)cyclopentane-1,3-dione (3h)
2-(2-Nitro-1-(2-nitrophenyl)ethyl)cyclopentane-1,3-dione (3i)
2-(2-Nitro-1-(p-tolyl)ethyl)cyclopentane-1,3-dione (3j)
2-(1-(4-Methoxyphenyl)-2-nitroethyl)cyclopentane-1,3-dione (3k)
2-(2-Nitro-1-phenylpropyl)cyclopentane-1,3-dione (3l)
2-(1-(Furan-2-yl)-2-nitroethyl)cyclopentane-1,3-dione (3m)
3-(2-Nitro-1-phenylethyl)furan-2,4(3H,5H)-dione (3n)
2-(2-Nitro-1-phenylethyl)-1-phenylbutane-1,3-dione (3o)
Ethyl 2-benzoyl-4-nitro-3-phenylbutanoate (3p)
Ethyl 2-(4-methoxybenzoyl)-4-nitro-3-phenylbutanoate (3q)
2-(2-Nitro-1-phenylethyl)-1,3-diphenylpropane-1,3-dione (3r)
3-(1-(Furan-2-yl)-2-nitroethyl)furan-2,4(3H,5H)-dione (3s)