Supporting information for

Synthesis of Chiral \(N\)-Nitro-Oxazolidin-2-ones and \(O\)-(\(\beta\)-Nitraminoalkyl) Carbamates in Liquified 1,1,1,2-Tetrafluorethane Medium

Svetlana S. Arabazhi, Mikhail N. Zharkov, Ilya V. Kuchurov, * Sergei G. Zlotin**

N. D. Zelinsky Institute of Organic Chemistry, Russian Academy of Sciences, 47, Leninsky prosp., 119991 Moscow, Russian Federation. Fax: +7 499 135 53 28; Tel: +7 499 137 13 53.

* kuchurov@ioc.ac.ru
** zlotin@ioc.ac.ru

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1 General information

The reactions were carried out using nitration setup described previously.\(^1\)

Melting points were obtained on Stuart®, SMP40. \(^1\)H, \(^13\)C and \(^14\)N NMR spectra were recorded on a Bruker®, AM-300 (300.13, 75.47 and 21.69 MHz, respectively). The FTIR-ATR spectra were obtained on a Simex FT-801 spectrometer. The high-resolution mass spectra (HRMS) were measured with a Bruker microTOF II spectrometer by using electrospray ionization (ESI).

X-ray diffraction data were collected at 100K on a Bruker Quest D8 diffractometer equipped with a Photon-III area-detector (graphite monochromator, shutterless φ- and ω-scan technique), using Mo Kα-radiation (0.71073 Å). The intensity data were integrated by the SAINT program\(^2\) and were corrected for absorption and decay using SADABS.\(^3\) The structure was solved by direct methods using SHELXS-2013\(^4\) and refined on \(F^2\) using SHELXL-2018.\(^5\) All non-hydrogen atoms were refined with individual anisotropic displacement parameters. Positions of all hydrogen atoms were found from the electron density-difference map, these atoms were refined with individual isotropic displacement parameters. The SHELXTL program suite\(^1\) was used for molecular graphics. Atomic coordinates, bond lengths and angles and thermal parameters have been deposited at The Cambridge Crystallographic Data Centre (CCDC), reference numbers 1990598 (2e) and 1990599 (4bd).

1,1,1,2-Tetrafluoroethane and ammonia were obtained from «Linde Gas Rus». Starting compounds \(^6\) and DNP\(^7\) were prepared according to reported methods. Amines 3b,c were supplied by Acros Organics.

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\(^1\) Zharkov, M. N.; Kuchurov, I. V.; Fomenkov, I. V.; Tartakovsky, V. A.; Fedyanin, I. V.; Zlotin, S. G. Synthesis 2017, 49, 1103.


2 Experimental procedures

Synthesis of 3-nitrooxazolidin-2-ones 2 (General procedure)

A steel autoclave containing 5 mmol of substrate 1 was filled with liquid TFE at room temperature by one third of volume and cooled to 5 °C. DNP (0.59–4.86 g, 5.5–45.0 mmol) was placed into an auxiliary dosing vessel which was then closed and filled with the same fluid by half. The obtained DNP solution was slowly added to the autoclave. The dosing vessel was twice washed with the fluid (one third of volume) to transfer residual DNP into the autoclave. The reaction mixture was stirred at 0.6 MPa and ambient temperature for 1 hour. Then water (2 mL) was added to the reactor to decompose the excess of the nitrating agent. The fluid was removed by decompression. The autoclave was opened and ice water (20 mL) was added to the residue. The resulting mixture was neutralized with sodium hydrocarbonate aqueous solution and extracted with EtOAc (3×10 mL). The combined organic extracts were dried over anhydrous MgSO4. The solvent was evaporated under reduced pressure (50 Torr) to afford nitro compounds 2. The yields are given in Table 1 and Scheme 1.

(S)-4-Methyl-3-nitrooxazolidin-2-one (2a)

\[
\begin{align*}
\text{NO}_2 & \\
\text{O} & \\
\text{O} & \\
\end{align*}
\]

Yield: 87%; colorless solid; mp 63-64.5 °C (EtOAc); [\(\alpha\)\(^{20}\)D] = 150.12 (c 0.5, CHCl3).

IR (ATR): 2986, 1805, 1564, 1482, 1468, 1393, 1269, 1229, 1159, 1134, 1103, 1038, 978, 822, 759, 740, 702 cm\(^{-1}\).

\(^1\)H NMR (300.13 MHz, CDCl3): \(\delta = 4.81-4.69 \) (m, 1 H, CH), 4.56 (t, \(J = 8.5\) Hz, 1 H, CH), 4.02 (t, \(J = 7.7\) Hz, 1 H, CH), 1.6 (d, \(J = 5.9\) Hz, 3 H, CH\(_3\)).

\(^13\)C NMR (75.47 MHz, CDCl3): \(\delta = 147.9, 67.1, 53.5, 17.3\).

\(^14\)N NMR (21.69 MHz, CDCl3): \(\delta = -49.4\) (NO\(_2\)).

HRMS (ESI): \(m/z\) [M+Na\(^+\)] calcd for C\(_4\)H\(_6\)N\(_2\)O\(_4\): 169.0225, found: 169.0220.

(S)-4-Isopropyl-3-nitrooxazolidin-2-one (2b)

\[
\begin{align*}
\text{NO}_2 & \\
\text{O} & \\
\text{O} & \\
\end{align*}
\]

Yield: 85%; colorless solid; mp 115.5-117 °C (EtOAc); [\(\alpha\)\(^{20}\)D] = 138.13 (c 0.5, CHCl3).

IR (ATR): 2965, 1794, 1553, 1489, 1464, 1396, 1377, 1353, 1319, 1231, 1159, 1092, 1041, 976, 848, 807, 729, 708 cm\(^{-1}\).

\(^1\)H NMR (300.13 MHz, CDCl3): \(\delta = 4.73-4.66\) (m, 1 H, CH), 4.42 (t, \(J = 9\) Hz, 1 H, CH), 4.2 (dd, \(J_1 = 5.4\) Hz, \(J_2 = 9.2\) Hz, 1 H, CH), 2.58-2.46 (m, 1 H, CH), 0.98 (t, \(J = 6.4\) Hz, 6 H, 2×CH\(_3\)).

\(^13\)C NMR (75.47 MHz, CDCl3): \(\delta = 148.2, 62.1, 60.6, 27.9, 17.5, 14.9\).

\(^14\)N NMR (21.69 MHz, CDCl3): \(\delta = -49.36\) (NO\(_2\)).

HRMS (ESI): \(m/z\) [M+Na\(^+\)] calcd for C\(_6\)H\(_{10}\)N\(_2\)O\(_4\): 197.0540, found: 197.0533.
(S)-4-((R)-sec-Butyl)-3-nitrooxazolidin-2-one (2c)

Yield: 89%; colorless solid; mp 82.5-84.5 °C (EtOAc); [α]$_{D}^{20} = 133.16$ (c 0.5, CHCl$_3$).

IR (ATR): 2964, 2879, 1800, 1564, 1488, 1462, 1388, 1359, 1384, 1280, 1261, 1199, 1230, 1157, 1114, 1089, 1053, 1017, 993, 978, 892, 839, 812, 796, 730, 708 cm$^{-1}$.

$^1$H NMR (300.13 MHz, CDCl$_3$): δ = 4.81-4.74 (m, 1 H, CH), 4.4 (t, $J = 9$ Hz, 1 H, CH), 4.18 (dd, $J_1 = 5.7$ Hz, $J_2 = 9.2$ Hz, 1 H, CH), 2.35-2.24 (m, 1 H, CH), 1.43-1.15 (m, 2 H, 2×CH), 1.02-0.9 (m, 6 H, 2×CH$_3$).

$^{13}$C NMR (75.47 MHz, CDCl$_3$): δ = 148.2, 61.8, 59.7, 34.1, 25.1, 12.0, 11.7.

$^{14}$N NMR (21.69 MHz, CDCl$_3$): δ = -49.49 (NO$_2$).

HRMS (ESI): m/z [M+Na] calcd for C$_7$H$_{12}$N$_2$O$_4$: 211.0695; found: 211.0689.

Methyl (S)-3-nitro-2-oxooxazolidine-4-carboxylate (2d)

Yield: 94%; colorless solid; mp 68.0-69.4 °C (EtOAc); [α]$_{D}^{20} = -93.82$ (c 0.5, CHCl$_3$).

IR (ATR): 2971, 1796, 1760, 1579, 1474, 1443, 1400, 1368, 1330, 1221, 1165, 1101, 1055, 1035, 1002, 980, 892, 843, 767, 741, 708 cm$^{-1}$.

$^1$H NMR (300.13 MHz, CDCl$_3$): δ = 5.21 (dd, $J_1 = 3.7$ Hz, $J_2 = 8.6$ Hz, 1 H, CH), 4.63 (t, $J = 9$ Hz, 1 H, CH), 4.43 (dd, $J_1 = 3.7$ Hz, $J_2 = 9.4$ Hz, 1 H, CH), 3.88 (s, 3 H, OCH$_3$).

$^{13}$C NMR (75.47 MHz, CDCl$_3$): δ = 166.9, 146.5, 62.9, 57.1, 53.9.

$^{14}$N NMR (21.69 MHz, CDCl$_3$): δ = -52.2 (NO$_2$).


Methyl (4S,5R)-5-methyl-3-nitro-2-oxooxazolidine-4-carboxylate (2e)

Yield: 72%; colorless solid; mp 135.5-136 °C (EtOAc); [α]$_{D}^{20} = -63.02$ (c 0.5, CHCl$_3$).

IR (ATR): 3664, 2972, 2901, 1806, 1754, 1580, 1442, 1391, 1323, 1254, 1219, 1184, 1109, 1070, 995, 947, 921, 846, 784, 748, 706 cm$^{-1}$.

$^1$H NMR (300.13 MHz, DMSO-d$_6$): δ = 5.06 (d, $J = 6.8$ Hz, 1 H, CH), 4.84 (p, $J = 6.3$ Hz, 1 H, CH), 3.79 (s, 3 H, OCH$_3$), 1.53 (d, $J = 6.2$ Hz, 3 H, CH$_3$).

$^{13}$C NMR (75.47 MHz, DMSO-d$_6$): δ = 166.5, 146.6, 71.4, 63.1, 53.4, 19.2.

$^{14}$N NMR (21.69 MHz, DMSO-d$_6$): δ = -47.8 (NO$_2$).

((4R,5R)-5-Methyl-3-nitro-2-oxooxazolidin-4-yl)methyl nitrate (2f)

Yield: 82%; colorless solid; mp 102.8 °C (EtOAc); [α]_{D}^{20} = -55.30 (c 0.5, DMSO).

IR (ATR): 2943, 1809, 1633, 1621, 1591, 1458, 1391, 1337, 1275, 1246, 1203, 1171, 1115, 1076, 1049, 1003, 941, 882, 861, 825, 768, 755, 736, 705 cm⁻¹.

1H NMR (300.13 MHz, DMSO-d₆): δ = 5.01-4.84 (m, 2 H, CH₂), 4.76-4.60 (m, 2 H, 2×CH), 1.48 (d, J = 6 Hz, 3 H, CH₃).

13C NMR (75.47 MHz, DMSO-d₆): δ = 147.3, 71.4, 69.2, 59.9, 18.9.

14N NMR (21.69 MHz, DMSO-d₆): δ = -46.7 (NO₂).

HRMS (ESI): m/z [M+Na] calcd for C₁₅H₁₁N₃O₇: 244.0178; found: 244.0176.

(S)-3-Nitro-4-(4-nitrobenzyl)oxazolidin-2-one (2g)

Yield: 95%; colorless solid; mp 138.5-139.5°C (CHCl₃); [α]_{D}^{20} = 84.45 (c 0.5, DMSO).

IR (ATR): 3114, 2846, 1796, 1602, 1570, 1524, 1509, 1475, 1449, 1398, 1342, 1303, 1274, 1152, 1107, 1057, 1010, 930, 881, 856, 828, 733, 698 cm⁻¹.

1H NMR (300.13 MHz, DMSO-d₆): δ = 8.2 (d, J = 8.5 Hz, 2 H, 2×CH), 7.56 (d, J = 8.5 Hz, 2 H, 2×CH), 5.1-5.0 (m, 1 H, CH), 4.45 (t, J = 8.7 Hz, 1 H, CH), 4.22 (dd, J₁ = 5.6 Hz, J₂ = 8.7 Hz, 1 H, CH), 3.41-3.23 (m, 2 H, CH₂).

13C NMR (75.47 MHz, DMSO-d₆): δ = 147.9, 146.7, 143.4, 130.8, 123.6, 65.2, 56.5, 36.1.


(S)-4-(2,4-Dinitrobenzyl)-3-nitrooxazolidin-2-one (2g’)

Yield: 93%; colorless solid; mp 181-181.7 °C dec. (Acetone); [α]_{D}^{20} = -13.22 (c 0.5, DMSO).

IR (ATR): 3112, 2805, 1609, 1573, 1544, 1527, 1474, 1400, 1346, 1301, 1269, 1237, 1148, 1079, 1055, 1007, 928, 856, 836, 825, 757, 729, 716, 693 cm⁻¹.

1H NMR (300.13 MHz, DMSO-d₆): δ = 8.77 (d, J = 1.9 Hz, 1 H, CH), 8.52 (dd, J₁ = 2.0 Hz, J₂ = 8.4 Hz, 1 H, CH), 7.94 (d, J = 8.5 Hz, 1 H, CH), 5.21-5.11 (m, 1 H, CH), 4.54 (t, J = 8.7 Hz, 1 H, CH), 4.23 (dd, J₁ = 5.5 Hz, J₂ = 8.5 Hz 1 H, CH), 3.67-3.47 (m, 2 H, ×CH₂).

13C NMR (75.47 MHz, DMSO-d₆): δ = 149.1, 148.1, 146.7, 138.1, 134.6, 127.4, 120.0, 65.8, 56.2, 34.9.

Synthesis of O-(β-nitraminoalkyl) carbamates 4 (General procedure)

The nitration step was performed as described above. Once the nitration completed, the autoclave was cooled to 5 °C and liquid ammonia (3a) (0.54-4.45 mL, 20.0-165.0 mmol) or amine 3b,c (20 mmol) was gradually added with intensive stirring by the syringe pump at flow-rate 0.1÷0.2 mL/min. The reaction mass was stirred at ambient temperature for 0.5 h. Then the fluid and the excess of ammonia were removed via decompression and the autoclave was opened. Cold water (20 mL) was added to the residue and the mixture was acidified by 10 N HCl (2 mL) with vigorous stirring. The aqueous mixture was extracted with ethyl acetate (4 × 15 mL). The combined organic extracts were dried over anhydrous MgSO₄. The solvent was evaporated under reduced pressure (50 Torr) to afford corresponding nitramines 4. The yields are given in Table 1 and Scheme 1.

(R)-2-(Nitroamino)propyl carbamate (4aa)

Yield: 99%; colorless solid; mp 97.5 °C (EtOAc); [α]₀°D = 17.20 (c 0.5, DMSO).

IR (ATR): 3468, 3341, 3198, 3078, 2943, 2830, 1678, 1588, 1412, 1375, 1348, 1316, 1290, 1150, 1076, 951, 888, 778, 745 cm⁻¹.

¹H NMR (300.13 MHz, DMSO-d₆): δ = 12.01 (d, J = 5.7 Hz, 1 H, NH), 6.55 (br s, 2 H, NH₂), 4.28-4.19 (m, 1 H, CH), 4.03 (dd, J₁ = 4.3 Hz, J₂ = 11.3 Hz, 1 H, CH₃O), 3.84 (dd, J₁ = 7.2 Hz, J₂ = 11.0 Hz, 1 H, CH₃O), 1.11 (d, J = 6.7 Hz, 3 H, CH₃).

¹³C NMR (75.47 MHz, DMSO-d₆): δ = 156.8, 64.1, 51.5, 15.0.

¹⁴N NMR (21.69 MHz, DMSO-d₆): δ = -27.4 (NO₂).


(R)-2-(Nitroamino)propyl propylcarbamate (4ab)

Yield: 77%; yellow oil [α]₀°D = -2.86 (c 0.5, DMSO).

IR (ATR): 3340, 3217, 3118, 2964, 2877, 1694, 1578, 1527, 1460, 1410, 1354, 1320, 1295, 1236, 1140, 1045, 1007, 943, 890, 772 cm⁻¹.

¹H NMR (300.13 MHz, DMSO-d₆): δ = 11.98 (d, J = 5.6 Hz, 1 H, NH), 7.17 (t, J = 5 Hz, 1 H, NH), 4.30-4.20 (m, 1 H, CH), 4.05 (dd, J₁ = 4.3 Hz, J₂ = 11.3 Hz, 1 H, CH₃O), 3.87 (dd, J₁ = 7.2 Hz, J₂ = 11.2 Hz, 1 H, CH₃O), 2.91 (dd, J₁ = 6.6 Hz, J₂ = 13.2 Hz, 2 H, CH₂), 1.45-1.33 (m, 2 H, CH₂), 1.11 (d, J = 6.8 Hz, 3 H, CH₃), 0.82 (t, J = 7.4 Hz, 3 H, CH₃).

¹³C NMR (75.47 MHz, DMSO-d₆): δ = 155.9, 63.8, 51.0, 42.1, 22.6, 14.6, 11.2.

¹⁴N NMR (21.69 MHz, DMSO-d₆): δ = -26.9 (NO₂).

(R)-3-Methyl-2-(nitroamino)butyl carbamate (4ba)

![Chemical structure]

Yield: 98%; colorless oil; [α]20D = 4.98 (c 0.5, DMSO).
IR (FTIR): 3480, 3351, 2967, 2878, 1704, 1577, 1465, 1410, 1310, 1141, 1084, 1058, 1022, 951, 928, 870, 825, 777, 744 cm⁻¹.

1H NMR (300.13 MHz, DMSO-d₆): δ = 12.11 (d, J = 6.9 Hz, 1 H, NH), 6.53 (br s, 2 H, NH₂), 4.18-4.05 (m, 2 H, CH₂O), 3.83 (dd, J₁ = 8 Hz, J₂ = 10 Hz, 1 H, CH), 1.95-1.77 (m, 1 H, CH), 0.9 (t, J = 6 Hz, 6 H, 2×CH₃).

13C NMR (75.47 MHz, DMSO-d₆): δ = 156.3, 61.5, 60.3, 28.3, 18.8, 18.4.

14N NMR (21.69 MHz, DMSO-d₆): δ = -26.4 (NO₂).

(R)-3-Methyl-2-(nitroamino)butyl butylcarbamate (4bc)

![Chemical structure]

Yield: 77%; yellow oil; [α]20D = -4.22 (c 0.5, DMSO).
IR (FTIR): 3350, 3225, 3122, 2962, 2934, 2874, 1695, 1579, 1527, 1465, 1414, 1362, 1320, 1246, 1141, 1107, 1053, 1022, 772, 741 cm⁻¹.

1H NMR (300.13 MHz, DMSO-d₆): δ = 12.09 (d, J = 6.9 Hz, 1 H, NH), 7.14 (t, J = 5.4 Hz, 1 H, NH), 4.21-4.05 (m, 2 H, CH₂O), 3.85 (dd, J₁ = 8.5 Hz, J₂ = 10.9 Hz, 1 H, CH), 2.95 (dd, J₁ = 6.5 Hz, J₂ = 12.8 Hz, 2 H, CH₂), 1.91-1.80 (m, 1 H, CH), 1.41-1.18 (m, 4 H, 2×CH₂), 0.92-0.82 (m, 9 H, 3×CH₃).

13C NMR (75.47 MHz, DMSO-d₆): δ = 155.8, 61.8, 60.3, 31.4, 28.4, 19.3, 18.8, 18.4 13.6.

14N NMR (21.69 MHz, DMSO-d₆): δ = -26.45 (NO₂).

(R)-3-Methyl-2-(nitroamino)butyl diethylcarbamate (4bd)

![Chemical structure]

Yield: 95%; colorless solid; mp 55-56 °C (EtOAc); [α]20D = -32.37 (c 0.5, DMSO).
IR (FTIR): 3198, 3114, 2966, 2878, 1670, 1574, 1487, 1458, 1432, 1408, 1381, 1331, 1312, 1273, 1222, 1180, 1138, 1071, 988, 932, 902, 837,779, 767, 727 cm⁻¹.

1H NMR (300.13 MHz, DMSO-d₆): δ = 12.09 (br s, 1 H, NH), 4.23-4.14 (m, 2 H, CH₂O), 3.92 (dd, J₁ = 8.0 Hz, J₂ = 10.5 Hz, 1 H, CH), 3.24-3.08 (m, 4 H, 2×CH₂), 1.90-1.79 (m, 1 H, CH), 1.04-0.88 (m, 12 H, 4×CH₃).

13C NMR (75.47 MHz, DMSO-d₆): δ = 154.5, 63.0, 60.3, 28.1, 18.9, 18.6, 13.8, 13.3.

14N NMR (21.69 MHz, DMSO-d₆): δ = -25.6 (NO₂).
(2R,3S)-3-Methyl-2-(nitroamino)pentyl carbamate (4ca)

Yield: 79%; colorless oil; [α]^{20}_D = 21.60° (c 0.5, DMSO).

IR (ATR): 3469, 3350, 3201, 2965, 2935, 2878, 1705, 1578, 1410, 1304, 1143, 1082, 1023, 999, 866, 824, 777 cm⁻¹.

¹H NMR (300.13 MHz, DMSO-d₆): δ = 12.15 (s, 1 H, NH), 6.53 (br s, 2 H, NH₂), 4.2-4.11 (m, 2 H, CH₂O), 3.83 (dd, J₁ = 9.3 Hz, J₂ = 12.2 Hz, 1 H, CH), 1.69-1.59 (m, 1 H, CH), 1.45-1.37 (m, 1 H, CH₃), 1.21-1.11 (m, 1 H, CH), 0.88-0.82 (m, 6 H, 2×CH₃).

¹³C NMR (75.47 MHz, DMSO-d₆): δ = 156.8, 61.6, 59.5, 35.2, 25.6, 15.4, 11.6.

¹⁴N NMR (21.69 MHz, DMSO-d₆): δ = -27.0 (NO₂).


Methyl O-carbamoyl-N-nitro-D-serinate (4da)

Yield: 94%; colorless oil; [α]^{20}_D = -49.22 (c 0.5, DMSO).

IR (ATR): 3480, 3368, 3200, 2960, 2847, 1710, 1582, 1407, 1316, 1219, 1157, 1087, 1087, 1046, 975, 857, 775 cm⁻¹.

¹H NMR (300.13 MHz, DMSO-d₆): δ = 12.69 (br s, 1 H, NH), 6.65 (br s, 2 H, NH₂), 4.81 (dd, J₁ = 4.2 Hz, J₂ = 7.5 Hz, 1 H, CH), 4.32 (dd, J₁ = 4.3 Hz, J₂ = 11.7 Hz, 1 H, CHOβ), 4.17 (dd, J₁ = 7.6 Hz, J₂ = 11.6 Hz, 1 H, CH), 3.7 (s, 3 H, CH₃).

¹³C NMR (75.47 MHz, DMSO-d₆): δ = 168.3, 156.4, 60.4, 57.9, 53.1.

¹⁴N NMR (21.69 MHz, DMSO-d₆): δ = -27.0 (NO₂).


Methyl O-carbamoyl-N-nitro-D-allothreoninate (4ea)

Yield: 95%; colorless solid; mp 128.5-129.5 °C (EtOAc); [α]^{20}_D = -6.81 (c 0.5, DMSO).

IR (FTIR): 3459, 3355, 3255, 3206, 3061, 2959, 2817, 1753, 1708, 1613, 1584, 1390, 1336, 1313, 1259, 1225, 1162, 1133, 1088, 1039, 999, 973, 905, 782, 760, 702, cm⁻¹.

¹H NMR (300.13 MHz, DMSO-d₆): δ = 12.72 (s, 1 H, NH), 6.45 (br s, 2 H, NH₂), 5.06-4.98 (m, 1 H, CH), 4.80 (d, J = 4.4 Hz, 1 H, CH), 3.68 (s, 3 H, OCH₃), 1.24 (d, J = 6.4 Hz, 3 H, CH₃).

¹³C NMR (75.47 MHz, DMSO-d₆): δ = 168.2, 155.4, 66.9, 61.8, 52.6, 17.1.

¹⁴N NMR (21.69 MHz, DMSO-d₆): δ = -26.4 (NO₂).

(R)-2-(nitroamino)-3-(4-nitrophenyl)propyl carbamate (4ga)

Yield: 92%; wax; $[\alpha]_{D}^{20} = -44.62$ (c 0.5, DMSO).

IR (ATR): 3489, 3368, 3200, 3108, 2925, 2852, 1705, 1579, 1514, 1408, 1338, 1181, 1107, 1063, 1015, 851, 816, 775, 745, 701 cm$^{-1}$.

$^1$H NMR (300.13 MHz, DMSO-d$_6$): $\delta$ = 12.21 (d, $J$ = 5.7 Hz, 1 H, NH), 8.18 (d, $J$ = 8.5 Hz, 1 H, CH$^\text{Ar}$), 7.54 (d, $J$ = 8.2 Hz, 1 H, CH$^\text{Ar}$), 6.59 (br s, 2 H, NH$_2$), 4.52 (br s, 1 H, CH), 4.18 (dd, $J_1$ = 4 Hz, $J_2$ = 11.5 Hz, 1 H, CH), 3.88 (dd, $J_1$ = 7.3 Hz, $J_2$ = 11.5 Hz, 1 H, CH), 3.03 (dd, $J_1$ = 5.5 Hz, $J_2$ = 13.9 Hz, 1 H, CH$_{\text{O}^A}$), 2.89 (dd, $J_1$ = 9 Hz, $J_2$ = 13.8 Hz, 1 H, CH$_{\text{O}^B}$).

$^{13}$C NMR (75.47 MHz, DMSO-d$_6$): $\delta$ = 156.2, 146.4, 145.5, 130.4, 123.4, 62.4, 56.1, 34.4.

HRMS (ESI): $m/z$ [M+Na] calcd for C$_{10}$H$_{12}$N$_3$O$_6$: 307.0654; found: 307.0649

(R)-3-(2,4-dinitrophenyl)-2-(nitroamino)propyl carbamate (4ga$'$)

Yield: 92%; wax; $[\alpha]_{D}^{20} = 27.15$ (c 0.5, DMSO).

IR (FTIR): 3493, 3368, 3200, 3108, 2925, 2852, 1705, 1601, 1582, 1527, 1407, 1339, 1200, 1100, 1063, 908, 849, 835, 812, 774, 740, 723 cm$^{-1}$.

$^1$H NMR (300.13 MHz, DMSO-d$_6$): $\delta$ = 12.2 (s, 1 H, NH), 8.74 (d, $J$ = 2.1 Hz, 1 H, CH$^\text{Ar}$), 8.52 (dd, $J_1$ = 2.2 Hz, $J_2$ = 8.4 Hz, 1 H, CH$^\text{Ar}$), 7.82 (d, $J$ = 8.5 Hz, 1 H, CH$^\text{Ar}$), 6.57 (br s, 2 H, NH$_2$), 4.62-4.59 (m, 1 H, CH), 4.20 (dd, $J_1$ = 4.3 Hz, $J_2$ = 11.6 Hz, 1 H, CH), 3.96 (dd, $J_1$ = 7.3 Hz, $J_2$ = 11.5 Hz, 1 H, CH), 3.35 (dd, $J_1$ = 4.5 Hz, $J_2$ = 14.1 Hz, 1 H, CH$_{\text{O}^A}$), 3.06 (dd, $J_1$ = 9.7 Hz, $J_2$ = 14 Hz, 1 H, CH$_{\text{O}^B}$).

$^{13}$C NMR (75.47 MHz, DMSO-d$_6$): $\delta$ = 156.1, 149.1, 146.5, 138.8, 134.1, 127.3, 120.1, 62.6, 55.0, 32.2.


Complex of O-carbamoyl-N-nitro-D-allothreoninate (4ea) and (R)-(+)-$\alpha$-methylbenzylamine (MBA)

MBA (15 μL, 0.12 mmol) was added dropwise to a solution of functionalized nitramine 4ea (25 mg, 0.11 mmol) in 0.5 mL EtOAc. The mixture was diluted with Et$_2$O (1 mL) and stirred at rt for 0.5 h. The resulting precipitate was filtered, washed twice with Et$_2$O (1 mL) and dried under vacuum (1 Torr).

$^1$H NMR (300.13 MHz, DMSO-d$_6$): $\delta$ = 8.35 (br s, 3 H, NH$_3$), 7.49-7.30 (m, 5 H, CH$^\text{Ar}$), 6.38 (br s, 2 H, NH$_2$), 4.85 (quint, $J$ = 6.2 Hz, 1 H, CH), 4.37 (q, $J$ = 6.7 Hz, 1 H, CH), 4.18 (d, $J$ = 5.2 Hz, 1 H, CH), 3.53 (s, 3 H, CH$_3$), 1.48 (d, $J$ = 6.7 Hz, 1 H, CH$_3$), 1.14 (d, $J$ = 6.5 Hz, 1 H, CH$_3$).
Cytotoxicity in vitro

The IC₅₀ values of the synthesized compounds 2 and 4 against cells were determined by the MTT method.⁸ HEK293 cells were seeded at 1.0 x 10⁴ cells/200 μL in 96-well plates and incubated at 37 °C in a humidified atmosphere with 5% CO₂. After 24 h of preincubation, the various concentrations of the tested compounds (100-1.56 μM) were added into each well, and these cells were incubated under similar conditions for 72 h. All compounds were dissolved in DMSO. The final DMSO concentration in each well did not exceed 1% and was not toxic for the cells. The wells with a specific cell culture containing 1% DMSO solution in the medium were monitored as control. After incubation, 20 mM MTT reagent (3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide), at a final concentration of 5 mg/mL, was added into each well, and the cells were incubated for another 2 h. The medium was removed and 100 μL DMSO was added to each well. The optical density was measured at 544 nm minus background absorption at 620 nm using the Victor3 (Perkin Elmer) microplate reader. Concentrations (IC₅₀) were calculated according to the dose-dependent inhibition curves with GraphPad Prism 7 software. The experiments were carried out in triplicate.

Table 1. Cytotoxicity of compounds 2, 4 and Linezolid towards HEK293 cells.

<table>
<thead>
<tr>
<th>Entry</th>
<th>Compound</th>
<th>IC₅₀, μM</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Linezolid</td>
<td>2 (IC₂₀)ᵃ</td>
</tr>
<tr>
<td>2</td>
<td>2a</td>
<td>225.07±13.47</td>
</tr>
<tr>
<td>3</td>
<td>2b</td>
<td>130.63±7.48</td>
</tr>
<tr>
<td>4</td>
<td>2c</td>
<td>246.15±5.99</td>
</tr>
<tr>
<td>5</td>
<td>2d</td>
<td>226.70±10.28</td>
</tr>
<tr>
<td>6</td>
<td>2e</td>
<td>116.60±10.73</td>
</tr>
<tr>
<td>7</td>
<td>2f</td>
<td>126.18±10.69</td>
</tr>
<tr>
<td>8</td>
<td>2g</td>
<td>126.18±10.69</td>
</tr>
<tr>
<td>9</td>
<td>2g’</td>
<td>170.14±6.06</td>
</tr>
<tr>
<td>10</td>
<td>4aa</td>
<td>105.12±5.01</td>
</tr>
<tr>
<td>11</td>
<td>4ba</td>
<td>157.64±5.75</td>
</tr>
<tr>
<td>12</td>
<td>4ca</td>
<td>270.04±20.39</td>
</tr>
<tr>
<td>13</td>
<td>4da</td>
<td>270.04±20.39</td>
</tr>
<tr>
<td>14</td>
<td>4ea</td>
<td>270.04±20.39</td>
</tr>
<tr>
<td>15</td>
<td>4ga</td>
<td>270.04±20.39</td>
</tr>
<tr>
<td>16</td>
<td>4ga’</td>
<td>270.04±20.39</td>
</tr>
</tbody>
</table>

ᵃ 20% inhibitory concentration (IC₂₀) for Linezolid was determined after 48 hours of incubation of HEK293 cells for 48 hours;ᵇ cytotoxicity was not detected.

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3 NMR data for compounds 2 and 4.
(S)-4-methyl-3-nitrooxazolidin-2-one (2a)
(S)-4-isopropyl-3-nitrooxazolidin-2-one (2b)
(S)-4-isopropyl-3-nitrooxazolidin-2-one (2b)
(S)-4-isopropyl-3-nitroxazolidin-2-one (2b)
(S)-4-((R)-sec-butyl)-3-nitrooxazolin-2-one (2c)
(S)-4-[(R)-sec-butyl]-3-nitrooxazolidin-2-one (2c)
(S)-4-(((R)-sec-butyl)-3-nitroxazolidin-2-one (2c)
methyl (S)-3-nitro-2-oxooxazolidine-4-carboxylate (2d)
methyl (S)-3-nitro-2-oxooxazolidine-4-carboxylate (2d)
methyl (S)-3-nitro-2-oxooxazolidine-4-carboxylate (2d)
methyl (4S,5R)-5-methyl-3-nitro-2-oxooxazolidine-4-carboxylate (2e)
methyl (4S,5R)-5-methyl-3-nitro-2-oxooxazolidine-4-carboxylate (2e)
(4R,5R)-5-methyl-3-nitro-2-oxooxazolidin-4-yl)methyl nitrate (2f)
((4R,5R)-5-methyl-3-nitro-2-oxooxazolidin-4-yl)methyl nitrate (2f)
((4R,5R)-5-methyl-3-nitro-2-oxooxazolidin-4-yl)methyl nitrate (2f)
(S)-3-nitro-4-(4-nitrobenzyl)oxazolidin-2-one (2g)
(S)-3-nitro-4-(4-nitrobenzyl)oxazolidin-2-one (2g)
(S)-4-(2,4-dinitrobenzyl)-3-nitrooxazolidin-2-one (2g')
(S)-4-(2,4-dinitrobenzyl)-3-nitrooxazolidin-2-one (2g')
(R)-2-(nitroamino)propyl carbamate (4aa)
13C NMR for (R)-2-(nitroamino)propyl propylcarbamate (4ab)
(R)-2-(nitroamino)propyl propylcarbonate (4ab)
(R)-2-(nitroamino)propyl propylcarbamate (4ab)
(R)-3-methyl-2-(nitroamino)butyl carbamate (4ba)
(R)-3-methyl-2-(nitroamino)butyl carbamate (4ba)
(R)-3-methyl-2-(nitroamino)butyl carbamate (4ba)

\[ \text{O}_2\text{N} \quad \begin{array}{c}
\text{H} \\
\text{O} \\
\text{NH}_2
\end{array} \]

1400 1200 1000 800 600 400 200 0 -200 -400 -600 -800 -1000 -1200 ppm

41
(R)-3-methyl-2-(nitroamino)butyl butylcarbamate (4bc)
(R)-3-methyl-2-(nitroamino)butyl butyrylcarbamate (4bc)
(R)-3-methyl-2-(nitroamino)butyl butylcarbamate (4bc)
(R)-3-methyl-2-(nitroamino)butyl diethylcarbamate (4bd)
$^{14}$N NMR for (R)-3-methyl-2-(nitroamino)butyl diethylcarbamate (4bd)
$^1$H NMR for (2$R$,3$S$)-3-methyl-2-(nitroamino)pentyl carbamate (4ca)
(2R,3S)-3-methyl-2-[(nitroamino)pentyl carbamate (4ca)
(2R,3S)-3-methyl-2-(nitroamino)pentyl carbamate (4ca)
methyl O-carbamoyl-N-nitro-D-serinate (4da)
methyl O-carbamoyl-N-nitro-D-serinate (4da)
methyl O-carbamoyl-N-nitro-D-allothreoninate (4ea)
methyl O-carbamoyl-N-nitro-D-allothreoninate (4ea)
(R)-2-(nitroamino)-3-(4-nitrophenyl)propyl carbamate (4ga)
(R)-2-(nitroamino)-3-(4-nitrophenyl)propyl carbamate (4ga)
(R)-3-(2,4-dinitrophenyl)-2-(nitroamino)propyl carbamate (4ga*)
$^1$H NMR spectra of $O$-carbamoyl-$N$-nitro-$D$-allothreoninate (4ea) and ($R$)-($+$)-$\alpha$-methylbenzylamine (MBA)
4 FTIR spectra for compounds 2 and 4.
(S)-4-isopropyl-3-nitrooxazolidin-2-one (2b)
(S)-4-((R)-sec-butyl)-3-nitrooxazolidin-2-one (2c)
methyl (S)-3-nitro-2-oxooxazolidine-4-carboxylate (2d)
methyl (4S,5R)-5-methyl-3-nitro-2-oxooxazolidine-4-carboxylate (2e)
$\left(4R,5R\right)$-5-methyl-3-nitro-2-oxooxazolidin-4-yl)methyl nitrate (2f)
(S)-3-nitro-4-(4-nitrobenzyl)oxazolidin-2-one (2g)
(S)-4-(2,4-dinitrobenzyl)-3-nitrooxazolidin-2-one (2g')
(R)-2-(nitroamino)propyl carbamate (4aa)
(R)-2-(nitroamino)propyl propylcarbamate (4ab)
(R)-3-methyl-2-(nitroamino)butyl carbamate (4ba)
(R)-3-methyl-2-(nitroamino)butyl butylcarbamate (4bc)
(R)-3-methyl-2-(nitroamino)butyl diethylcarbamate (4bd)
(2R,3S)-3-methyl-2-(nitroamino)pentyl carbamate (4ca)
methyl O-carbamoyl-N-nitro-D-allothreoninate (4ea)
(R)-2-(nitroamino)-3-(4-nitrophenyl)propyl carbamate (4ga)