Improved Syntheses of SAENTA [5'-*S*-(2-Aminoethyl)-6-*N*-(4-nitrobenzyl)-5'-thioadenosine], Analogues, and Fluorescent Probe Conjugates; Analysis of Cell-Surface hENT1 Levels for Prediction of the Antitumor Efficacy of Gemcitabine

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Supporting Information

Table 1. Inhibition of [^{3}H]uridine uptake in yeast producing recombinant hENT1. Uptake of [^{3}H]uridine (1 μM) was measured at ambient temperature during 20 min in the absence (control) or presence of either unlabeled NBMPR (3 nM) or each of the compounds **18a–18w** (3 nM). Uptake values in the presence of **18a–18w** are expressed as a percentage of control values in the absence of an inhibitor. Results from three independent experiments were used to calculate the SE values.

Compound	[^{3}H]Urd (% control)	SE (±)		Compound	[^{3}H]Urd (% control)	SE (±)
Control	100.0	2.1		Control	100.0	2.1
NBMPR	51.0	3.0		**18l**	72.0	2.4
18a	72.0	11.2		**18m**	84.0	6.5
18b	78.0	5.5		**18n**	75.0	12.5
18c	77.0	5.0		**18o**	76.0	5.6
18d	75.0	8.0		**18p**	74.0	7.8
18e	81.0	8.9		**18q**	83.0	5.5
18f	73.0	4.8		**18r**	74.0	6.1
18g	84.0	6.0		**18s**	81.0	4.8
18h	79.0	5.0		**18t**	74.0	6.8
18i	81.0	8.7		**18u**	76.0	7.4
18j	87.0	7.0		**18v**	74.0	6.1
18k	77.0	2.1		**18w**	57.0	3.4

General Procedures A–G. The general procedures are described in detail for **13c** (procedure A), **14c** (procedure B), **16k** (procedure C), **17k** (procedure D), **17n** (procedure E), **18b** (procedure F), and **3** (procedure G) in the Experimental Section of the paper.

2-(Acetamido)ethanethiol.[i] Ac_2O (42.4 mL, 45.9 g, 0.45 mol) and KOH/H_2O (8 M, ~110 mL, to maintain pH ~8) were added dropwise to a stirred solution of 2-aminoethanethiol hydrochloride (17 g, 0.15 mol) in 120 mL of H_2O. The pH was then adjusted (to pH 7) with HCl/H_2O, stirring was continued for 1 h at ambient temperature, and the solution was cooled in an ice-bath. Solid KOH (30 g, 0.54 mol) was added slowly, and stirring was continued for 50 min at ambient temperature. NaCl was added to saturation and the mixture was extracted (CH_2Cl_2, 3×). Volatiles were removed under vacuum, and chromatography of the residue (5% MeOH/CH_2Cl_2) gave 2-(acetamido)ethanethiol (13.65 g, 77%) as a colorless oil: ^{1}H NMR ($CDCl_3$, 500 MHz) δ 6.06 (br s, 1H), 3.41–3.45 (m, 2H), 2.67 (dt, *J* = 6.0, 8.0 Hz) 2.00 (s, 3H), 1.36 (t, *J* = 8.3 Hz); HRMS (FAB) *m/z* 120.0477 (MH^+ [$C_4H_{10}NOS$] = 120.0483).

***N*-Ethyl-4-[(trifluoroacetamido)methyl]benzamide (13a).** Treatment of 4-(aminomethyl)benzoic acid (**12**) (600 mg, 3.97 mmol) by procedure A [well-powdered $EtNH_2$·HCl (3.30 g, 40.4 mmol) and pyridine (4.80 mL, 4.70 g, 59.5 mmol) rather than ethylamine, chromatography with 50% EtOAc/hexanes] gave **13a** (610 mg, 56%) as a white solid: ^{1}H NMR ($CDCl_3$, 500 MHz) δ 7.74 (d, *J* = 8.0 Hz, 2H), 7.34 (d, *J* = 8.0 Hz, 2H), 6.79 (br s, 1H), 6.08 (br s, 1H), 4.59 (d, *J* = 6.0 Hz, 2H), 3.48-3.54 (m, 2H), 1.27 (t, *J* = 7.5 Hz, 3H); HRMS (EI) *m/z* 274.0946 (M^+ [$C_{12}H_{13}F_3N_2O_2$] = 274.0929).

***N*-Propyl-4-[(trifluoroacetamido)methyl]benzamide (13b).** Treatment of **12** (1.00 g, 6.61 mmol) and propylamine by procedure A (chromatography with 30 → 50% EtOAc/hexanes) gave **13b** (1.03 g, 54%) as a white solid: ^{1}H NMR (DMSO-d_6, 300 MHz) δ 9.98 (t, *J* = 6.0 Hz, 1H),

8.38 (t, J = 5.7 Hz, 1H), 7.80 (dt, J = 1.5, 8.1 Hz, 2H), 7.32 (d, J = 8.4 Hz, 2H), 4.42 (d, J = 6.3 Hz, 2H), 3.18–3.24 (m, 2H), 1.53 (hex, J = 4.5 Hz, 2H), 0.89 (t, J = 7.4 Hz, 3H); HRMS (FAB) *m/z* 311.0998 (MNa^+ [$C_{13}H_{15}F_3N_2O_2Na$] = 311.0983).

***N*-Hexyl-4-[(trifluoroacetamido)methyl]benzamide (13d).** Treatment of **12** (500 mg, 3.31 mmol) and hexylamine by procedure A (chromatography with 30% EtOAc/hexanes) gave **13d** (610 mg, 56%;) as a white solid: ^{1}H NMR (DMSO-d_6, 500 MHz) δ 10.06 (br s, 1H), 8.42 (t, J = 5.5 Hz, 1H), 7.80 (d, J = 8.5 Hz, 2H), 7.33 (d, J = 8.5 Hz, 2H), 4.44 (br s, 2H), 3.23 (dd, J = 6.5, 13.0 Hz, 2H), 1.50 (pent, J = 7.0 Hz, 2H), 1.24–1.33 (br m, 6H), 0.86 (t, J = 6.5 Hz, 3H); HRMS (FAB) *m/z* 353.1458 (MNa^+ [$C_{16}H_{21}F_3N_2O_2Na$] = 353.1453).

***N*-Phenyl-4-[(trifluoroacetamido)methyl]benzamide (13e).** Treatment of **12** (1.00 g, 6.61 mmol) and aniline by procedure A (chromatography with 30% EtOAc/hexanes → EtOAc → 10% MeOH/EtOAc) gave **13e** (1.34 g, 63%) as a white solid: ^{1}H NMR (DMSO-d_6, 500 MHz) δ 10.23 (s, 1H), 10.11 (t, J = 6.0 Hz, 1H), 7.94 (d, J = 8.0 Hz, 2H), 7.77 (d, J = 8.5 Hz, 2H), 7.42 (d, J = 8.5 Hz, 2H), 7.35 (t, J = 7.8 Hz, 2H), 7.10 (t, J = 7.3 Hz, 1H), 4.48 (d, J = 6.0 Hz, 2H); HRMS (EI) *m/z* 322.0917 (M^+ [$C_{16}H_{13}F_3N_2O_2$] = 322.0929).

***N*-Benzyl-4-[(trifluoroacetamido)methyl]benzamide (13f).** Treatment of **12** (1.00 g, 6.61 mmol) and benzylamine by procedure A (chromatography with 50% EtOAc/hexanes → EtOAc → 10% MeOH/EtOAc) gave **13f** (1.32 g, 59%) as a white solid: ^{1}H NMR (DMSO-d_6, 500 MHz) δ 10.08 (t, J = 5.5 Hz, 1H), 9.04 (t, J = 5.8 Hz, 1H), 7.88 (d, J = 8.5 Hz, 2H), 7.30–7.38 (m, 6H), 7.20–7.26 (m, 1H), 4.48 (d, J = 6.0 Hz, 2H), 4.45 (d, J = 6.0 Hz, 2H); HRMS (EI) *m/z* 336.1093 (M^+ [$C_{17}H_{15}F_3N_2O_2$] = 336.1086).

***N*,*N*-Dimethyl-4-[(trifluoroacetamido)methyl]benzamide (13g).** Treatment of **12** (1.00 g, 6.61 mmol) by procedure A [well-powdered Me_2NH·HCl (2.70 g, 33.3 mmol) and pyridine (2.67

mL, 2.62 g, 33.2 mmol) rather than Me_2NH, chromatography with 30 → 50 % EtOAc/hexanes] gave **13g** (1.02 g, 56%) as a white solid: ^{1}H NMR ($CDCl_3$, 500 MHz) δ 7.79 (br s, 1H), 7.28 (d, *J* = 8.0 Hz, 2H), 7.19 (d, *J* = 8.5 Hz, 2H), 4.49 (d, *J* = 6.5 Hz, 2H), 3.41–3.78 (m, 6H); HRMS (EI) *m/z* 274.0924 (M^+ [$C_{12}H_{13}F_3N_2O_2$] = 274.0929).

***N*,*N*-Diethyl-4-[(trifluoroacetamido)methyl]benzamide (13h).** Treatment of **12** (1.00 g, 6.61 mmol) and Et_2NH by procedure A (chromatography with 30% → 50% EtOAc/hexanes) gave **13h** (1.34 g, 67%) as a white solid: ^{1}H NMR ($CDCl_3$, 500 MHz) δ 7.98 (br s, 1H), 7.22 (d, *J* = 8.5 Hz, 2H), 7.14 (d, *J* = 8.0 Hz, 2H), 4.47 (d, *J* = 6.0 Hz, 2H), 3.53–3.54 (m, 2H), 3.21–3.22 (m, 2H), 1.25 (t, *J* = 6.3 Hz, 3H), 1.09 (t, *J* = 6.0 Hz, 3H); HRMS (EI) *m/z* 302.1227 (M^+ [$C_{14}H_{17}F_3N_2O_2$] = 302.1242).

***N*-[4-(Piperidine-1-carbonyl)benzyl]trifluoroacetamide (13i).** Treatment of **12** (1.00 g, 6.61 mmol) and piperidine by procedure A (chromatography with 30 → 50% EtOAc/hexanes → EtOAc) gave **13i** (1.43 g, 69%) as a white solid: ^{1}H NMR ($CDCl_3$, 500 MHz) δ 7.94 (s, 1H), 7.24 (d, *J* = 8.0 Hz, 2H), 7.15 (d, *J* = 8.5 Hz, 2H), 4.47 (d, *J* = 5.5 Hz, 2H), 3.70 (br s, 2H), 3.30 (br s, 2H), 1.68 (br s, 4H), 1.50 (br s, 2H); HRMS (EI) *m/z* 314.1224 (M^+ [$C_{15}H_{17}F_3N_2O_2$] = 314.1242).

***N*-[4-(Morpholine-4-carbonyl)benzyl]trifluoroacetamide (13j).** Treatment of **12** (1.00 g, 6.61 mmol) and morpholine by procedure A (chromatography with 50% EtOAc/hexanes → EtOAc) gave **13j** (1.33 g, 64%) as a white solid: ^{1}H NMR ($CDCl_3$, 500 MHz) δ 7.54 (br s, 1H), 7.29 (d, *J* = 8.0 Hz, 2H), 7.18 (d, *J* = 8.5 Hz, 2H), 4.50 (d, *J* = 6.0 Hz, 2H), 3.11 (s, 4H), 2.96 (s, 4H); HRMS (EI) *m/z* 316.1022 (M^+ [$C_{14}H_{15}F_3N_2O_3$] = 316.1035).

***tert*-Butyl *N*-[4-(Propanamido)benzyl]carbamate (16l).** Treatment of **15** (1.00 g, 4.50 mmol), propanoyl chloride (600 μL, 640 mg, 6.91 mmol), and pyridine (2.20 mL, 2.16 g, 27.3 mmol) by procedure C (chromatography with 20 → 50% EtOAc/hexanes) gave **16l** (1.12 g,

89%) as a white solid: ^{1}H NMR (DMSO-d_6, 500 MHz) δ 9.82 (s, 1H), 7.51 (d, *J* = 8.5 Hz, 2H), 7.33 (t, *J* = 6.0 Hz, 1H), 7.13 (d, *J* = 8.5 Hz, 2H), 4.05 (d, *J* = 5.5 Hz, 2H), 2.30 (q, *J* = 7.5 Hz, 2H), 1.39 (s, 9H), 1.07 (t, *J* = 7.3 Hz, 3H); HRMS (FAB) *m/z* 279.1689 (MH^+ [$C_{15}H_{23}N_2O_3$] = 279.1709).

***tert*-Butyl *N*-[4-(Hexanamido)benzyl]carbamate (16m).** Treatment of **15** (1.20 g, 5.41 mmol), hexanoyl chloride (1.12 mL, 1.10 g, 8.17 mmol), and Et_3N (2.25 mL, 1.63 g, 16.1 mmol) by procedure C (chromatography with 30 → 50% EtOAc/hexanes) gave **16m** (1.64 g, 95%) as a white solid: ^{1}H NMR ($CDCl_3$, 500 MHz) δ 7.47 (d, *J* = 9.0 Hz, 2H), 7.23 (d, *J* = 8.5 Hz, 2H), 7.14 (br s, 1H), 4.81 (br s, 1H), 4.27 (d, *J* = 5.5 Hz, 2H), 2.35 (t, *J* = 7.8 Hz, 2H), 1.73 (pent, *J* = 7.5 Hz, 2H), 1.46 (s, 9H), 1.33–1.38 (m, 4H), 0.91 (t, *J* = 7.0 Hz, 3H); HRMS (EI) *m/z* 320.2092 (M^+ [$C_{18}H_{28}N_2O_3$] = 320.2100).

***tert*-Butyl *N*-[4-(Nonanamido)benzyl]carbamate (16n).** Treatment of **15** (1.10 g, 4.85 mmol), nonanoyl chloride (1.10 mL, 1.03 g, 5.85 mmol), and Et_3N (2.10 mL, 1.52 g, 15.1 mmol) by procedure C (chromatography with 20 → 30% EtOAc/hexanes) gave **16n** (1.67 g, 93%) as a white solid: ^{1}H NMR (DMSO-d_6, 500 MHz) δ 9.81 (s, 1H), 7.50 (d, *J* = 8.5 Hz, 2H), 7.33 (t, *J* = 6.3 Hz, 1H), 7.13 (d, *J* = 8.5 Hz, 2H), 4.04 (d, *J* = 6.5 Hz, 2H), 2.27 (t, *J* = 7.3 Hz, 2H), 1.56 (pent, *J* = 7.0 Hz, 2H), 1.37 (s, 9H), 1.25–1.32 (m, 10 H), 0.85 (t, *J* = 6.8 Hz, 3H); HRMS (FAB) *m/z* 385.2474 (MNa^+ [$C_{21}H_{34}N_2O_3Na$] = 385.2467).

***tert*-Butyl *N*-[4-(Pivalamido)benzyl]carbamate (16o).** Treatment of **15** (1.22 g, 5.50 mmol), pivaloyl chloride (1.00 mL, 980 mg, 8.13 mmol), and Et_3N (2.30 mL, 1.67 g, 16.5 mmol) by procedure C (chromatography with 20 → 50% EtOAc/hexanes → 5% MeOH/CH_2Cl_2) gave **16o** (1.45g, 86%) as a white solid: ^{1}H NMR ($CDCl_3$, 500 MHz) δ 7.49 (dt, *J* = 1.8, 8.0 Hz, 2H),

7.32 (s, 1H), 7.24 (d, J = 8.0 Hz, 2H), 4.80 (br s, 1H), 4.27 (s, 2H), 1.46 (s, 9H), 1.32 (s, 9H); HRMS (FAB) *m/z* 329.1849 (MNa^+ [$C_{17}H_{26}N_2O_3Na$] = 329.1841).

***tert*-Butyl *N*-[4-(Benzamido)benzyl]carbamate (16p).** Treatment of **15** (1.0 g, 4.5 mmol), benzoyl chloride (0.78 mL, 0.94 g, 6.7 mmol), and Et_3N (3.14 mL, 2.28 g, 22.6 mmol) by procedure C (chromatography with 50% EtOAc/hexanes → 10% MeOH/EtOAc) gave **16p** (1.35g, 92%) as a white solid: ^{1}H NMR (DMSO-d_6, 500 MHz) δ 10.23 (s, 1H), 7.93–7.96 (m, 2H), 7.70 (d, J = 8.0 Hz, 2H), 7.51–7.60 (m, 3H), 7.38 (t, J = 6.3 Hz, 1H), 7.21 (d, J = 8.5 Hz, 2H), 4.09 (d, J = 6.0 Hz, 2H), 1.40 (s, 9H); HRMS (FAB) *m/z* 349.1539 (MNa^+ [$C_{19}H_{22}N_2O_3Na$] = 349.1528).

***tert*-Butyl *N*-[4-(4-Methylbenzamido)benzyl]carbamate (16q).** Treatment of **15** (1.10 g, 4.95 mmol), 4-methylbenzoyl chloride (0.98 mL, 1.2 g, 7.4 mmol), and Et_3N (2.10 mL, 1.52 g, 15.1 mmol) by procedure C (chromatography with 30 → 50% EtOAc/hexanes) gave **16q** (1.45 g, 86%) as a white solid: ^{1}H NMR (DMSO-d_6, 500 MHz) δ 10.13 (s, 1H), 7.86 (d, J = 8.0 Hz, 2H), 7.68 (d, J = 8.0 Hz, 2H), 7.36 (t, J = 6.3 Hz, 1H), 7.32 (d, J = 8.0 Hz, 2H), 7.19 (d, J = 8.5 Hz, 2H), 4.08 (d, J = 6.5 Hz, 2H), 2.37 (s, 3H), 1.39 (s, 9H); HRMS (EI) *m/z* 340.1779 (M^+ [$C_{20}H_{24}N_2O_3$] = 340.1787).

***tert*-Butyl *N*-[4-(4-Nitrobenzamido)benzyl]carbamate (16r).** Treatment of **15** (1.10 g, 4.95 mmol), 4-nitrobenzoyl chloride (1.38 g, 7.44 mmol), and Et_3N (2.10 mL, 1.52 g, 15.1 mmol) by procedure C (chromatography with 30% → 50% EtOAc/hexanes) gave **16r** (1.51g, 82%) as a light yellow solid: ^{1}H NMR (DMSO-d_6, 500 MHz) δ 10.56 (s, 1H), 8.37 (d, J = 8.5 Hz, 2H), 8.18 (d, J = 9.0 Hz, 2H), 7.71 (d, J = 8.0 Hz, 2H), 7.39 (t, J = 6.3 Hz, 1H), 7.24 (d, J = 8.5 Hz, 2H), 4.11 (d, J = 6.5 Hz, 2H), 1.40 (s, 9H); HRMS (EI) *m/z* 371.1483 (M^+ [$C_{19}H_{21}N_3O_5$] = 371.1481).

***tert*-Butyl *N*-[4-(Methylsulfonamido)benzyl]carbamate (16s)** was prepared as described.[ii]

***tert*-Butyl *N*-{4-[4-(Methylphenyl)sulfonamido]benzyl}carbamate (16t).** A stirred solution of **15** (1.10 g, 4.95 mmol) in dried pyridine (10 mL) was cooled in an ice-bath, and tosyl chloride (1.10 g, 5.77 mmol) was added slowly. Stirring was continued overnight at ambient temperature, and volatiles were removed under vacuum. The mixture was neutralized (8 M $NaOH/H_2O$), and volatiles were removed under vacuum. Chromatography of the residue (20% → 30% EtOAc/hexanes) gave **16t (**1.67 g, 90%) as white solid: ^{1}H NMR (DMSO-d_6, 500 MHz) δ 10.16 (s, 1H), 7.63 (d, J = 8.5 Hz, 2H), 7.32 (d, J = 7.5 Hz, 2H), 7.29 (t, J = 6.5 Hz, 1H), 7.07 (d, J = 8.0 Hz, 2H), 7.01 (d, J = 8.5 Hz, 2H), 4.00 (d, J = 6.0 Hz, 2H), 2.32 (s, 3H), 1.37 (s, 9H); HRMS (EI) *m/z* 376.1457 (M^+ [$C_{19}H_{24}N_2O_4S$] = 376.1457).

***N*-Ethyl-3-(Nitrobenzyl)amine Hydrochloride** was prepared as described.[iii]

(4-Nitrophenyl)methanethiol. A mixture of potassium thioacetate (2.64 g, 23.1 mmol) and 4-nitrobenzyl bromide (5.0 g, 23 mmol) in CH_3CN (100 mL) was irradiated in an ultrasonic bath for 20 min and then filtered. Volatiles were removed from the filtrate under vacuum to give *S*-(4-nitrobenzyl) thioacetate as a light brown soild: ^{1}H NMR (DMSO-d_6, 500 MHz) δ 8.16 (d, J = 8.5 Hz, 2H), 7.57 (d, J = 9.0 Hz, 2H), 4.23 (s, 2H), 2.37 (s, 3H); HRMS (EI) *m/z* 211.0297 (M^+ [$C_9H_9NO_3S$] = 211.0303). The thioacetate was subjected to the reported[iv] acidic hydrolysis procedure to give the thiol (90%) as a light brown solid: ^{1}H NMR (DMSO-d_6, 500 MHz) δ 8.19 (d, J = 9.0 Hz, 2H), 7.63 (d, J = 9.0 Hz, 2H), 3.86 (d, J = 8.5 Hz, 2H), 3.16 (t, J = 8.3 Hz, 1H); HRMS (EI) *m/z* 169.0189 (M^+ [$C_7H_7NO_2S$] = 169.2010).

5'-*S*-(2-Acetamidoethyl)-6-*N*-[4-(*N*-ethylcarbamoyl)benzyl]-5'-thioadenosine (18a). Treatment of crude **14a** {HRMS (EI) *m/z* 178.1098, M^+ [$C_{10}H_{14}N_2O$] = 178.1106; obtained from **13a** by procedure B}, **11a** (250 mg, 0.55 mmol), and Et_3N (150 µL, 110 mg, 1.09 mmol) by

procedure F (chromatography with 5 → 10% MeOH/CH_2Cl_2) gave material (280 mg, 96%) that was recrystallized (MeOH) to give **18a** as a white solid: UV (MeOH) max 267 nm (ε 23 600), min 240 nm (ε 13 400); ^{1}H NMR (DMSO-d_6, 500 MHz) δ 8.48 (br s, 1H), 8.40 (s, 1H), 8.37 (t, *J* = 5.8 Hz, 1H), 8.21 (s, 1H), 7.94 (t, *J* = 5.3 Hz, 1H), 7.75 (d, *J* = 8.5 Hz, 2H), 7.38 (d, *J* = 7.5 Hz, 2H), 5.90 (d, *J* = 5.5 Hz, 1H), 5.50 (d, *J* = 5.5 Hz, 1H), 5.33 (d, *J* = 4.5 Hz, 1H), 4.75 (br s, 3H), 4.14 (dd, *J* = 4.5, 8.5 Hz, 1H), 3.99-4.02 (m, 1H), 3.23-3.28 (m, 2H), 3.17 (dd, *J* = 7.0, 13.0 Hz, 2H), 2.92 (dd, *J* = 6.0, 14.0 Hz, 1H), 2.84 (dd, *J* = 6.8, 13.8 Hz, 1H), 2.56 (dt, *J* = 2.5, 7.0 Hz, 2H), 1.78 (s, 3H), 1.09 (t, *J* = 7.3 Hz, 3H); ^{13}C NMR (DMSO-d_6, 125 MHz) δ 169.2, 165.8, 154.4, 152.6, 148.9, 143.1, 140.0, 133.1, 127.1, 126.8, 119.6, 87.4, 83.9, 72.64, 72.57, 42.7, 38.6, 34.0, 33.9, 31.4, 22.6, 14.8; HRMS (FAB) *m/z* 530.2182 (MH^+ [$C_{24}H_{32}N_7O_5S$] = 530.2186).

5'-*S*-(2-Acetamidoethyl)-6-*N*-[4-(butylcarbamoyl)benzyl]-5'-thioadenosine (18c). Treatment of crude **14c** {HRMS (EI) *m/z* 206.1414, M^+ [$C_{12}H_{18}N_2O$] = 206.1419; obtained from **13c** by procedure B}, **11a** (0.27 g, 0.59 mmol), and Et_3N (165 μL, 120 mg, 1.19 mmol), by procedure F(chromatography with 10% MeOH/CH_2Cl_2) gave material (300 mg, 91%) that was recrystallized (MeOH) to give **18c** as a white solid: UV (MeOH) max 267 nm (ε 24 000), min 239 nm (ε 13 900); ^{1}H NMR (DMSO-d_6, 500 MHz) δ 8.48 (br s, 1H), 8.40 (s, 1H), 8.34 (t, *J* = 5.8 Hz, 1H), 8.21 (s, 1H), 7.94 (t, *J* = 5.3 Hz, 1H), 7.75 (d, *J* = 8.5 Hz, 2H), 7.38 (d, *J* = 8.0 Hz, 2H), 5.90 (d, *J* = 6.0 Hz, 1H), 5.51 (d, *J* = 6.0 Hz, 1H), 5.34 (d, *J* = 4.5 Hz, 1H), 4.75 (br s, 3H), 4.14 (dd, *J* = 4.5, 8.5 Hz, 1H), 4.00 (dt, *J* = 4.0, 6.5 Hz, 1H), 3.22 (dd, *J* = 6.8, 12.8 Hz, 2H), 3.17 (dd, *J* = 7.0, 13.0 Hz, 2H), 2.93 (dd, *J* = 5.8, 13.8 Hz, 1H), 2.84 (dd, *J* = 6.8, 13.8 Hz, 1H), 2.56 (dt, *J* = 2.5, 7.0 Hz, 2H), 1.78 (s, 3H), 1.48 (pent, *J* = 7.5 Hz, 2H), 1.30 (hex, *J* = 7.5 Hz, 2H), 0.88 (t, *J* = 7.3 Hz, 3H); ^{13}C NMR (DMSO-d_6, 125 MHz) δ 169.2, 166.0, 154.4, 152.6, 148.9,

143.1, 140.0, 133.2, 127.1, 126.8, 119.6, 87.4, 83.9, 72.64, 72.58, 42.7, 38.8, 38.6, 33.9, 31.4, 31.3, 22.6, 19.7, 13.8; HRMS (FAB) *m/z* 580.2318 (MNa^+ [$C_{26}H_{35}N_7O_5SNa$] = 580.2318).

5'-*S*-(2-Acetamidoethyl)-6-*N*-[4-(hexylcarbamoyl)benzyl]-5'-thioadenosine (18d). Treatment of crude **14d** {HRMS (EI) *m/z* 234.1722, M^+ [$C_{14}H_{22}N_2O$] = 234.1732; obtained from **13c** by procedure B}, **11a** (500 mg, 1.10 mmol), and Et_3N (455 μL, 330 mg, 3.27 mmol) by procedure F (chromatography with 5 → 10% MeOH/CH_2Cl_2) gave material (620 mg, 96%) that was recrystallized (MeOH) to give **18d** as a white solid: UV (MeOH) max 267 nm (ε 23 000), min 239 nm (ε 13 400); ^{1}H NMR (DMSO-d_6, 500 MHz) δ 8.49 (br s, 1H), 8.40 (s, 1H), 8.35 (t, *J* = 5.8 Hz, 1H), 8.22 (s, 1H), 7.95 (t, *J* = 5.3 Hz, 1H), 7.75 (d, *J* = 8.0 Hz, 2H), 7.39 (d, *J* = 8.5 Hz, 2H), 5.91 (d, *J* = 5.5 Hz, 1H), 5.51 (d, *J* = 6.0 Hz, 1H), 5.35 (d, *J* = 5.0 Hz, 1H), 4.75 (br s, 3H), 4.14–4.16 (m, 1H), 3.99–4.03 (m, 1H), 3.22 (dd, *J* = 7.0, 13.0 Hz, 2H), 3.18 (dd, *J* = 7.0, 13.0 Hz, 2H), 2.93 (dd, *J* = 5.8, 14.3 Hz, 1H), 2.84 (dd, *J* = 6.8, 13.8 Hz, 1H), 2.56 (dt, *J* = 2.5, 7.0 Hz, 2H), 1.78 (s, 3H), 1.46–1.52 (m, 2H), 1.27–1.30 (m, 6H), 0.84–0.87 (m, 3H); ^{13}C NMR (DMSO-d_6, 125 MHz) δ 169.2, 165.9, 154.4, 152.6, 148.9, 143.1, 140.0, 133.2, 127.1, 126.8, 119.6, 87.4, 83.9, 72.65, 72.58, 42.7, 38.6, 33.9, 31.4, 31.0, 29.1, 26.2, 22.6, 22.1, 14.0; HRMS (FAB) *m/z* 608.2612 (MNa^+ [$C_{28}H_{39}N_7O_5SNa$] = 608.2631).

5'-*S*-(2-Acetamidoethyl)-6-*N*-[4-(phenylcarbamoyl)benzyl]-5'-thioadenosine (18e). Treatment of crude **14e** {HRMS (EI) *m/z* 218.1418, M^+ [$C_{13}H_{18}N_2O$] = 218.1419; obtained from **13e** by procedure B}, **11a** (250 mg, 0.55 mmol), and Et_3N (152 μL, 110 mg, 1.09 mmol) by procedure F [chromatography with 10% MeOH/CH_2Cl_2 followed by recrystallization (MeOH)] gave **18e** (160 mg, 50%,) as a white solid: UV (MeOH) max 272 nm (ε 33 100), min 236 nm (ε 13 000); ^{1}H NMR (DMSO-d_6, 500 MHz) δ 10.16 (s, 1H), 8.53 (br s, 1H), 8.41 (s, 1H), 8.23 (s, 1H), 7.95 (t, *J* = 5.8 Hz, 1H), 7.87 (d, *J* = 8.5 Hz, 2H), 7.75 (d, *J* = 8.0 Hz, 2H), 7.47 (d, *J* = 8.0

Hz, 2H), 7.32–7.35 (m, 2H), 7.08 (t, *J* = 7.8 Hz, 1H), 5.91 (d, *J* = 6.0 Hz, 1H), 5.51 (d, *J* = 6.5 Hz, 1H), 5.34 (d, *J* = 5.0 Hz, 1H), 4.77 (br s, 3H), 4.15 (dd, *J* = 4.5, 8.5 Hz, 1H), 3.99–4.02 (m, 1H), 3.17 (dd, *J* = 6.8, 12.8 Hz, 2H), 2.93 (dd, *J* = 5.8, 13.8 Hz, 1H), 2.84 (dd, *J* = 6.8, 13.8 Hz, 1H), 2.56 (dt, *J* = 2.5, 7.0 Hz, 2H), 1.78 (s, 3H); ^{13}C NMR (DMSO-*d*$_6$, 125 MHz) δ 169.2, 165.5, 154.4, 152.6, 148.9, 143.9, 140.0, 139.2, 133.4, 128.6, 127.7, 126.9, 123.6, 120.3, 119.6, 87.4, 83.9, 72.63, 72.58, 42.8, 38.6, 33.8, 31.4, 22.6; HRMS (FAB) *m/z* 600.2023 (MNa^+ [$C_{28}H_{31}N_7O_5SNa$] = 600.2005).

5'-*S*-(2-Acetamidoethyl)-6-*N*-[4-(benzylcarbamoyl)benzyl]-5'-thioadenosine (18f). Treatment of crude **14f** {HRMS (EI) *m/z* 220.1216, M^+ [$C_{12}H_{16}N_2O_2$] = 220.1212; obtained from **13f** by procedure B}, **11a** (310 mg, 0.68 mmol), and Et_3N (193 μL, 140 mg, 1.39 mmol) by procedure F [chromatography with 5 → 10% MeOH/CH_2Cl_2 followed by recrystallization (MeOH)] gave **18f** (280 mg, 71%) as a white solid: UV (MeOH) max 267 nm (ε 24 400), min 241 nm (ε 15 500); ^{1}H NMR (DMSO-*d*$_6$, 500 MHz) δ 8.97 (t, *J* = 6.3 Hz, 1H), 8.50 (br s, 1H), 8.40 (s, 1H), 8.21 (s, 1H), 7.95 (t, *J* = 5.5 Hz, 1H), 7.82 (d, *J* = 8.5 Hz, 2H), 7.41 (d, *J* = 8.5 Hz, 2H), 7.28–7.33 (m, 4H), 7.21–7.23 (m, 1H), 5.90 (d, *J* = 5.5 Hz, 1H), 5.51 (d, *J* = 6.0 Hz, 1H), 5.34 (d, *J* = 5.0 Hz, 1H), 4.75 (br s, 3H), 4.46 (d, *J* = 6.0 Hz, 2H), 4.15 (dd, *J* = 4.3, 10.3 Hz, 1H), 4.00 (dt, *J* = 3.5, 6.5 Hz, 1H), 3.17 (dd, *J* = 6.5, 13.0 Hz, 2H), 2.93 (dd, *J* = 5.8, 13.8 Hz, 1H), 2.84 (dd, *J* = 7.0, 14.0 Hz, 1H), 2.56 (dt, *J* = 2.5, 7.0 Hz, 2H), 1.78 (s, 3H); ^{13}C NMR (DMSO-*d*$_6$, 125 MHz) δ 169.2, 166.1, 154.4, 152.6, 148.9, 143.5, 140.1, 139.7, 132.8, 128.3, 127.3, 127.2, 126.9, 126.7, 119.6, 87.4, 83.9, 72.64, 72.58, 42.7, 42.5, 38.6, 33.9, 31.4, 22.6; HRMS (FAB) *m/z* 614.2148 (MNa^+ [$C_{29}H_{33}N_7O_5SNa$] = 614.2162).

5'-*S*-(2-Acetamidoethyl)-6-*N*-[4-(dimethylcarbamoyl)benzyl]-5'-thioadenosine (18g). Treatment of crude **14g** {HRMS (EI) *m/z* 226.1116, M^+ [$C_{14}H_{14}N_2O$] = 226.1106; obtained from

13g by procedure B}, **11a** (360 mg, 0.79 mmol), and Et_3N (220 μL, 160 mg, 1.58 mmol) by procedure F (chromatography with 10 → 15% MeOH/EtOAc) gave **18g** (380 mg, 91%) as a white solid foam: UV (MeOH) max 268 nm (ε 21 600), min 237 nm (ε 9300); ^{1}H NMR (DMSO-d_6, 500 MHz) δ 8.48 (br s, 1H), 8.40 (s, 1H), 8.23 (s, 1H), 7.95 (t, *J* = 5.8 Hz, 1H), 7.37 (d, *J* = 8.0 Hz, 2H), 7.32 (d, *J* = 8.5 Hz, 2H), 5.90 (d, *J* = 6.0 Hz, 1H), 5.51 (d, *J* = 6.0 Hz, 1H), 5.34 (d, *J* = 5.0 Hz, 1H), 4.70–4.78 (br m, 3H), 4.14 (dd, *J* = 4.5, 9.0 Hz, 1H), 4.00 (dt, *J* = 3.5, 6.5 Hz, 1H), 3.17 (dd, *J* = 7.0, 13.0 Hz, 2H), 2.82–2.95 (m, 8H), 2.56 (dt, *J* = 2.5, 7.0 Hz, 2H), 1.78 (s, 3H); ^{13}C NMR (DMSO-d_6, 125 MHz) δ 170.1, 169.2, 154.4, 152.6, 148.9, 141.4, 140.0, 134.8, 127.0, 126.8, 119.6, 87.4, 83.9, 72.64, 72.58, 42.6, 38.6, 34.8, 33.9, 31.4, 22.6; HRMS (FAB) *m/z* 552.2022 (MNa^+ [$C_{24}H_{31}N_7O_5SNa$] = 552.2005).

5'-*S*-(2-Acetamidoethyl)-6-*N*-[4-(diethylcarbamoyl)benzyl]-5'-thioadenosine (18h). Treatment of crude **14h** {HRMS (EI) *m/z* 240.1271, M^+ [$C_{15}H_{16}N_2O$] = 240.1263; obtained from **13h** by procedure B}, **11a** (360 mg, 0.79 mmol), and Et_3N (220 μL, 160 mg, 1.58 mmol) by procedure F (chromatography with 5 → 10% MeOH/CH_2Cl_2) gave **18h** (380 mg, 86%) as a white solid foam: UV (MeOH) max 268 nm (ε 21 000), min 237 nm (ε 8300); ^{1}H NMR (DMSO-d_6, 500 MHz) δ 8.48 (br s, 1H), 8.40 (s, 1H), 8.23 (s, 1H), 7.95 (t, *J* = 5.8 Hz, 1H), 7.37 (d, *J* = 8.0 Hz, 2H), 7.27 (d, *J* = 8.0 Hz, 2H), 5.91 (d, *J* = 6.0 Hz, 1H), 5.51 (d, *J* = 6.0 Hz, 1H), 5.34 (d, *J* = 5.0 Hz, 1H), 4.70–4.78 (br m, 3H), 4.15 (dd, *J* = 4.3, 8.8 Hz, 1H), 4.00 (dt, *J* = 4.0, 6.5 Hz, 1H), 3.39 (br s, 2H), 3.17 (dd, *J* = 7.0, 13.0 Hz, 2H), 3.14 (br s, 2H), 2.93 (dd, *J* = 5.8, 13.8 Hz, 1H), 2.84 (dd, *J* = 6.8, 13.8 Hz, 1H), 2.56 (dt, *J* = 2.5, 7.0 Hz, 2H), 1.78 (s, 3H), 1.11 (br s, 3H), 1.02 (br s, 3H); ^{13}C NMR (MeOH-d_4, 125 MHz) δ 173.7, 173.5, 156.2, 154.1, 150.2, 142.4, 141.2, 137.0, 128.8, 127.7, 121.2, 90.2, 85.9, 75.0, 74.2, 45.1, 44.8, 41.0, 40.3, 35.2, 33.2, 22.7, 14.5, 13.2; HRMS (FAB) *m/z* 580.2335 (MNa^+ [$C_{26}H_{35}N_7O_5SNa$] = 580.2318).

5'-*S*-(2-Acetamidoethyl)-6-*N*-[4-(piperidine-1-carbonyl)benzyl]-5'-thioadenosine (18i). Treatment of crude **14i** {HRMS (EI) *m/z* 178.1096, M^+ [$C_{10}H_{14}N_2O$] = 178.1106; obtained from **13i** by procedure B}, **11a** (350 mg, 0.77 mmol), and Et_3N (220 µL, 160 mg, 1.58 mmol) by procedure F (chromatography with 10% MeOH/CH_2Cl_2) gave **18i** (350 mg, 81%) as a white solid foam: UV (MeOH) max 267 nm (ε 23 700), min 237 nm (ε 12 100); ^{1}H NMR (DMSO-d_6, 500 MHz) δ 8.48 (br s, 1H), 8.40 (s, 1H), 8.23 (s, 1H), 7.95 (t, *J* = 5.5 Hz, 1H), 7.37 (d, *J* = 8.5 Hz, 2H), 7.29 (d, *J* = 8.5 Hz, 2H), 5.90 (d, *J* = 6.0 Hz, 1H), 5.51 (d, *J* = 6.0 Hz, 1H), 5.34 (d, *J* = 5.0 Hz, 1H), 4.70–4.78 (br m, 3H), 4.15 (dd, *J* = 4.5, 8.0 Hz, 1H), 4.00 (dt, *J* = 3.5, 6.5 Hz, 1H), 3.54 (br s, 2H), 3.24 (br s, 2H), 3.17 (dd, *J* = 7.0, 13.0 Hz, 2H), 2.93 (dd, *J* = 5.8, 14.3 Hz, 1H), 2.84 (dd, *J* = 7.0, 14.0 Hz, 1H), 2.56 (dt, *J* = 2.5, 7.0 Hz, 2H), 1.78 (s, 3H), 1.57-1.61 (m, 2H), 1.51 (br s, 2H), 1.42 (br s, 2H); ^{13}C NMR (MeOH-d_4, 125 MHz) δ 173.4, 172.4, 156.2, 154.1, 150.2, 142.7, 141.2, 136.2, 128.8, 128.2, 121.2, 90.2, 85.8, 75.0, 74.1, 50.2, 44.7, 44.5, 40.3, 35.2, 33.1, 27.7, 26.9, 25.6, 22.7; HRMS (FAB) *m/z* 592.2328 (MNa^+ [$C_{27}H_{35}N_7O_5SNa$] = 592.2318).

5'-*S*-(2-Acetamidoethyl)-6-*N*-[4-(mopholine-4-carbonyl)benzyl]-5'-thioadenosine (18j). Treatment of crude **14j** {HRMS (EI) *m/z* 206.1419, M^+ [$C_{12}H_{18}N_2O$] = 206.1419; obtained from **13j** by procedure B}, **11a** (310 mg, 0.68 mmol), and Et_3N (193 µL, 140 mg, 1.39 mmol) by procedure F (chromatography with 5 → 10% MeOH/CH_2Cl_2) gave **18j** (290 mg, 75%) as a white solid foam: UV (MeOH) max 267 nm (ε 21 600), min 236 nm (ε 9900); ^{1}H NMR (DMSO-d_6, 500 MHz) δ 8.49 (br s, 1H), 8.40 (s, 1H), 8.22 (s, 1H), 7.95 (t, *J* = 5.8 Hz, 1H), 7.39 (d, *J* = 8.0 Hz, 2H), 7.34 (d, *J* = 8.0 Hz, 2H), 5.90 (d, *J* = 6.0 Hz, 1H), 5.51 (d, *J* = 6.0 Hz, 1H), 5.34 (d, *J* = 5.0 Hz, 1H), 4.68–4.78 (br m, 3H), 4.13–4.16 (m, 1H), 4.00 (dt, *J* = 3.5, 6.5 Hz, 1H), 3.57 (br s, 6H), 3.31 (br s, 2H), 3.15-3.19 (m, 2H), 2.92 (dd, *J* = 5.8, 13.8 Hz, 1H), 2.84 (dd, *J* = 6.8, 13.8

Hz, 1H), 2.56 (dt, *J* = 2.5, 7.0 Hz, 2H), 1.78 (s, 3H); ^{13}C NMR (MeOH-d_4, 125 MHz) δ 173.4, 172.5, 156.1, 154.1, 150.2, 143.1, 141.1, 135.2, 128.8, 128.6, 121.1, 90.1, 85.8, 75.0, 74.1, 67.9, 44.7, 44.0 40.3, 35.2, 33.1, 22.7; HRMS (FAB) *m/z* 594.2098 (MNa^+ [$C_{26}H_{33}N_7O_6SNa$] = 594.2111).

4-[(*tert*-Butyloxycarbonyl)aminomethyl]aniline (15). The *t*-butyl (aminobenzyl)carbamate **15** was prepared as described,[ii] and acylated or sulfonylated by procedure C to give **16k**–**16t**, which were subjected to procedure D or procedure E for removal of the *t*-BOC protecting group to give **17k**–**17t**.

6-*N*-(4-Acetamidobenzyl)-5'-*S*-(2-acetamidoethyl)-2',3'-di-*O*-acetyl-5'-thioadenosine. A mixture of **11a** (43 mg, 0.095 mmol), 4-acetamidobenzylamine hydrochloride[v] (**17k**) (28 mg, 0.14 mmol), and Et_3N (54 μL, 39 mg, 0.39 mmol) in MeOH (3 mL) was stirred for 3 h at ambient temperature. Volatiles were removed under vacuum, and chromatography of the residue (3 → 5% MeOH/CH_2Cl_2) gave the title compound (45 mg, 79%) as a light yellow oil: UV (MeOH) max 265 nm, min 229 nm; ^{1}H NMR (DMSO-d_6, 500 MHz) δ 9.88 (s, 1H), 8.46 (br s, 1H), 8.42 (s, 1H), 8.25 (s, 1H), 7.94 (t, *J* = 5.5 Hz, 1H), 7.48 (d, *J* = 8.0 Hz, 2H), 7.25 (d, *J* = 8.5 Hz, 2H), 6.20 (d, *J* = 6.0 Hz, 1H), 6.10 (t, *J* = 5.8 Hz, 1H), 5.56 (dd, *J* = 4.3, 5.8 Hz, 1H), 4.64 (br s, 2H), 4.26–4.29 (m, 1H), 3.16 (dd, *J* = 6.8, 12.8 Hz, 2H), 3.03 (dd, *J* = 5.8, 13.8 Hz, 1H), 2.98 (dd, *J* = 7.3, 13.8 Hz, 1H), 2.56 (dt, *J* = 2.5, 7.0 Hz, 2H), 2.13 (s, 3H), 2.007 (s, 3H), 2.002 (s, 3H), 1.77 (s, 3H); ^{13}C NMR (DMSO-d_6, 125 MHz) δ 169.5, 169.3, 169.2, 168.1, 154.4, 152.9, 148.5, 140.1, 137.9, 134.4, 127.6, 119.6, 118.9, 85.2, 81.5, 72.2, 71.8, 42.5, 38.5, 33.1, 31.3, 23.9, 22.5, 20.5, 20.2; HRMS (FAB) *m/z* 622.2041 (MNa^+ [$C_{27}H_{33}N_7O_7SNa$] = 622.2060).

6-*N*-(4-Acetamidobenzyl)-5'-*S*-(2-acetamidoethyl)-5'-thioadenosine (18k). Treatment of 4-acetamidobenzylamine hydrochloride[v] (170 mg, 0.85 mmol), **11a** (260 mg, 0.57 mmol), and

Et_3N (331 μL, 240 mg, 2.38 mmol) by procedure F [chromatography with 10% MeOH/CH_2Cl_2 followed by recrystallization (MeOH)] gave **18k** (220 mg, 75%) as a white solid: UV (MeOH) max 253 (sh), 267 nm (ε 21 400, 26 700), min 228 nm (ε 10 100); ^{1}H NMR (DMSO-d_6, 500 MHz) δ 9.88 (s, 1H), 8.38 (s, 1H), 8.36 (br s, 1H), 8.22 (s, 1H), 7.95 (t, *J* = 5.5 Hz, 1H), 7.48 (d, *J* = 8.5 Hz, 2H), 7.25 (d, *J* = 8.5 Hz, 2H), 5.90 (d, *J* = 5.5 Hz, 1H), 5.51 (d, *J* = 6.0 Hz, 1H), 5.34 (d, *J* = 4.5 Hz, 1H), 4.73–4.76 (m, 1H), 4.64 (br s, 2H), 4.15 (dd, *J* = 4.3, 8.8 Hz, 1H), 4.00 (dt, *J* = 4.0, 6.5 Hz, 1H), 3.15–3.19 (m, 2H), 2.93 (dd, *J* = 5.8, 13.8 Hz, 1H), 2.84 (dd, *J* = 7.0, 14.0 Hz, 1H), 2.56 (dt, *J* = 2.5, 7.0 Hz, 2H), 2.00 (s, 3H), 1.78 (s, 3H); ^{13}C NMR (DMSO-d_6, 125 MHz) δ 169.2, 168.1, 154.4, 152.6, 148.8, 139.9, 137.9, 134.6, 127.5, 119.6, 118.9, 87.4, 83.9, 72.7, 72.6, 42.5, 38.6, 33.9, 31.4, 24.0, 22.6; HRMS (FAB) *m/z* 516.2030 (MH^+ [$C_{23}H_{30}N_7O_5S$] = 516.2029).

5'-*S*-(2-Acetamidoethyl)-6-*N*-(4-propanamidobenzyl)-5'-thioadenosine (18l). Treatment of the crude TFA salt of **17l** {HRMS (EI) *m/z* 178.1111, M^+ [$C_{10}H_{14}N_2O$] = 178.1106}, **11a** (250 mg, 0.55 mmol), and Et_3N (303 μL, 220 mg, 2.18 mmol) by procedure F [chromatography with 10% MeOH/CH_2Cl_2 followed by recrystallization (MeOH)] gave **18l** (270 mg, 93%) as a white solid: UV (MeOH) max 254 (sh), 267nm (ε 22 800, 27 900), min 228 nm (ε 10 200); ^{1}H NMR (DMSO-d_6, 500 MHz) δ 9.79 (s, 1H), 8.37 (s, 1H), 8.36 (br s, 1H), 8.22 (s, 1H), 7.94 (t, *J* = 5.5 Hz, 1H), 7.49 (d, *J* = 9.0 Hz, 2H), 7.24 (d, *J* = 9.0 Hz, 2H), 5.90 (d, *J* = 5.5 Hz, 1H), 5.50 (d, *J* = 6.0 Hz, 1H), 5.33 (d, *J* = 4.5 Hz, 1H), 4.74 (dd, *J* = 5.5, 10.0 Hz, 1H), 4.64 (br s, 2H), 4.14 (dd, *J* = 4.5, 9.0 Hz, 1H), 4.00 (dt, *J* = 4.0, 6.5 Hz, 1H), 3.17 (dd, *J* = 7.0, 13.5 Hz, 2H), 2.92 (dd, *J* = 6.0, 14.0 Hz, 1H), 2.84 (dd, *J* = 7.0, 14.0 Hz, 1H), 2.56 (dt, *J* = 2.0, 7.0 Hz, 2H), 2.28 (q, *J* = 7.5 Hz, 2H), 1.78 (s, 3H), 1.05 (t, *J* = 7.5 Hz, 3H); ^{13}C NMR (DMSO-d_6, 125 MHz) δ 171.8, 169.2,

154.4, 152.6, 148.8, 139.9, 138.0, 134.5, 127.5, 119.6, 118.9, 87.4, 83.9, 72.64, 72.58, 42.5, 38.6, 33.9, 31.4, 29.4, 22.6, 9.7; HRMS (FAB) *m/z* 530.2183 (MH^+ [$C_{24}H_{32}N_7O_5S$] = 530.2186).

5'-*S*-(2-Acetamidoethyl)-6-*N*-(4-hexanamidobenzyl)-5'-thioadenosine (18m). Treatment of the crude TFA salt of **17m** {HRMS (EI) *m/z* 220.1581, M^+ [$C_{13}H_{20}N_2O$] = 220.1576}, **11a** (240 mg, 0.53 mmol), and Et_3N (262 μL, 190 mg, 1.88 mmol) by procedure F [chromatography with 10% MeOH/CH_2Cl_2 followed by recrystallization (MeOH)] gave **18m** (240 mg, 80%) as a white solid: UV (MeOH) max 257 (sh), 267 nm (ε 25 000, 29 000), min 228nm (ε 10 300); ^{1}H NMR (DMSO-d_6, 500 MHz) δ 9.80 (s, 1H), 8.37 (s, 1H), 8.36 (br s, 1H), 8.22 (s, 1H), 7.94 (t, *J* = 5.3 Hz, 1H), 7.49 (d, *J* = 8.5 Hz, 2H), 7.24 (d, *J* = 8.5 Hz, 2H), 5.89 (d, *J* = 5.5 Hz, 1H), 5.50 (d, *J* = 5.5 Hz, 1H), 5.33 (d, *J* = 5.0 Hz, 1H), 4.73–4.76 (m, 1H), 4.64 (br s, 2H), 4.14 (dd, *J* = 4.5, 9.0 Hz, 1H), 3.98–4.02 (m, 1H), 3.15–3.19 (m, 2H), 2.92 (dd, *J* = 6.0, 14.0 Hz, 1H), 2.84 (dd, *J* = 7.0, 14.0 Hz, 1H), 2.56 (dt, *J* = 2.0, 7.0 Hz, 2H), 2.25 (t, *J* = 7.5 Hz, 2H), 1.77 (s, 3H), 1.56 (pent, *J* = 7.3 Hz, 2H), 1.24–1.31 (m, 4H), 0.86 (t, *J* = 7.0 Hz, 3H); ^{13}C NMR (DMSO-d_6, 125 MHz) δ 171.1, 169.2, 154.4, 152.6, 148.8, 139.9, 137.9, 134.5, 127.5, 119.6, 118.9, 87.4, 83.9, 72.64, 72.58, 42.5, 38.6, 36.3, 33.9, 31.4, 30.9, 24.8, 22.6, 21.9, 13.9; HRMS (FAB) *m/z* 594.2466 (MNa^+ [$C_{27}H_{37}N_7O_5SNa$] = 594.2475).

5'-*S*-(2-Acetamidoethyl)-6-*N*-(4-nonanamidobenzyl)-5'-thioadenosine (18n). Treatment of the crude TFA salt of **17n** {HRMS (EI) *m/z* 262.2047, M^+ [$C_{16}H_{26}N_2O$] = 262.2045}, **11a** (200 mg, 0.44 mmol), and Et_3N (123 μL, 89 mg, 0.88 mmol) by procedure F [chromatography with 5 → 10% MeOH/CH_2Cl_2 followed by recrystallization (MeOH)] gave **18n** (240 mg, 89%) as a white solid: UV (MeOH) max 254 (sh), 267 nm (ε 20 500, 24 900), min 228 nm (ε 9100); ^{1}H NMR (DMSO-d_6, 500 MHz) δ 9.79 (s, 1H), 8.37 (s, 1H), 8.36 (br s, 1H), 8.22 (s, 1H), 7.94 (t, *J* = 5.3 Hz, 1H), 7.49 (d, *J* = 8.5 Hz, 2H), 7.24 (d, *J* = 8.5 Hz, 2H), 5.90 (d, *J* = 6.0 Hz, 1H), 5.50

(d, *J* = 5.5 Hz, 1H), 5.33 (d, *J* = 5.0 Hz, 1H), 4.74 (dd, *J* = 5.0, 9.5 Hz, 1H), 4.64 (br s, 2H), 4.14 (dd, *J* = 4.5, 9.0 Hz, 1H), 3.98–4.02 (m, 1H), 3.17 (dd, *J* = 7.0, 13.0 Hz, 2H), 2.92 (dd, *J* = 5.5, 13.8 Hz, 1H), 2.84 (dd, *J* = 7.3, 13.8 Hz, 1H), 2.56 (dt, *J* = 2.5, 6.8 Hz, 2H), 2.25 (t, *J* = 7.5 Hz, 2H), 1.78 (s, 3H), 1.55 (pent, *J* = 6.8 Hz, 2H), 1.24-1.26 (m, 10H), 0.84 (t, *J* = 6.8 Hz, 1H); ^{13}C NMR (DMSO-d_6, 125 MHz) δ 171.8, 169.2, 154.4, 152.6, 148.8, 139.9, 137.9, 134.5, 127.5, 119.6, 118.9, 87.4, 83.9, 72.64, 72.58, 42.5, 38.6, 36.3, 33.9, 31.4, 31.3, 28.8, 28.7, 28.6, 25.1, 22.6, 22.1, 14.0; HRMS (FAB) *m/z* 636.2951 (MNa^+ [$C_{30}H_{43}N_7O_5SNa$] = 636.2944).

5'-*S*-(2-Acetamidoethyl)-6-*N*-(4-pivalamidobenzyl)-5'-thioadenosine (18o). Treatment of **17o** {HRMS (EI) *m/z* 206.1427, M^+ [$C_{12}H_{18}N_2O$] = 206.1419}, **11a** (200 mg, 0.44 mmol), and Et_3N (123 μL, 89 mg, 0.88 mmol) by procedure F (chromatography with 5 → 10% MeOH/CH_2Cl_2) gave **18o** (190 mg, 78%) as a white solid foam: UV (MeOH) max 254 (sh), 267 nm (ε 21 200, 26 500), min 229 nm (ε 11 000); ^{1}H NMR (DMSO-d_6, 500 MHz) δ 9.14 (s, 1H), 8.38 (s, 1H), 8.36 (br s, 1H), 8.22 (s, 1H), 7.94 (t, *J* = 5.5 Hz, 1H), 7.52 (d, *J* = 9.0 Hz, 2H), 7.24 (d, *J* = 8.5 Hz, 2H), 5.90 (d, *J* = 5.5 Hz, 1H), 5.50 (d, *J* = 6.0 Hz, 1H), 5.33 (d, *J* = 4.5 Hz, 1H), 4.73–4.76 (m, 1H), 4.64 (br s, 2H), 4.14 (dd, *J* = 4.5, 9.0 Hz, 1H), 4.00 (dt, *J* = 3.5, 6.3 Hz, 1H), 3.15–3.19 (m, 2H), 2.92 (dd, *J* = 5.8, 13.8 Hz, 1H), 2.84 (dd, *J* = 7.0, 14.0 Hz, 1H), 2.56 (dt, *J* = 2.0, 7.0 Hz, 2H), 1.78 (s, 3H), 1.20 (s, 9H); ^{13}C NMR (DMSO-d_6, 125 MHz) δ 176.3, 169.2, 154.4, 152.6, 148.8, 139.9, 137.9, 134.7, 127.2, 120.2, 119.6, 87.4, 83.9, 72.64, 72.58, 42.5, 39.1, 38.6, 33.9, 31.4, 27.2, 22.6; HRMS (FAB) *m/z* 580.2313 (MNa^+ [$C_{26}H_{35}N_7O_5SNa$] = 580.2318).

5'-*S*-(2-Acetamidoethyl)-6-*N*-(4-benzamidobenzyl)-5'-thioadenosine (18p). Treatment of the crude TFA salt of **17p** {HRMS (EI) *m/z* 226.1092, M^+ [$C_{14}H_{14}N_2O$] = 226.1106}, **11a** (200 mg, 0.44 mmol), and Et_3N (220 μL, 160 mg, 1.58 mmol) by procedure F [after deprotection, volatiles were removed under vacuum and the residue was recrystallized (MeOH)] gave **18p**

(140 mg, 55%) as a white solid: UV (MeOH) max 274 nm (ε 33 300), min 239 nm (ε 11 300); ^{1}H NMR (DMSO-d_6, 500 MHz) δ 10.21 (s, 1H), 8.40 (br s, 1H), 8.39 (s, 1H), 8.23 (s, 1H), 7.92–7.96 (m, 3H), 7.68 (d, *J* = 8.5 Hz, 2H), 7.56–7.59 (m, 1H), 7.50–7.53 (m, 2H), 7.32 (d, *J* = 8.5 Hz, 2H), 5.91 (d, *J* = 6.0 Hz, 1H), 5.51 (d, *J* = 6.0 Hz, 1H), 5.33 (d, *J* = 4.5 Hz, 1H), 4.75 (dd, *J* = 5.5, 10.0 Hz, 1H), 4.68 (br s, 2H), 4.15 (dd, *J* = 4.3, 8.8 Hz, 1H), 4.00 (dt, *J* = 3.5, 6.5 Hz, 1H), 3.18 (dd, *J* = 6.8, 12.8 Hz, 2H), 2.93 (dd, *J* = 5.8, 13.8 Hz, 1H), 2.84 (dd, *J* = 7.0, 14.0 Hz, 1H), 2.56 (dt, *J* = 2.0, 7.0 Hz, 2H), 1.78 (s, 3H); ^{13}C NMR (DMSO-d_6, 125 MHz) δ 169.2, 165.4, 154.4, 152.6, 148.8, 139.9, 137.7, 135.3, 134.9, 131.5, 128.4, 127.6, 127.4, 120.3, 119.6, 87.4, 83.9, 72.65, 72.58, 42.5, 38.6, 33.9, 31.4, 22.6; HRMS (FAB) *m/z* 578.2183 (MH^+ $[C_{28}H_{32}N_7O_5S]$ = 578.2186).

5'-*S*-(2-Acetamidoethyl)-6-*N*-[4-(4-methylbenzamido)benzyl]-5'-thioadenosine (18q). Treatment of the crude HCl salt of **17q** {after deprotection, volatiles were removed under vacuum without neutralization with Et_3N; HRMS (EI) *m/z* 240.1267, M^+ $[C_{15}H_{16}N_2O]$ = 240.1263}, **11a** (260 mg, 0.57 mmol), and Et_3N (320 μL, 230 mg, 2.28 mmol) by procedure F [after deprotection, volatiles were removed under vacuum and the residue was recrystallized (MeOH)] gave **18q** (230 mg, 68%) as a white solid: UV (MeOH) max 274 nm (ε 35 100), min 234 nm (ε 14 300); ^{1}H NMR (DMSO-d_6, 500 MHz) δ 10.11 (s, 1H), 8.40 (br s, 1H), 8.39 (s, 1H), 8.23 (s, 1H), 7.94 (t, *J* = 5.5 Hz, 1H), 7.85 (d, *J* = 8.0 Hz, 2H), 7.67 (d, *J* = 9.0 Hz, 2H), 7.30–7.33 (m, 4H), 5.90 (d, *J* = 5.5 Hz, 1H), 5.51 (d, *J* = 6.0 Hz, 1H), 5.33 (d, *J* = 5.0 Hz, 1H), 4.75 (dd, *J* = 5.0, 10.5 Hz, 1H), 4.68 (br s, 2H), 4.15 (dd, *J* = 4.3, 8.8 Hz, 1H), 3.99–4.02 (m, 1H), 3.17 (dd, *J* = 6.8, 13.3 Hz, 2H), 2.93 (dd, *J* = 5.8, 12.8 Hz, 1H), 2.84 (dd, *J* = 6.8, 13.8 Hz, 1H), 2.56 (dt, *J* = 2.5, 7.0 Hz, 2H), 2.37 (s, 3H), 1.78 (s, 3H); ^{13}C NMR (DMSO-d_6, 125 MHz) δ 169.2, 165.2, 154.4, 152.6, 148.8, 141.5, 139.9, 137.8, 135.2, 132.0, 128.9, 127.7, 127.4, 120.3,

119.6, 87.4, 83.9, 72.64, 72.58, 42.5, 38.6, 33.9, 31.4, 22.6, 21.0; HRMS (FAB) *m/z* 614.2163 (MNa^+ [$C_{29}H_{33}N_7O_5SNa$] = 614.2162).

5'-*S*-(2-Acetamidoethyl)-6-*N*-[4-(4-nitrobenzamido)benzyl]-5'-thioadenosine (18r). Treatment of the crude TFA salt of **17r** {HRMS (EI) *m/z* 271.0946, M^+ [$C_{14}H_{13}N_3O_3$] = 271.0957}, **11a** (200 mg, 0.44 mmol), and Et_3N (248 μL, 180 mg, 1.78 mmol) by procedure F [after deprotection, volatiles were removed under vacuum and the residue was recrystallized (MeOH)] gave **18r** (190 mg, 70%) as a light yellow solid: UV (MeOH) max 267, 298 (sh) nm (ε 32 400, 11 500), min 229 nm (ε 14 700); ^{1}H NMR (DMSO-d_6, 500 MHz) δ 10.54 (s, 1H), 8.42 (br s, 1H), 8.39 (s, 1H), 8.36 (d, *J* = 9.5 Hz, 2H), 8.24 (s, 1H), 8.17 (d, *J* = 8.5 Hz, 2H), 7.95 (t, *J* = 5.3 Hz, 1H), 7.69 (d, *J* = 8.5 Hz, 2H), 7.34 (d, *J* = 8.5 Hz, 2H), 5.91 (d, *J* = 6.0 Hz, 1H), 5.51 (d, *J* = 6.0 Hz, 1H), 5.34 (d, *J* = 5.0 Hz, 1H), 4.75–4.76 (m, 1H), 4.69 (br s, 2H), 4.15 (dd, *J* = 5.0, 9.0 Hz, 1H), 3.99–4.02 (m, 1H), 3.18 (dd, *J* = 6.8, 12.8 Hz, 2H), 2.93 (dd, *J* = 5.8, 13.8 Hz, 1H), 2.84 (dd, *J* = 7.0, 14.0 Hz, 1H), 2.56 (dt, *J* = 2.0, 7.0 Hz, 2H), 1.78 (s, 3H); ^{13}C NMR (DMSO-d_6, 125 MHz) δ 169.2, 163.7, 154.4, 152.6, 149.1, 148.8, 140.6, 139.9, 137.2, 135.9, 129.2, 127.5, 123.6, 120.5, 119.6, 87.4, 83.9, 72.65, 72.58, 42.5, 38.6, 33.9, 31.4, 22.6; HRMS (FAB) *m/z* 623.2035 (MH^+ [$C_{28}H_{31}N_8O_7S$] = 623.2036).

5'-*S*-(2-Acetamidoethyl)-6-*N*-[4-(methylsulfonamido)benzyl]-5'-thioadenosine (18s). Treatment of the crude TFA salt of **17s**,[ii] **11a** (200 mg, 0.44 mmol), and Et_3N (220 μL, 160 mg, 1.58 mmol) by procedure F (chromatography with 5 → 10% MeOH/CH_2Cl_2) gave **18s** (180 mg, 74%) as a white solid foam: UV (MeOH) max 228 (sh), 268 nm (ε 13 200, 19 400), min 244 nm (ε 7300); ^{1}H NMR (DMSO-d_6, 500 MHz) δ 9.63 (s, 1H), 8.39 (br s, 1H), 8.38 (s, 1H), 8.22 (s, 1H), 7.95 (t, *J* = 5.8 Hz, 1H), 7.30 (d, *J* = 8.0 Hz, 2H), 7.13 (d, *J* = 8.5 Hz, 2H), 5.90 (d, *J* = 5.5 Hz, 1H), 5.51 (d, *J* = 6.0 Hz, 1H), 5.34 (d, *J* = 5.0 Hz, 1H), 4.75 (dd, *J* = 5.5, 10.5 Hz, 1H), 4.65

(br s, 2H), 4.14 (dd, *J* = 5.0, 9.0 Hz, 1H), 3.98–4.02 (m, 1H), 3.15–3.16 (m, 2H), 2.90–2.94 (m, 4H), 2.84 (dd, *J* = 7.0, 14.0 Hz, 1H), 2.56 (dt, *J* = 2.5, 7.0 Hz, 2H), 1.78 (s, 3H); ^{13}C NMR (MeOH-d_4, 125 MHz) δ 173.5, 156.1, 154.2, 150.1, 141.1, 138.6, 136.9, 129.8, 122.0, 121.0, 90.1, 85.8, 75.1, 74.1, 44.6, 40.3, 39.2, 35.2, 33.1, 22.7; HRMS (FAB) *m/z* 552.1690 (MH^+ $[C_{22}H_{30}N_7O_6S_2]$ = 552.1699).

5'-*S*-(2-Acetamidoethyl)-6-*N*-{4-[(4-methylphenyl)sulfonamido]benzyl}-5'-thioadenosine (18t). Treatment of the crude TFA salt of **17t** {HRMS (EI) *m/z* 276.0934, M^+ $[C_{14}H_{16}N_2O_2S]$ = 276.0933}, **11a** (200 mg, 0.44 mmol), and Et_3N (220 μL, 160 mg, 1.58 mmol) by procedure F (chromatography with 5 → 10% MeOH/CH_2Cl_2) gave **18t** (220 mg, 80%) as a white solid foam: UV (MeOH) max 229 (sh), 268 nm (ε 17 900, 23 000), min 244 nm (ε 12 900); ^{1}H NMR (DMSO-d_6, 500 MHz) δ 10.13 (s, 1H), 8.37 (s, 1H), 8.33 (br s, 1H), 8.19 (s, 1H), 7.94 (t, *J* = 5.5 Hz, 1H), 7.61 (d, *J* = 8.5 Hz, 2H), 7.31 (d, *J* = 8.5 Hz, 2H), 7.17 (d, *J* = 8.5 Hz, 2H), 6.99 (d, *J* = 8.0 Hz, 2H), 5.89 (d, *J* = 6.0 Hz, 1H), 5.50 (d, *J* = 6.0 Hz, 1H), 5.34 (d, *J* = 5.0 Hz, 1H), 4.74 (dd, *J* = 5.5, 10.5 Hz, 1H), 4.58 (br s, 2H), 4.14 (dd, *J* = 5.0, 8.5 Hz, 1H), 4.00 (dt, *J* = 3.5, 6.5 Hz, 1H), 3.15–3.19 (m, 2H), 2.92 (dd, *J* = 6.0, 13.5 Hz, 1H), 2.83 (dd, *J* = 7.0, 14.0 Hz, 1H), 2.56 (dt, *J* = 2.5, 7.0 Hz, 2H), 2.31 (s, 3H), 1.78 (s, 3H); ^{13}C NMR (DMSO-d_6, 125 MHz) δ 169.2, 154.3, 152.6, 148.8, 143.2, 139.9, 136.7, 136.3, 135.7, 129.7, 127.9, 126.7, 120.0, 119.5, 87.4, 83.9, 72.7, 72.6, 42.3, 38.6, 33.9, 31.4, 22.6, 21.0; HRMS (FAB) *m/z* 650.1832 (MNa^+ $[C_{28}H_{33}N_7O_6S_2Na]$ = 650.1831).

5'-*S*-(2-Acetamidoethyl)-6-*N*-ethyl-6-*N*-(3-nitrobenzyl)-5'-thioadenosine (18u). Treatment of *N*-ethyl-(3-nitrobenzyl)amine (240 mg, 1.11 mmol), **11a** (250 mg, 0.55 mmol), and Et_3N (303 μL, 220 mg, 2.18 mmol) by procedure F [chromatography with 5% MeOH/CH_2Cl_2 followed by recrystallization (5% MeOH/CH_2Cl_2)] gave **18u** (132 mg, 45%) as a white solid:

UV (MeOH) max 274 nm (ε 31 900), min 234 nm (ε 7000); ^{1}H NMR (MeOH-d_4, 500 MHz) δ 8.26 (s, 1H), 8.21 (s, 1H), 8.16 (s, 1H), 8.11 (d, *J* = 8.5 Hz, 1H), 7.70 (d, *J* = 7.5 Hz, 1H), 7.54 (t, *J* = 8.0 Hz, 1H), 6.01 (d, *J* = 5.0 Hz, 1H), 5.36 (br s, 2H), 4.72 (t, *J* = 5.3 Hz, 1H), 4.29 (t, *J* = 5.3 Hz, 1H), 4.18 (dd, *J* = 5.3, 10.8 Hz, 1H), 4.04 (br s, 2H), 3.29–3.32 (m, 2H), 2.99 (dd, *J* = 5.3, 14.3 Hz, 1H), 2.92 (dd, *J* = 6.0, 14.0 Hz, 1H), 2.65 (dt, *J* = 3.0, 7.0 Hz, 2H), 1.89 (s, 3H), 1.26 (t, *J* = 7.3 Hz, 3H); ^{13}C NMR (MeOH-d_4, 125 MHz) δ 173.5, 155.7, 153.6, 152.1, 150.0, 142.7, 140.0, 135.0, 130.9, 123.35, 123.26, 121.2, 90.0, 85.8, 75.1, 74.1, 51.7, 44.9, 40.3, 35.2, 33.2, 22.7, 13.7; HRMS (FAB) *m/z* 554.1790 (MNa^+ [$C_{23}H_{29}N_7O_6SNa$] = 554.1798).

5'-*S*-(2-Acetamidoethyl)-6-*N*-[2-(4-nitrophenyl)ethyl]-5'-thioadenosine (18v). Treatment of 2-(4-nitrobenzyl)ethylamine hydrochloride (170 mg, 0.80 mmol), **11a** (250 mg, 0.55 mmol), and Et_3N (303 μL, 0.22 g, 2.18 mmol) by procedure F [chromatography with 10% MeOH/CH_2Cl_2 followed by recrystallization (MeOH)] gave **18v** (270 mg, 95%) as a light yellow solid: UV (MeOH) max 271 nm (ε 25 400), min 233 nm (ε 4800); ^{1}H NMR (DMSO-d_6, 500 MHz) δ 8.36 (s, 1H), 8.26 (s, 1H), 8.15 (d, *J* = 8.5 Hz, 2H), 7.93–7.96 (br m, 2H), 7.54 (d, *J* = 8.0 Hz, 2H), 5.89 (d, *J* = 6.0 Hz, 1H), 5.50 (d, *J* = 5.5 Hz, 1H), 5.34 (d, *J* = 4.5 Hz, 1H), 4.74 (dd, *J* = 5.8, 10.8 Hz, 1H), 4.14 (dd, *J* = 5.0, 9.0 Hz, 1H), 4.00 (dt, *J* = 3.5, 6.5 Hz, 1H), 3.78 (br s, 2H), 3.15–3.19 (m, 2H), 3.08 (t, *J* = 7.3 Hz, 2H), 2.92 (dd, *J* = 5.8, 13.8 Hz, 1H), 2.84 (dd, *J* = 7.3, 13.8 Hz, 1H), 2.56 (dt, *J* = 2.5, 7.0 Hz, 2H), 1.78 (s, 3H); ^{13}C NMR (DMSO-d_6, 125 MHz) δ 169.1, 154.4, 152.6, 148.7, 148.1, 146.0, 139.7, 130.0, 123.3, 119.6, 87.3, 83.8, 72.6, 72.5, 40.6, 38.6, 34.7, 33.9, 31.4, 22.5; HRMS (FAB) *m/z* 540.1657 (MNa^+ [$C_{22}H_{27}N_7O_6SNa$] = 540.1641).

5'-*S*-(2-Acetamidoethyl)-6-*S*-(4-nitrobenzyl)-5',6-dithioinosine (18w). Treatment of (4-nitrobenzyl)methanethiol (160 mg, 0.95 mmol), **11a** (290 mg, 0.64 mmol), and Et_3N (220 μL, 160 mg, 1.58 mmol) by procedure F [chromatography with 5 → 10% MeOH/CH_2Cl_2 followed

by recrystallization (MeOH)] gave **18w** (310 mg, 94%) as a white solid: UV (MeOH) max 284, 289 nm (ε 27 100, 26 500); min 240 nm (ε 5700); ^{1}H NMR (DMSO-d_6, 500 MHz) δ 8.79 (s, 1H), 8.72 (s, 1H), 8.17 (dt, *J* = 2.0, 9.0 Hz, 2H), 7.94 (t, *J* = 5.3 Hz, 1H), 7.75 (d, *J* = 9.0 Hz, 2H), 5.99 (d, *J* = 6.0 Hz, 1H), 5.57 (d, *J* = 6.0 Hz, 1H), 5.39 (d, *J* = 5.5 Hz, 1H), 4.80 (s, 2H), 4.76 (dd, *J* = 5.5, 11.0 Hz, 1H), 4.16 (dd, *J* = 4.5, 9.0 Hz, 1H), 4.04 (dt, *J* = 4.0, 6.3 Hz, 1H), 3.16 (dd, *J* = 6.8, 13.8 Hz, 2H), 2.93 (dd, *J* = 6.0, 14.0 Hz, 1H), 2.85 (dd, *J* = 7.5, 13.5 Hz, 1H), 2.55 (dt, *J* = 2.5, 7.0 Hz, 2H), 1.77 (s, 3H); ^{13}C NMR (DMSO-d_6, 125 MHz) δ 169.2, 158.4, 151.7, 148.5, 146.5, 146.4, 144.0, 131.0, 130.2, 123.6, 87.8, 84.2, 72.7, 72.5, 38.6, 33.8, 31.4, 30.7, 22.6; HRMS (FAB) *m/z* 543.1105 (MNa^+ [$C_{21}H_{24}N_6O_6S_2Na$] = 543.1096).

Supporting Information References

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