Electronic Supplementary Material (ESI) for RSC Advances.


**Supporting information**

## SI #1 Relative percentage of the α/β–pyranose and furanose isomers of compounds 1, 3, 6, 9, and 10 (Table SI-1); NMR data and UHPLC-MS analyses of compounds 1 and 6.

Table SI-1. Relative percentage of the isomers of compounds **1**, **3**, **6**, **9**, and **10.**

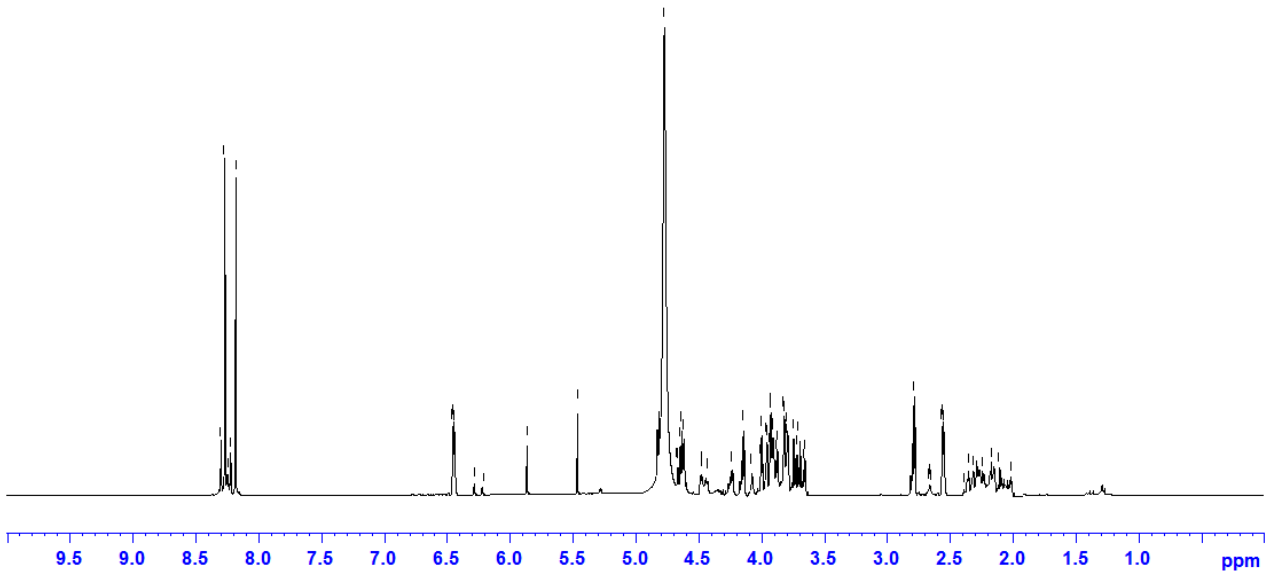
| Entry | Nucleobases | Condition[b] | **Amount of products (%)[a]** | | | |
|---|---|---|---|---|---|---|
| 1 | - | - | **1pβ** | **1fβ** | **1pα** | **1fα** |
| | | | 23 | 30 | 38 | 9 |
| 2 | 2 | A | **3pβ** | **3fβ** | **3pα** | **3fα** |
| | | | 56 | 19 | 10 | 15 |
| 3 | | B | 70 | 14 | 11 | 5 |
| 4 | | C | 61 | 34 | 3 | 2 |
| 5 | - | - | **6pβ** | **6fβ** | **6pα** | **6fα** |
| | | | 16 | 24 | 54 | 6 |
| 6 | 7 | A | **9pβ** | **9fβ** | **9pα** | **9fα** |
| | | | 57 | 17 | 23 | 3 |
| 7 | | B | 77 | 14 | 5 | 4 |
| 8 | | C | 51 | 40 | 6 | 3 |
| 9 | 8 | A | **10pβ** | **10fβ** | **10pα** | **10fα** |
| | | | 66 | 10 | 20 | 4 |
| 10 | | B | 61 | 19 | 14 | 6 |
| 11 | | C | 55 | 35 | 8 | 2 |

[a]The ratio between the β and α anomers, including both pyranose and furanose forms, was determined after isolation with semi-preparative HPLC purification and characterization by NMR analysis. Data were in accordance with standard compounds. The data are the mean value of three experiments with a standard deviation equal to or less than 0.1 %.[b] Panel A: dry-film condition (condition A). Panel B: formamide (condition B). Panel C: formamide + NWA 1465 (condition C).

## Synthesis, NMR data and UHPLC-MS analyses of compounds 1 and 6.

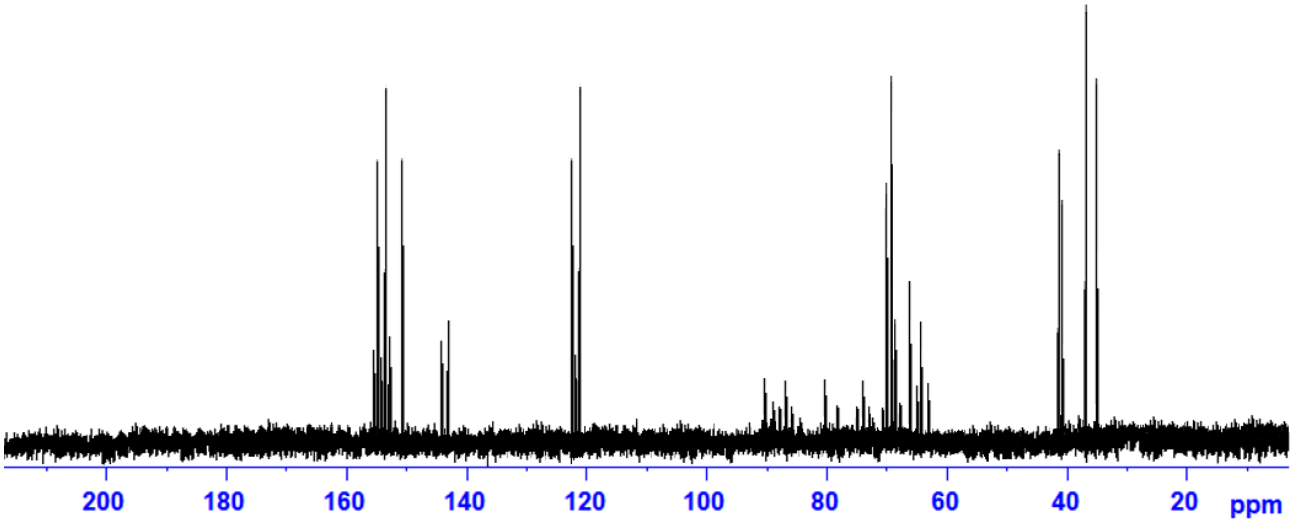
**Synthesis of $N^6$-(D-2'-deoxyribos-1-yl)-2'-deoxyadenosine 1.**

Compound **1** was prepared as previously reported in the literature.[29] 2'-Deoxyadenosine **4**(144 mg, 0.57 mmol) and 2'-deoxy-D-ribose (343 mg, 2.62 mmol) were dissolved in glacial acetic acid (300 μl) and methanol (700μl). The mixture was stirred at 40°C for 72 h. At the end of the reaction the solvent was removed under reduced pressure to afford a dark yellow residue successively purified by flash chromatography (95/5.0 v/v dichloromethane/methanol) to yield **1** as a mixture of the four corresponding α/β pyranose and furanose isomers **1pα, 1pβ**, and **1fα, 1fβ** (105 mg, 0.28 mmol 50% total yield). The assignment of the structure of different isomers was carried out by comparison of recorded chromatograms with HPLC-UV analysis previously reported in the literature [29], and the relative percentage of α/β-pyranose and furanose isomers was calculated by comparison of the relative percentage of the peaks' area. In the successive transformations compound **1** was used as a mixture.



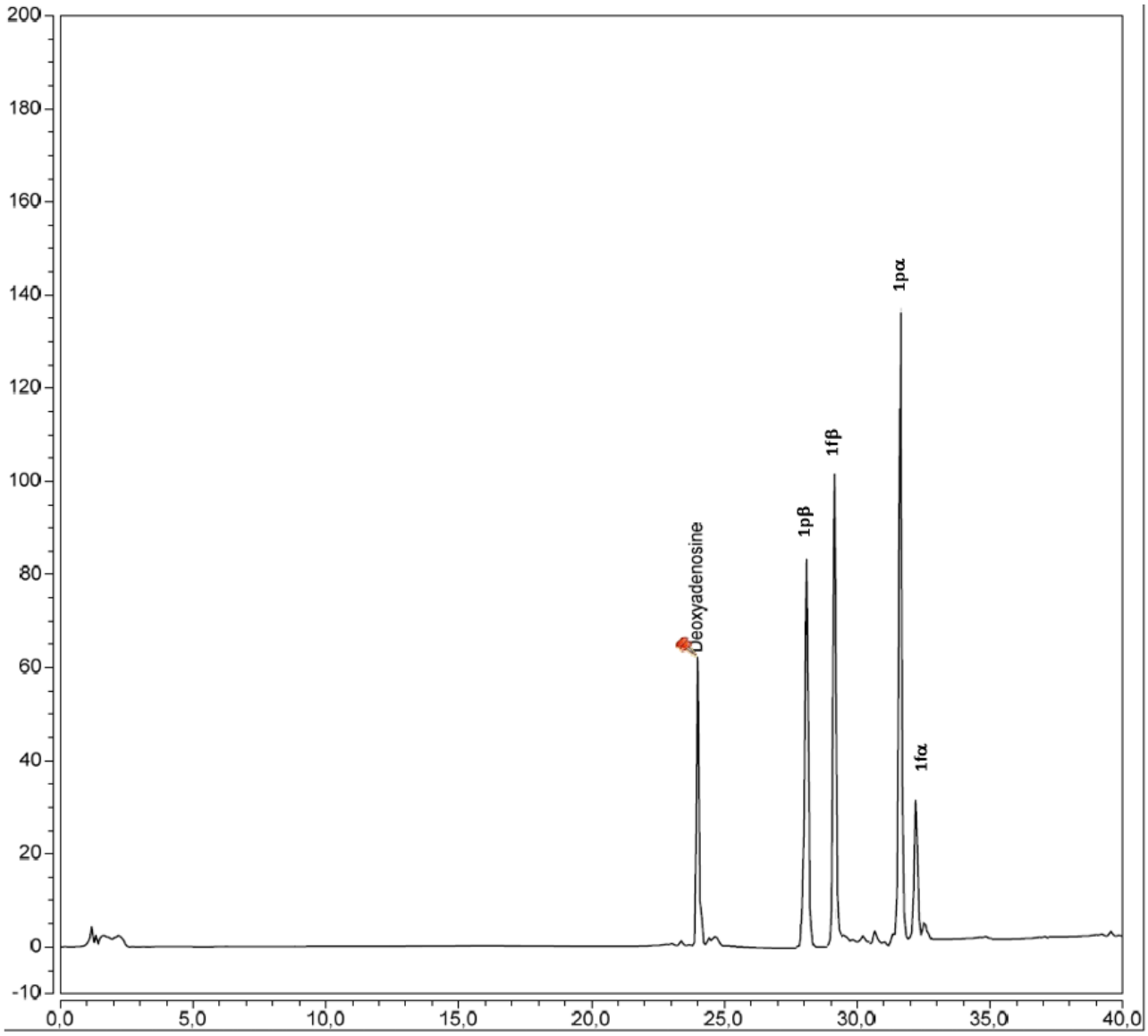

$^1$H-NMR spectrum of compound **1** in $D_2O$.

**$^1$H-NMR (**400 MHz, $D_2O$) 8.30 (s, CH, H8), 8.29 (s, CH,H8), 8.27 (s, CH H8), 8.26 (s, CH, H2), 8.25 (s, CH, H2), 8.20 (s, CH, H2), 6.43 ( t, *J*=8Hz CH, H1'), 6.28 (s, CH, H1''),6.21 (s, CH, H1''), 5.81 (s, CH, H1''), 5.48 (s, CH, H1''), 4.64 (m, CH, H3'), 4.47 (m, CH, H3''), 4.44(m, CH, H3''), 4.29 (m, CH, H3''), 4.17 (m, CH, H4'), 4.10 (m, CH, H4''), 4.07 (m, CH, H3''), 4.02 (m, CH, H4''), 3.94 (m, $CH_2$, H5''), 3.90 (m, CH, H4''), 3.84(m, $CH_2$, H5''), 3.83 (m, $CH_2$, H5'), 3.79 (m, $CH_2$, H5''), 3.77 (m, $CH_2$, H5'), 3.76 (m, $CH_2$, H5''), 3.70 (m, $CH_2$, H5''), 3.69 (m, $CH_2$, H5''), 3.65 (m, CH, H5''), 3.64 (m, $CH_2$, H5''), 2.80 (m, $CH_2$, H2'), 2.66 (m, $CH_2$, H2''), 2.55 (m, $CH_2$, H2'), 2.39 (m, $CH_2$, H2''), 2.33 (m, $CH_2$, H2''), 2.24 (m, $CH_2$, H2''), 2.16 (m, $CH_2$, H2''), 2.13 (m, $CH_2$, H2''), 2.08 (m, $CH_2$, H2''), 2.07 (m, $CH_2$, H2'').



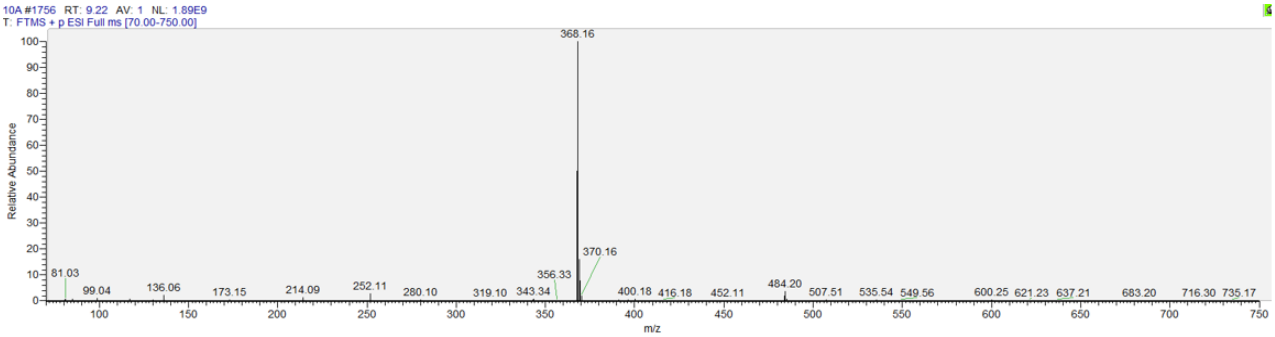

$^{13}$C-NMR spectrum of compound **1** in $D_2O$.

**$^{13}$C-NMR (**100 MHz, $D_2O$) 156.1 (C6), 156.0 (C6), 155.9 (C6), 154.9 (C2), 154.8 (C2), 154.7 (C2),151.3 (C4), 143.5 (C8), 143.3 (C8), 122.2 (C5), 122.1(C5), 122.0(C5), 90.1 (C4'), 88.6 (C4''), 87.9 (C4''), 87.4 (C1'), 87.3 (C1''), 84,5 (C1''), 80.3 (C1''), 77.9(C1''), 74.3(C3''), 73.9 (C3'), 73.8 (C3''), 70.3 (C3''), 69.6 (C5''), 69.3 (C4''), 69.2 (C4''), 68.5 (C3''), 66.1 (C5''), 64.7(C5''),64.4 (C5'), 63.9 (C5''), 41.7 (C2'), 41.6 (C2''), 37.1 (C2''), 35.6 (C2''). ESI-MS: m/z: 368.16 $[M + H]^+$. Elemental Analysis for $C_{15}H_{21}N_5O_6$ calculated: C, 49.04; H, 5.76; N, 19.06; O, 26.13, found: C, 48.94; H, 5.94; N, 18.98; O, 27.15.



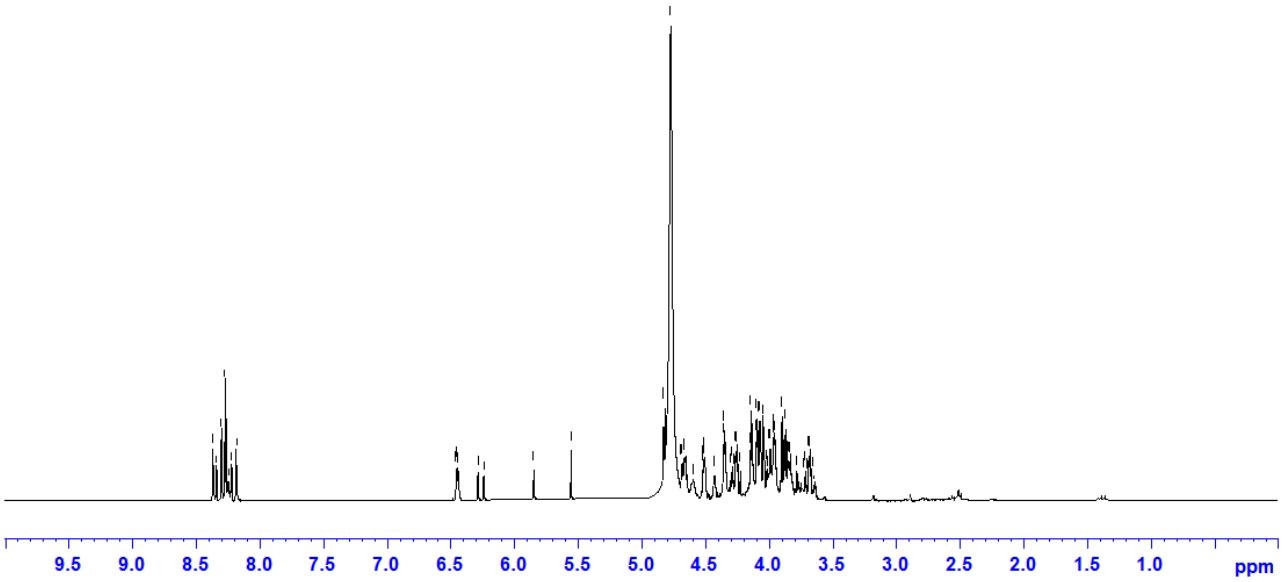

UHPLC chromatogram of compound **1**. The assignment of peaks of isomers **1pα**, **1pβ**, **1fα**, and **1fβ**, was performed on the basis of reference 29.

## Original m/z fragmentation spectra of compound 1.



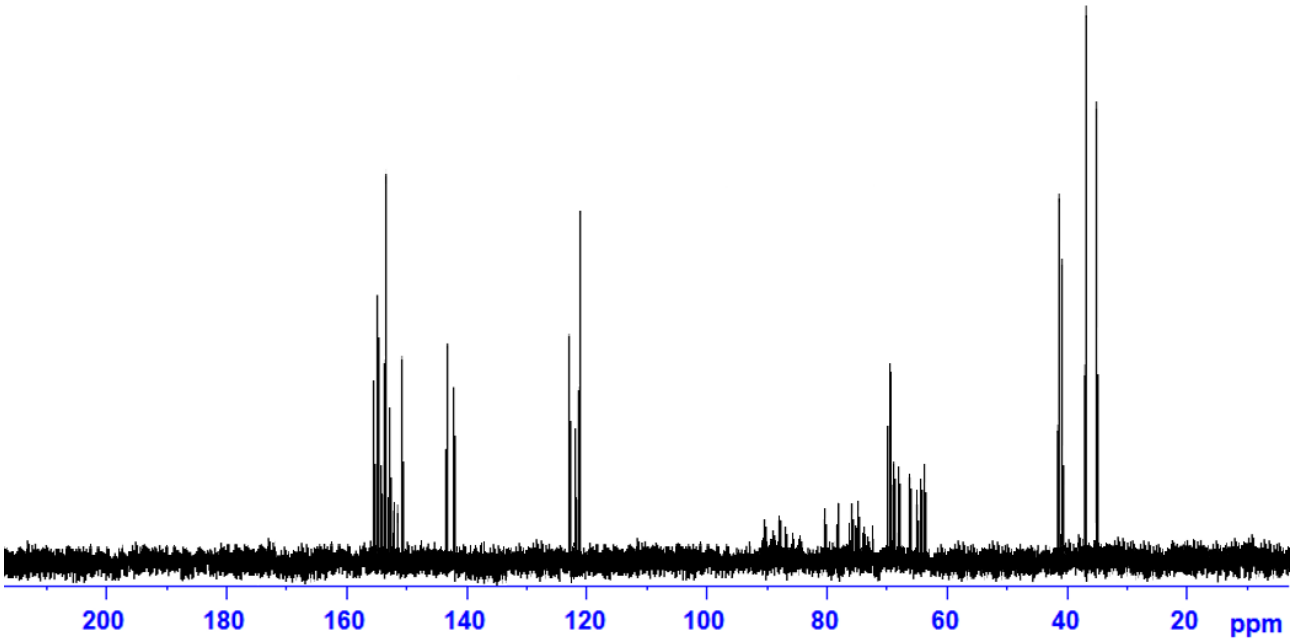
**Synthesis of $N^6$-(D-ribos-1-yl)-adenosine 6**

Compounds **6** was prepared by applying the procedure previously applied for the synthesis of **1**.[29] Briefly, adenosine **11** (152 mg 0.57 mmol) and D-ribose (393 mg 2.62 mmol) were dissolved in glacial acetic acid and methanol (1:3 v/v) and the reaction was stirred at 40◦C for 72 h. Thereafter the solvent was removed under reduced pressure and the resulting dark yellow residue purified by flash chromatography (95/5.0 v/v dichloromethane/methanol) to afford **6** (57 mg, 0.14 mmol 25% total yield) as a mixture of the four possible isomers (**6pα, 6pβ**, **6fα** and **6fβ**). UHPLC-MS analyses of **6** were in accordance with reported data (see Supplementary material SI #1). In the successive transformations compound **6** was used as a mixture.



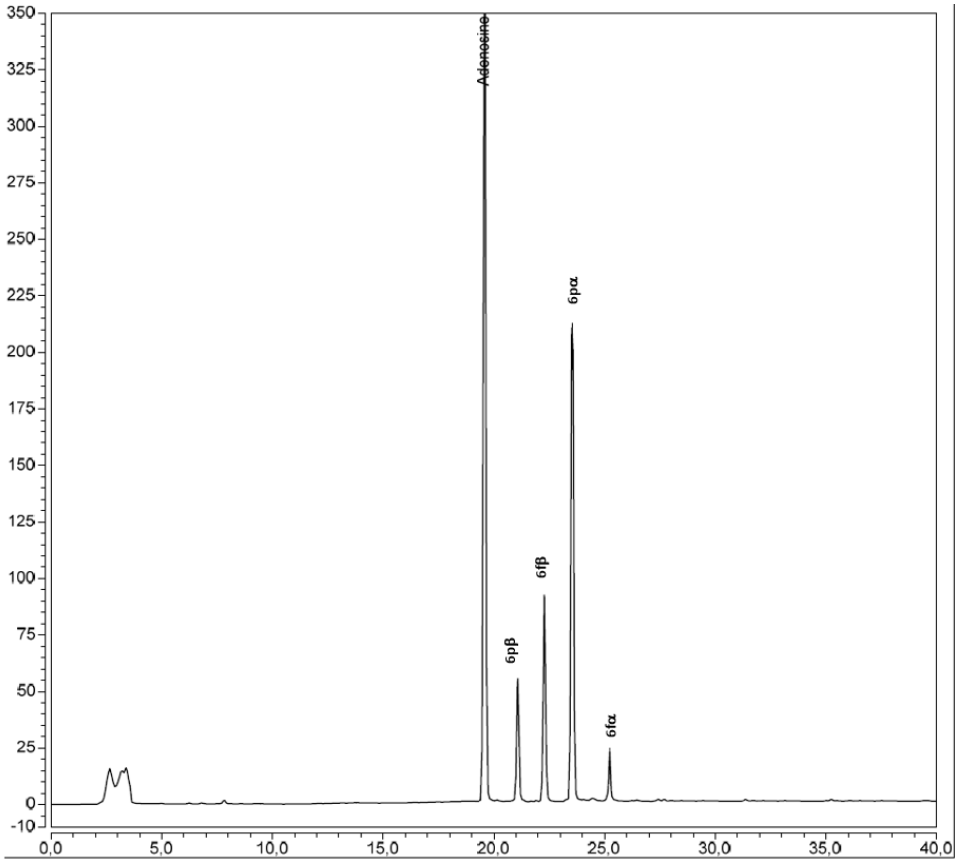

$^1$H-NMR spectrum of compound **6** in $D_2O$.

**$^1$H-NMR** (400 MHz, $D_2O$) 8.37 (s, CH, H8), 8.35 (s, CH,H8), 8.30 (s, CH H8), 8.29 (s, CH, H2), 8.27 (s, CH, H2), 8.23 (s, CH, H2), 8.19 (s, CH, H2), 6.45 ( t, *J*=8Hz CH, H1'), 6.27 (s, CH, H1''),6.24 (s, CH, H1''), 5.85 (s, CH, H1''), 5.56 (s, CH, H1''), 4.82 (m, CH, H3'), 4.70 (m, CH, H2') 4.67 (m, CH, H3''),4.62 (m, CH, H2''), 4.52 (m, CH, H3''), 4.46 (m, CH, H2''), 4.34 (m, CH, H3''), 4.29 (m, CH, H2''), 4.25 (m, CH, H4'), 4.22 (m, CH, H4''), 4.15 (m, CH, H3''), 4.10 (m, CH, H2'') 4.02 (m, CH, H4''), 4.00 (m, $CH_2$, H5''), 3.92 (m, CH, H4''), 3.87(m, $CH_2$, H5''), 3.83 (m, $CH_2$, H5'), 3.78 (m, $CH_2$, H5''), 3.77 (m, $CH_2$, H5'), 3.75 (m, $CH_2$, H5''), 3.72 (m, $CH_2$, H5''), 3.70 (m, $CH_2$, H5''), 3.68 (m, CH, H5''), 3.65(m, $CH_2$, H5'').



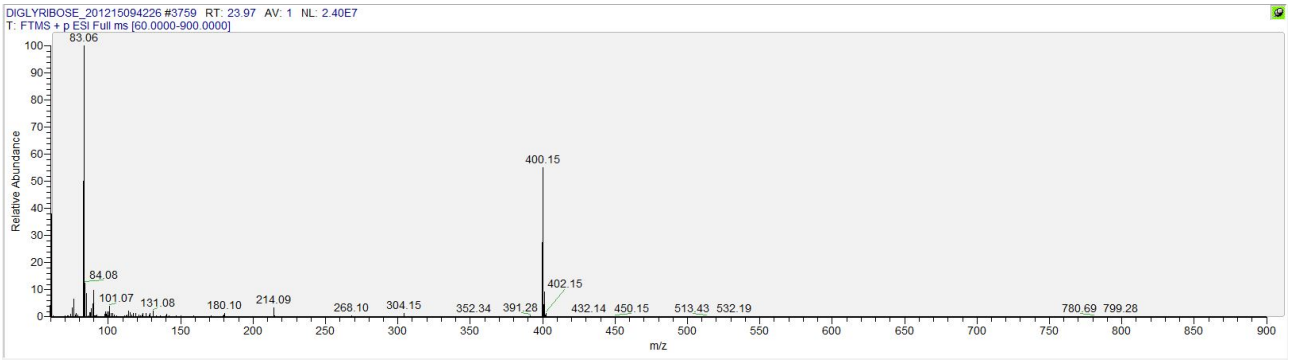

$^{13}$C-NMR spectrum of compound **6** in $D_2O$.

**$^{13}$C-NMR** (100 MHz, $D_2O$) 156.3 (C6), 156.0 (C6), 155.5 (C6), 154.9 (C2), 154.8 (C2), 154.7 (C2),151.8 (C4), 143.0 (C8), 142.0 (C8), 122.5 (C5), 122.0 (C5), 120.8 (C5), 90.3 (C4'), 88.7 (C4''), 87.9 (C4''), 86.2 (C1'), 85.4 (C1''), 84,5 (C1''), 80.5 (C1''), 77.9 (C1''), 75.8 (C3''), 75.6 (C3'), 75.4 (C3''), 75.1 (C2''), 74.7 (C2'), 74.2 (C2''), 73.3 (C3''), 72.2 (C2''), 69.8 (C5''), 69.4 (C4''), 69.3 (C4''), 68.7 (C3''), 66.3 (C5''), 64.8 (C5''), 64.5 (C5'), 64.0 (C5''). ESI-MS: m/z: 400.16 $[M+H]^+$. Elemental Analysis for $C_{15}H_{21}N_5O_8$ calculated: C, 45.11; H, 5.30; N, 17.54; O, 32.05, found: C, 45.05; H, 5.41; N, 17.52; O, 32.84.




UHPLC chromatogram of compound **6**. The assignment of peaks of isomers **6pα**, **6pβ**, **6fα**, and **6fβ**, was performed on the basis of reference 29.

## Original m/z fragmentation spectra of compound 6.



## SI #2 Preparation of the powdered sample, elemental composition and cosmo-origin data of meteorite NWA 1465

NWA 1465 was from Sahara-nayzak, Asnieres sur Seine, France. Dust (approximately 100 mg) was extracted by a two-steps procedure to remove possible organics. The first consisted in the addition of 1.0 mL 0.1 N NaOH and 3.0 mL of 2:1 chloroform-methanol, the second step in the addition of 1.0 mL 0.1 N sulphuric acid and 3.0 mL of 2:1 chloroform-methanol. Between steps the powder was recovered by centrifugation (6000 rpm, 10 min) and the supernatant phase was decanted.

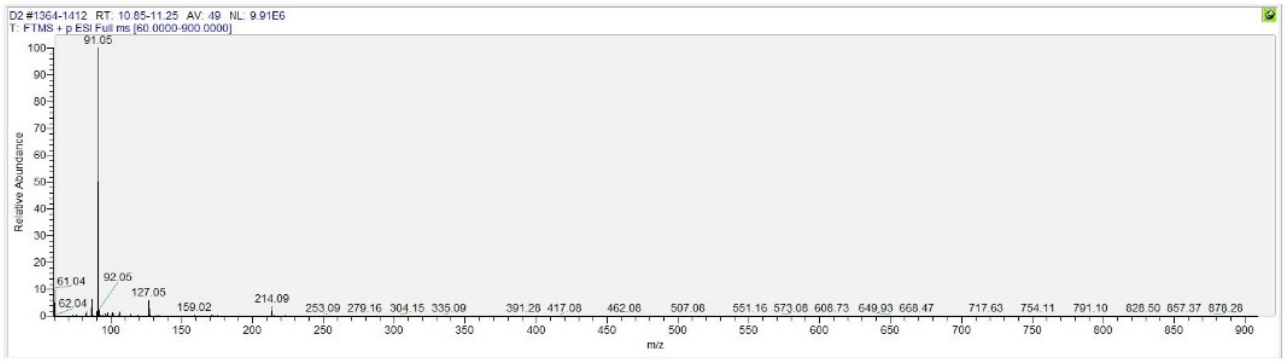
NWA 1465 was found in 2001 in the Western Saharan desert. NWA 1465 [55] (shock stage, S4) is classified as a carbonaceous chondrite (type 3) with flattened chondrules, mineral fragments, and refractory objects in a compact anhydrous matrix of Fe-rich olivine, Ca-rich pyroxene, enstatite, forsterite, troilite, magnetite, FeNi-metal, and weathering products (degree of weathering, W3). NWA 1465 also contains Ca in the order of cm dimension, Al-rich inclusions and large inclusions of dark material). The oxygen isotope composition of the bulk of NWA 1465 is: $\delta^{18}O$ = 4.89‰, $\delta^{17}O$ =0.71‰. The oxygen isotope composition of dark material ($\delta^{18}O$ =13.08‰, $\delta^{17}O$ = 5.83‰) is not in equilibrium with that of the host meteorite.[56]

## SI #3 Mass to charge (m/z) ratio values and relative MS peak abundances of products of 1-11.

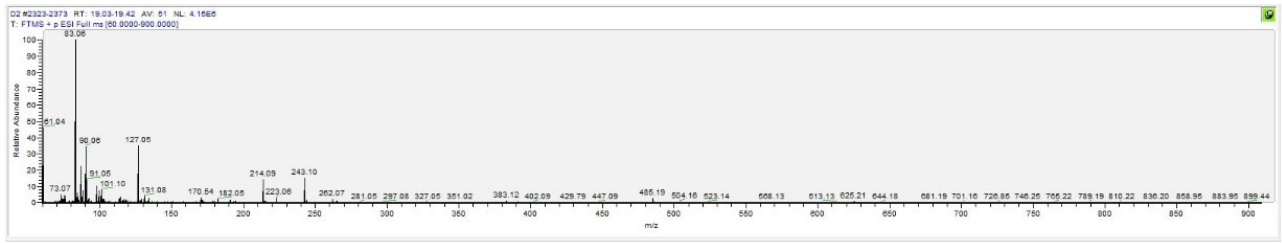
| Product | m/z |
|---|---|
| **1** | 368.16 $[M+H]^+$ (100), 252.11$[M-116+H]^+$ (4), 136.06 $[M-232+H]^+$ (3) |
| **2** | 127.05 $[M+H]^+$ (8), 91.05 (100) |
| **3** | 243.10 $[M+H]^+$ (16), 127.05 $[M-116+H]^+$ (36), 83.06 (100) |
| **4** | 252.11 $[M+H]^+$ (100), 136.06 $[M-116+H]^+$ (18) |
| **5** | 136.06 $[M+H]^+$ (100) |
| **6** | 400.15 $[M+H]^+$ (56), 268.10 $[M-132+H]^+$ (2), 83.06 (100) |
| **7** | 113.03 [M+H]+ (12), 91.05 (100) |
| **8** | 112.05 $[M+H]^+$ (100) |
| **9** | 245.08 $[M+H]^+$ (48), 113.03 $[M-132+H]^+$ (50), 61.04 (100) |
| **10** | 244.09 $[M+H]^+$ (100), 112.05 $[M-132+H]^+$ (36) |
| **11** | 268.10 $[M+H]^+$ (100), 136.06 $[M-132+H]^+$ (4) |

## SI #4 Original m/z fragmentation spectra of compounds 2-5, 7-11.

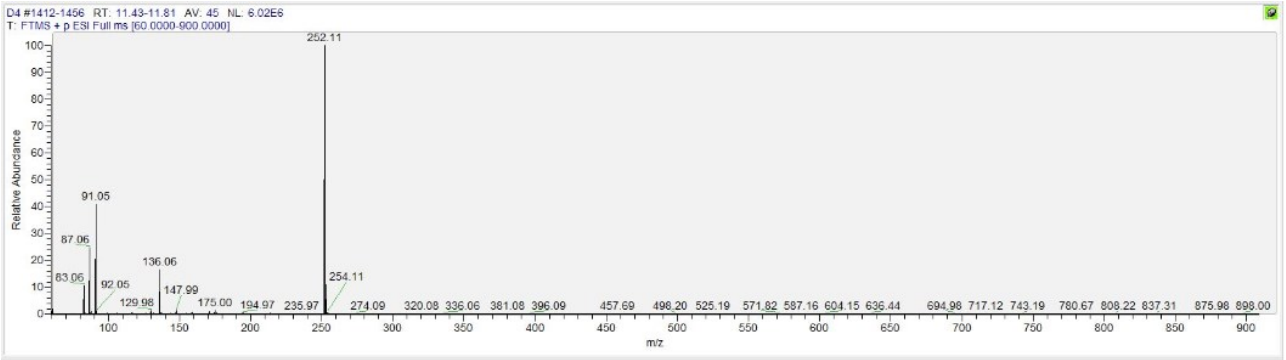
m/z fragmentation spectra of compound **2**.



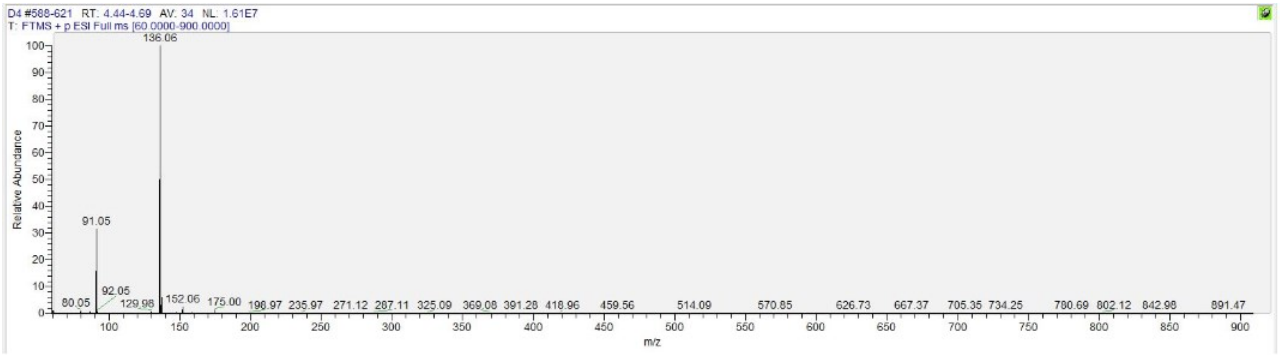

m/z fragmentation spectra of compound **3**.



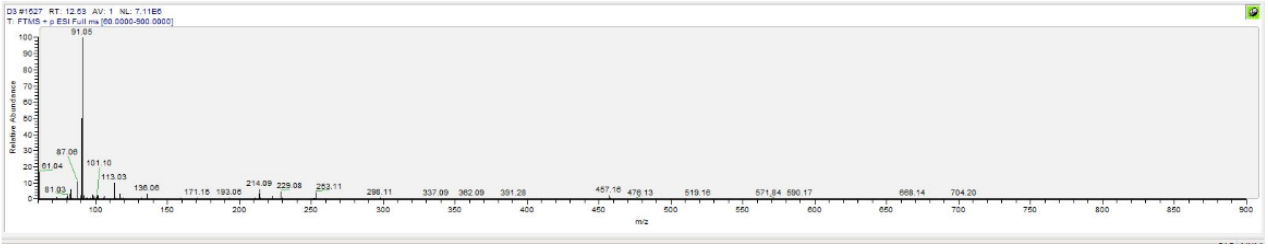

m/z fragmentation spectra of compound **4**.



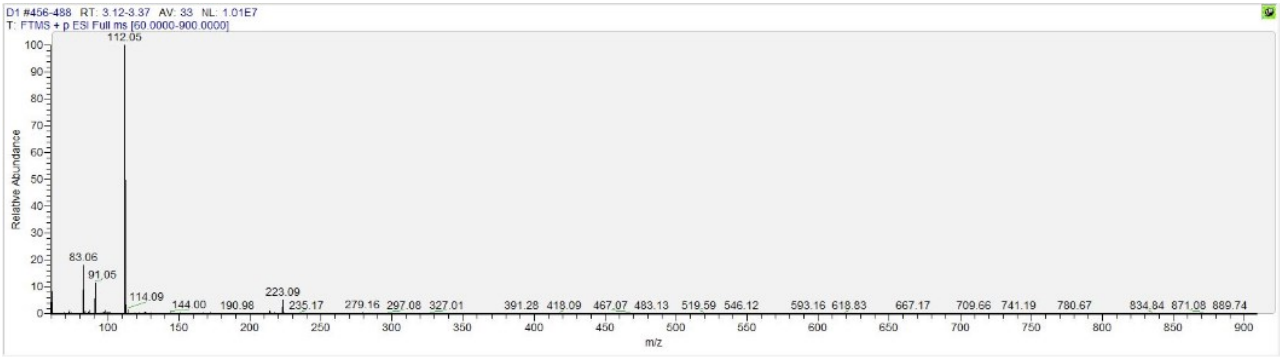

m/z fragmentation spectra of compound **5**.



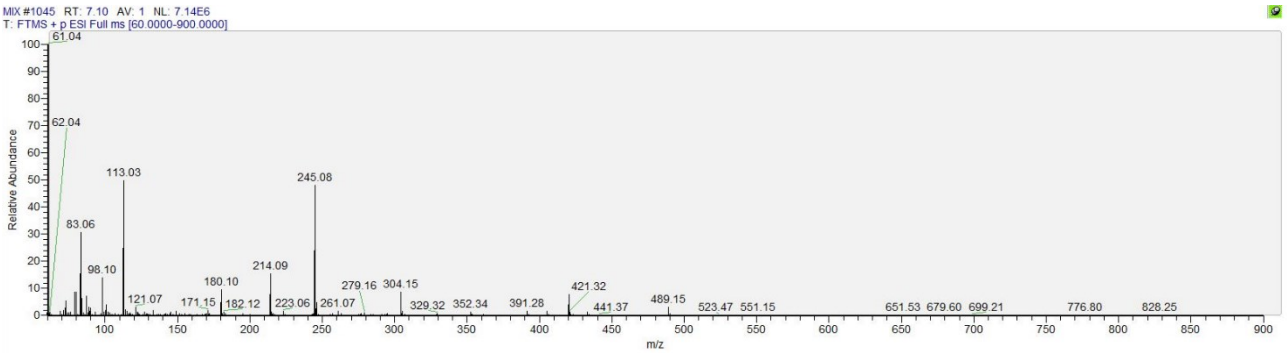

m/z fragmentation spectra of compound **7**.



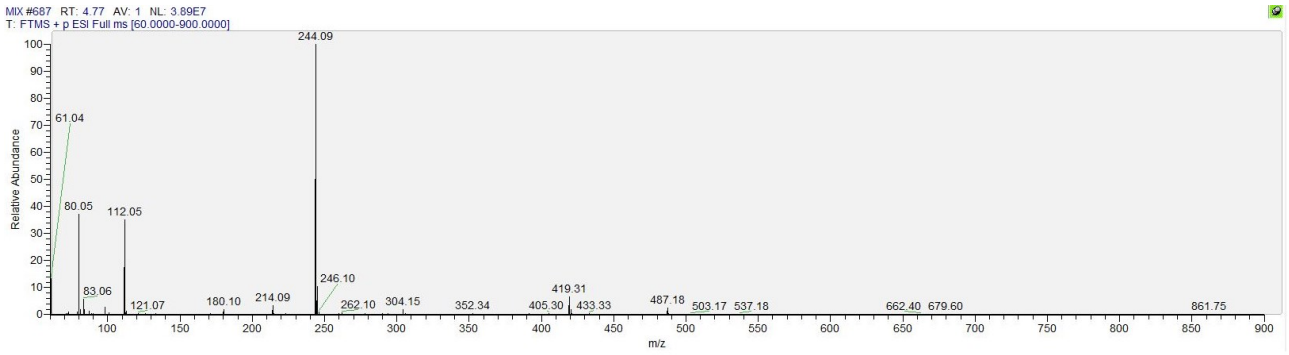

m/z fragmentation spectra of compound **8**.



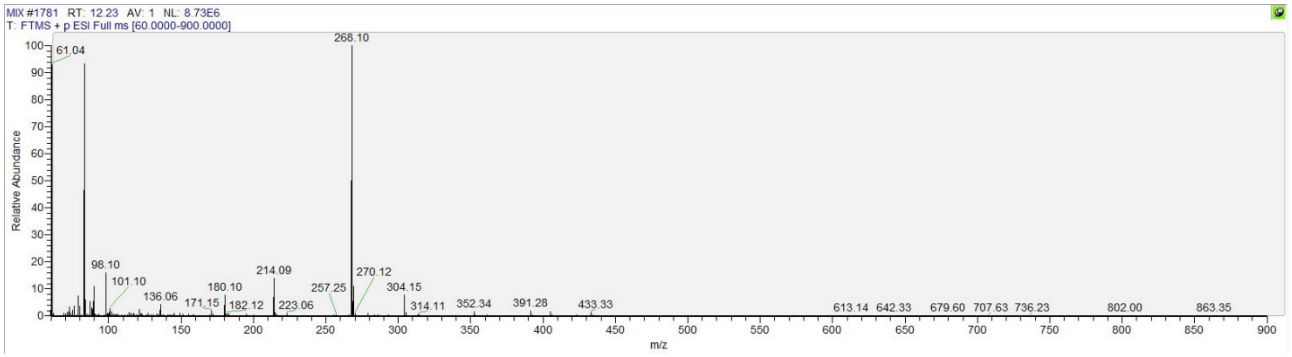

m/z fragmentation spectra of compound **9**.




m/z fragmentation spectra of compound **10**.

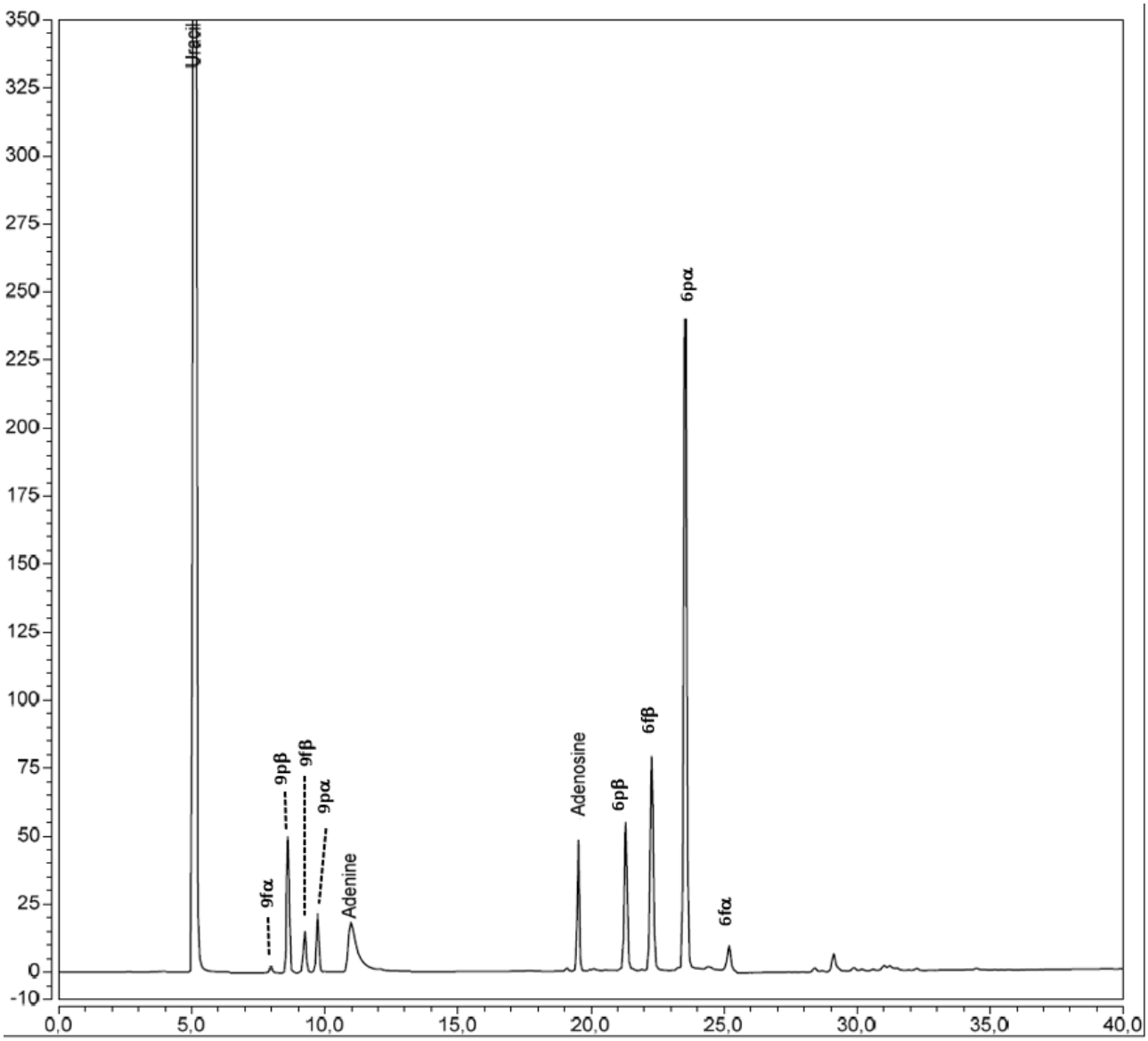



m/z fragmentation spectra of compound **11**.

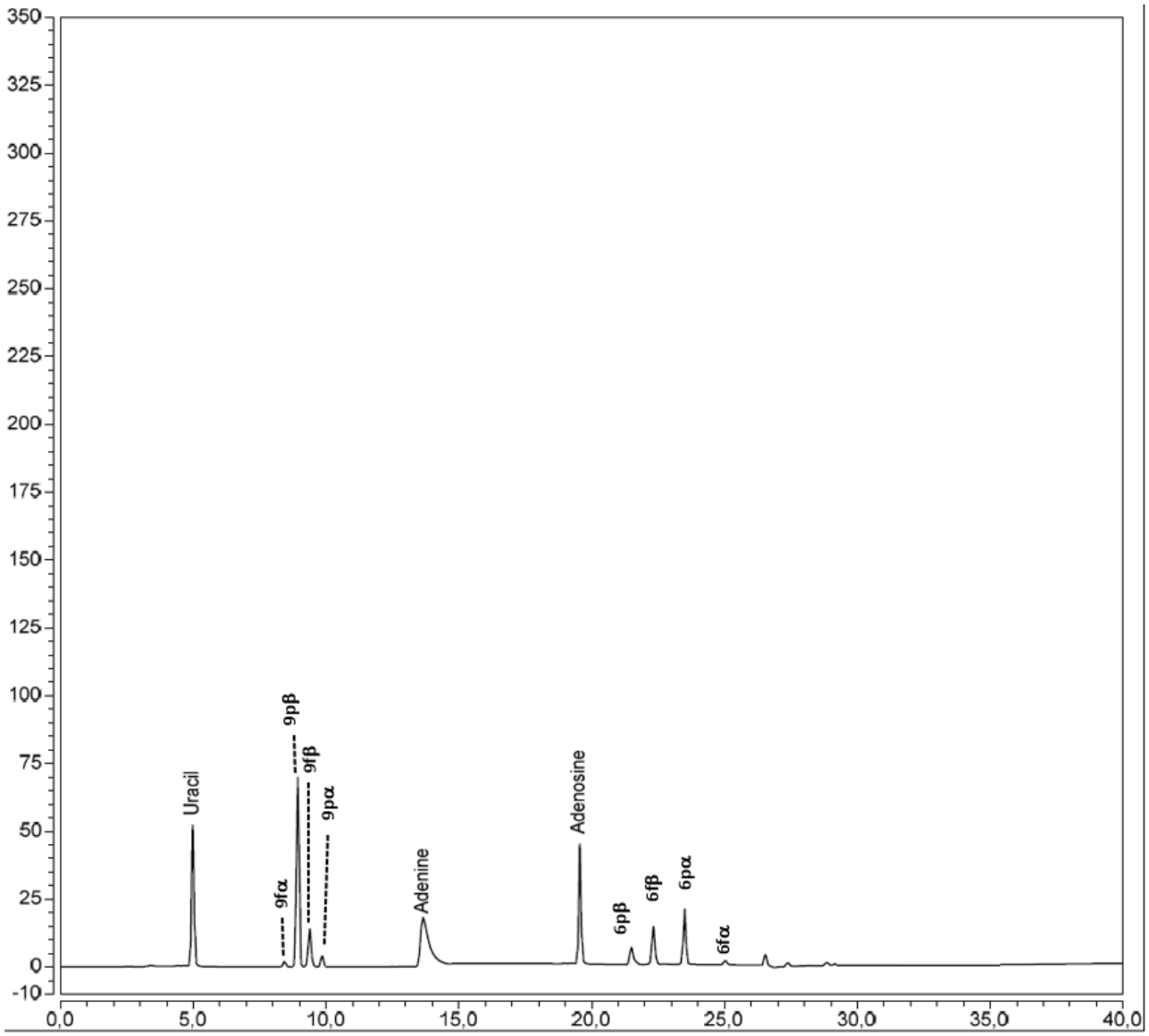


## SI #5 UHPLC of compounds 9-10.

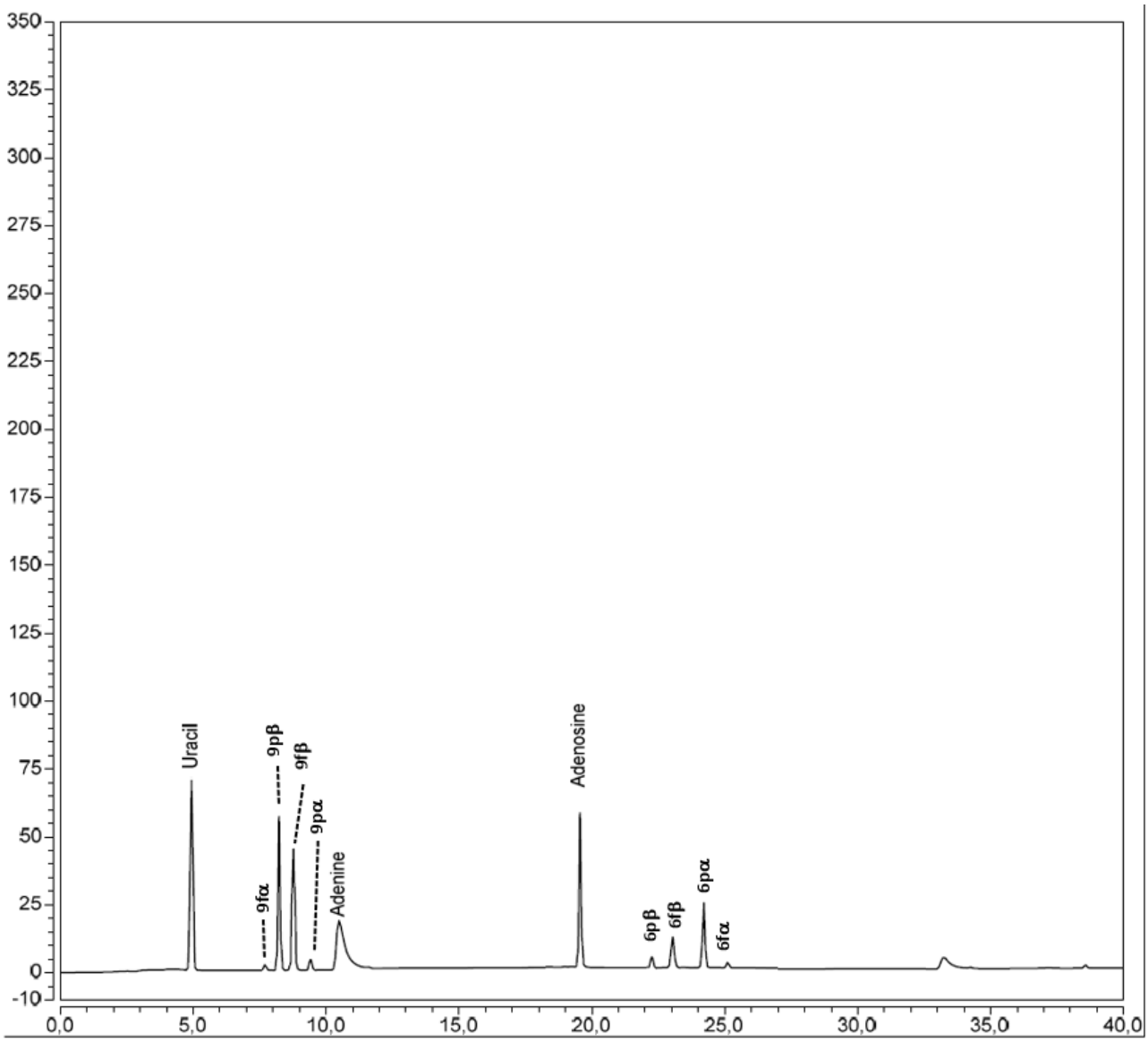
Synthesis of uridine **9** from **6** and uracil **7** in dry film (condition A).



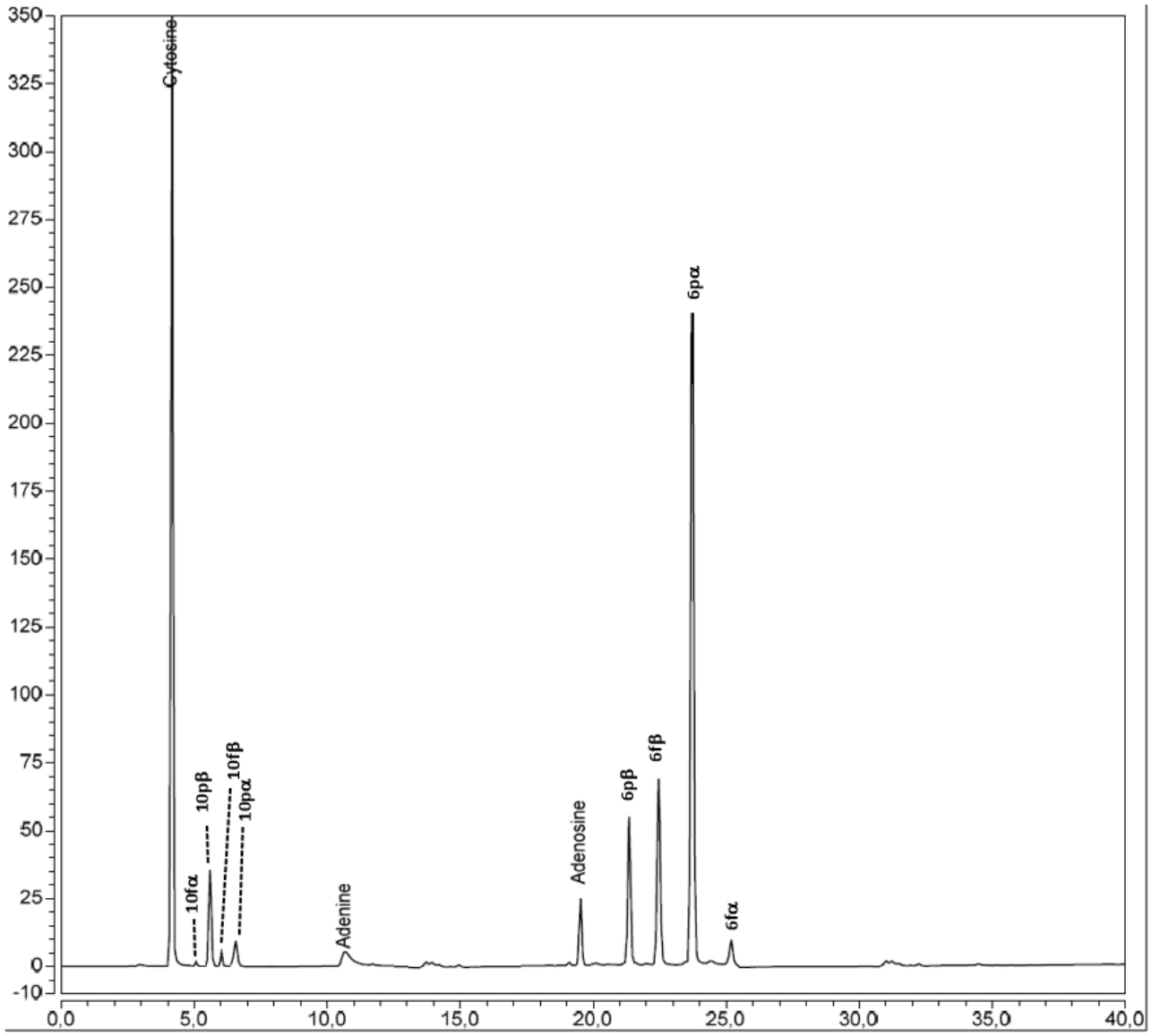
Synthesis of uridine **9** from **6** and uracil **7** in formamide solution (condition B).



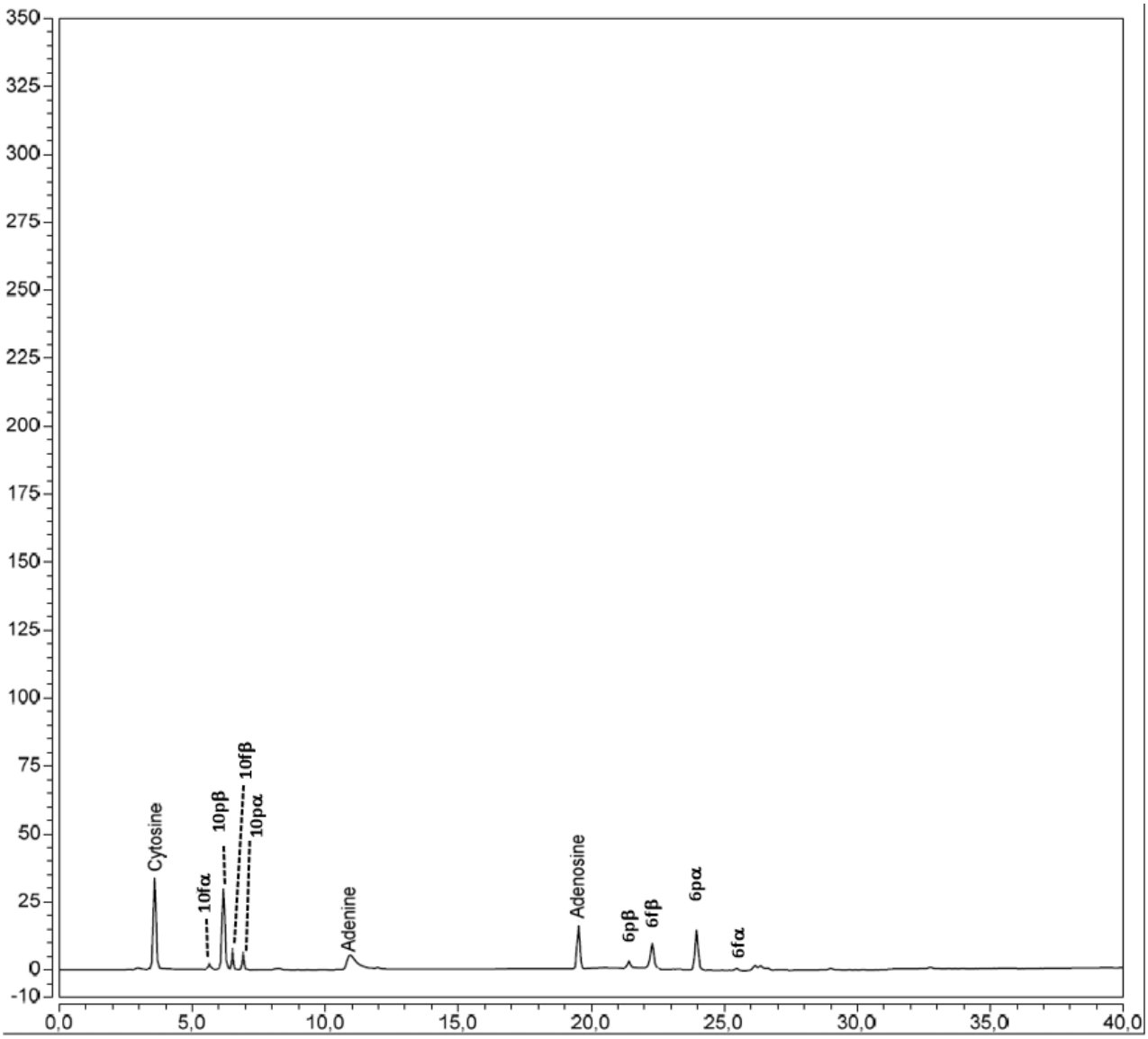
Synthesis of uridine **9** from **6** and uracil **7** in the presence of formamide and NWA 1465 (condition C).



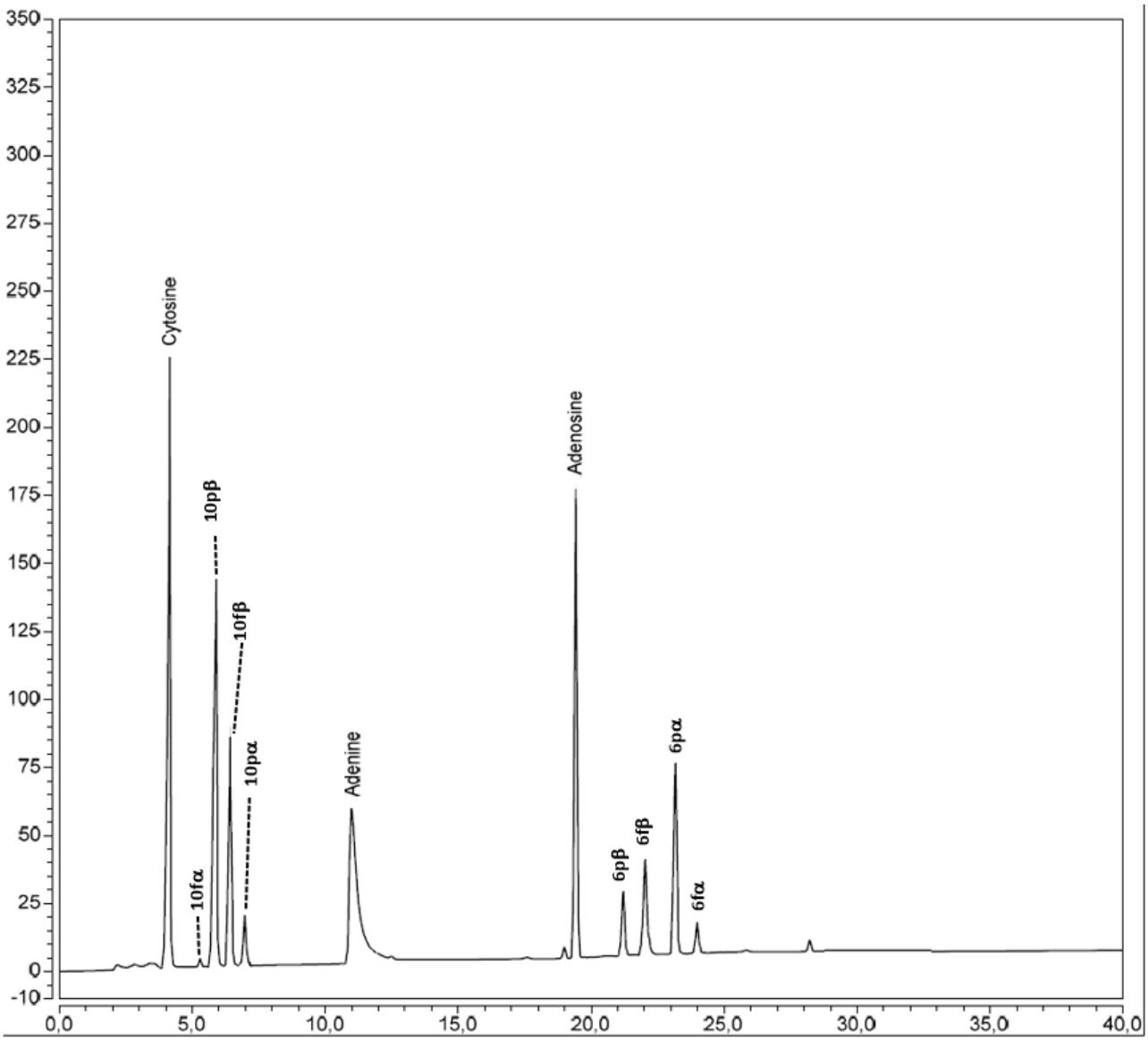
Synthesis of cytidine **10** from **6** and cytosine **8** in dry film (condition A).



Synthesis of cytidine **10** from **6** and cytosine **8** in formamide solution (condition B).



Synthesis of cytidine **10** from **6** and cytosine **8** in the presence of formamide and NWA 1465 (condition C).



## SI#6 Characterization data of products 3,9-10.

**1-(β-D-2'-deoxyribopyranosyl) thymine 3pβ**. White solid. $^1$H-NMR (400 MHz, $D_2O$, ppm): δ 7.61 (s, CH, H6), 5.96 (dd, *J* = 4.0Hz, 8.0 Hz, CH, H1'), 4.40-3.80 (m, CH, H3'-H4', $CH_2$, H5'), 2.11 (m, $CH_2$, H2'), 1.90 (s, $CH_3$). $^{13}$C-NMR (100 MHz, $D_2O$, ppm): δ 163.7 (C4), 150.8 (C2), 136.0 (C6), 110.9 (C5), 92.8 (C1'), 67.3 (C3'), 67.0 (C4'), 64.5 (C5'), 27.8 (C2'), 12.4 ($CH_3$). ESI-MS: m/z: 242,09 $[M + H]^+$ Elemental Analysis for $C_{10}H_{14}N_2O_5$ calculated: C, 49.58; H, 5.83; N, 11.56; O, 33.02 found: C, 49.51; H, 5.80; N, 11.52; O, 32.98.

**Thymidine 3fβ**. White solid. $^1$H-NMR (400 MHz, $CD_3OD$, ppm): δ 7.83 (d, *J* = 0.5 Hz, CH, H6), 6.29 (t, *J* = 8.0 Hz, CH, H1'), 4.61 (s, 3'-OH), 4.42 (ddd, *J* = 6.0 Hz, 3.5 Hz, 3.0 Hz, CH, H3'), 3.93 (dd, *J* = 7.0, Hz 3.5 Hz, CH, H4'), 3.82 (dd, *J* = 12 Hz, 3 Hz, 5'-OH), 3.75 (dd, *J* = 12.0 Hz, 1.5 Hz, $CH_2$, H5'), 2.25 (m, $CH_2$, H2'), 1.90 (d, *J* = 1.0 Hz, $CH_3$). $^{13}$C-NMR (100 MHz, $CD_3OD$, ppm): δ 166.4 (C4), 152.4 (C2), 138.2 (C6), 111.6 (C5), 88.8 (C1'), 86.3 (C3'), 72.2 (C4'), 62.8 (C5'), 41.2 (C2'), 12.4 ($CH_3$). ESI-MS: m/z: 242,09 $[M + H]^+$ Elemental Analysis for $C_{10}H_{14}N_2O_5$ calculated: C, 49.58; H, 5.83; N, 11.56; O, 33.02 found: C, 49.53; H, 5.79; N, 11.54; O, 32.97.

**1-(α-D-2'-deoxyribopyranosyl) thymine 3pα.** White solid. $^1$H-NMR (400 MHz, $D_2O$, ppm): δ 7.69 (s, CH, H6), 5.69 (dd, *J* = 4.0 Hz, 9.0 Hz, CH, H1'), 4.20-3.60 (m, CH, H3'-H4', $CH_2$, H5'), 2.09 (m, $CH_2$, H2'), 1.93 (s, $CH_3$). $^{13}$C-NMR (100 MHz, $D_2O$, ppm): δ 163.7 (C4), 150.8 (C2), 136.0 (C6), 110.9 (C5), 92.8 (C1'), 67.3 (C3'), 67.0 (C4'), 64.5 (C5'), 27.8 (C2'), 12.4 ($CH_3$). ESI-MS: m/z: 242,09 $[M + H]^+$ Elemental Analysis for $C_{10}H_{14}N_2O_5$ calculated: C, 49.58; H, 5.83; N, 11.56; O, 33.02 found: C, 49.52; H, 5.79; N, 11.53; O, 32.99.

**1-(α-D-2'-deoxyribofuranosyl) thymine 3fα.** White solid.$^1$H-NMR (400 MHz, DMSO, ppm): δ 11.27 (s, NH), 7.69 (s, CH, H6), 6.16 (t, *J* = 7.3 Hz, CH, H1'), 5.22 (d, *J* = 4.2 Hz, 3'-OH), 5.01 (t, *J* = 5.2 Hz, 5'-OH), 4.22 (m, CH, H4'), 3.92 (m, CH, H3'), 3.56 (m, $CH_2$, H5'), 2.07 (m, $CH_2$, H2'), 1.76 (s, $CH_3$). $^{13}$C-NMR (100 MHz, DMSO, ppm): δ 163.5 (C6), 150.6 (C2), 139.4 (C4), 110.7 (C5), 94.3 (C1'), 87.1 (C4'), 70.2 (C3'), 61.1 (C5'), 40.3 (C2'), 13.2 (5-$CH_3$). ESI-MS: m/z: 242,09 $[M + H]^+$ Elemental Analysis for $C_{10}H_{14}N_2O_5$ calculated: C, 49.58; H, 5.83; N, 11.56; O, 33.02 found: C, 49.55; H, 5.77; N, 11.49; O, 32.96.

**1-(β-D-Ribopyranosyl) uracil 9pβ.** White solid. $^1$H NMR (400 MHz, DMSO, ppm): δ 11.25 (s, $NH_2$), 7.66 (d, *J* = 8.1 Hz, CH, H6), 5.60 (d, *J* = 8.1 Hz, CH, H5), 5.58 (d, *J* = 9.4 Hz, CH, H1'), 5.11 (OH), 5.09 (OH), 4.84 (OH), 3.97 (d, *J* = 3.2 Hz, CH, H3'), 3.68 (d, *J* = 9.5 Hz, CH, H2'), 3.63 (ddd, *J* = 7.4, 6.0, 2.3 Hz, CH, H4'), 3.58 – 3.53 (m, $CH_2$, $H_a$5', $H_b$5'). $^{13}$C NMR (100 MHz, DMSO, ppm): δ 163.0 (C4), 151.1 (C2), 141.4 (C6), 101.67 (C5), 79.6 (C1'), 71.2 (C3'), 67.6 (C2'), 66.4 (C4'), 65.2 (C5'). ESI-MS: m/z: 245.07 $[M + H]^+$ Elemental Analysis for $C_9H_{12}N_2O_6$ calculated: C, 44.27; H, 4.95; N, 11.47; O, 39.31 found: C, 44.22; H, 4.91; N, 11.42; O, 38.97.

**Uridine 9fβ.** White solid.$^1$H-NMR (400 MHz, $CD_3OD$, ppm): δ 8.00 (d, *J* = 8.0 Hz, CH, H6), 5.90 (d, *J* = 4.4 Hz, CH, H1'), 5.69 (d, *J* = 8.0 Hz, CH, H5), 4.18 (t, *J* = 4.8 Hz, CH, H2'), 4.14 (t, *J* = 4.8 Hz, CH, H3'), 4.00 (m, CH, H4') 3.83-3.73 (m, $CH_2$, H5'). $^{13}$C-NMR (100 MHz, $CD_3OD$, ppm): d 166.2 (C4), 152.5 (C2), 142.8 (C6), 102.7 (C5), 90.8 (C1'), 86.4 (C4'), 75.8 (C2'), 71.4 (C3'), 62.3 (C5'). ESI-MS: m/z: 245.07 $[M + H]^+$ Elemental Analysis for $C_9H_{12}N_2O_6$ calculated: C, 44.27; H, 4.95; N, 11.47; O, 39.31 found: C, 44.20; H, 4.88; N, 11.39; O, 38.95.

**1-(α-D-Ribopyranosyl) uracil 9pα.** White solid**.** $^1$H-NMR (400 MHz, DMSO, ppm): δ 11.34 (s, $NH_2$), 7.70 (d, *J* = 8.2 Hz, CH, H6), 5.57 (d, *J* = 8.1 Hz, CH, H5), 5.47 (d, *J* = 1.2 Hz, CH, H1'), 5.27 (2'-OH), 5.17 – 5.12 (3'-OH), 5.10 (4'-OH), 3.96 (dd, *J* = 12.4 Hz, 1.6 Hz, CH, $H_a$5'), 3.75 (d, *J* = 12.2 Hz, CH, $H_b$5'), 3.72 (d, *J* = 7.4 Hz, CH, H2'), 3.70 – 3.66 (m, CH, H3', H4'). $^{13}$C (100 MHz, DMSO): 163.1 (C4), 150.0 (C2), 142.5 (C6), 100.1 (C5), 81.6 (C1'), 70.9 (C2'), 70.3 (C5'), 68.6 (C4'), 67.2 (C3'). ESI-MS: m/z: 245.07 $[M + H]^+$ Elemental Analysis for $C_9H_{12}N_2O_6$ calculated: C, 44.27; H, 4.95; N, 11.47; O, 39.31 found: C, 44.22; H, 4.87; N, 11.38; O, 38.94.

**1-(α-D-Ribofuranosyl) uracil 9fα.** White solid. $^1$H-NMR (400 MHz, DMSO, ppm): δ 11.18 (s, NH) 7.61 (d, *J* = 8.1 Hz, CH, H6), 6.01 (d, *J* = 4.6 Hz, CH, H1'), 5.56 (d, *J* = 8.1 Hz, CH, H5), 5.49 (OH), 5.12 (OH), 4.80 (OH), 4.16 (t, *J* = 4.5 Hz, CH, H2'), 4.06 – 3.98 (m, CH, H3', H4'), 3.58 (dd, *J* = 12.0 Hz, 2.7 Hz, CH, $H_a$5), 3.42 (dd, *J* = 12.2 Hz, 4.1 Hz, CH, $H_b$5). $^{13}$C-NMR (100 MHz, DMSO): δ 163.3 (C4), 150.6 (C2), 142.8 (C6), 99.8 (C5), 85.1 (C1'), 84.0 (C4'), 70.4 (C3'), 70.3 (C2'), 61.2 (C7). ESI-MS: m/z: 245.07 $[M + H]^+$ Elemental Analysis for $C_9H_{12}N_2O_6$ calculated: C, 44.27; H, 4.95; N, 11.47; O, 39.31 found: C, 44.19; H, 4.83; N, 11.35; O, 38.91.

**1-(β-D-ribopyranosyl) cytosine 10pβ.** White solid.$^1$H-NMR (400 MHz, DMSO, ppm): δ 7.54 (d, *J* = 7.4 Hz, CH, H6), 7.16-7.05 ($NH_2$), 5.70 (d, *J* = 9.6 Hz, CH, H1'), 5.68 (d, *J* = 7.5 Hz, CH, H5), 5.01 (OH), 4.83 (OH), 4.78 (OH), 3.96 (s, CH, H3'), 3.64 – 3.57 (m, CH, H4', H2'), 3.54 (d, *J* = 10.2 Hz, CH, $H_a$5'), 3.50 (dd, *J* = 10.3 Hz, 5.0 Hz, CH, $H_b$5'). $^{13}$C-NMR (100 MHz, DMSO): δ 165.3 (C4), 155.7 (C2), 141.8 (C6), 93.9 (C5), 79.8 (C1'), 71.2 (C3'), 68.0 (C2'), 66.7 (C4'), 65.2 (C5'). ESI-MS: m/z: 244,09 $[M + H]^+$ Elemental Analysis for $C_9H_{13}N_3O_5$ calculated: C, 44.45; H, 5.39; N, 17.28; O, 32.89 found: C, 44.42; H, 5.36; N, 17.25; O, 32.87

**Cytidine 10fβ.** White solid.$^1$H-NMR (400 MHz, $CD_3OD$, ppm): δ 7.45 (d, *J* = 7.2 Hz, CH, H6), 5.91 (d, *J* = 5.2 Hz, CH, H1'), 5.81 (d, *J* = 7.2 Hz, CH, H5), 5.00–3.52 (m, CH, H2', CH, H3', CH, H4', $CH_2$, H5'). $^{13}$C-NMR (400 MHz, $CD_3OD$, ppm): δ 166.8 (C4), 158.2 (C2), 142.4 (C6), 96.9 (C5), 91.2 (C1'), 84.6 (C4'), 74.8 (C2'), 70.1 (C3'), 61.6 (C5'). ESI-MS: m/z: 244,09 $[M + H]^+$ Elemental Analysis for $C_9H_{13}N_3O_5$ calculated: C, 44.45; H, 5.39; N, 17.28; O, 32.89 found: C, 44.41; H, 5.35; N, 17.24; O, 32.85.

**1-(α-D-ribopyranosyl) cytosine 10pα.** White solid $^1$H-NMR (400 MHz, DMSO, ppm): δ 7.61 (d, *J* = 7.4 Hz, CH, H6), 7.18 -7.02 ($NH_2$), 5.67 (d, *J* = 7.4 Hz, CH, H5), 5.47 (s, CH, H1'), 5.13 (d, *J* = 6.0 Hz, OH), 5.10 (d, *J* = 5.8 Hz, OH), 5.07 (d, *J* = 7.7 Hz, OH), 3.95 (dd, *J* = 12.2 Hz, 1.8 Hz, CH, $H_a$5'), 3.75 – 3.63 (m, CH, 4H, H2, H3, H4, $H_b$5'). $^{13}$C-NMR (100 MHz, DMSO): δ 165.5 (C4), 154.4 (C2), 143.1 (C6), 92.5 (C5), 82.3 (C1'), 70.6 (C2'), 70.3 (C5'), 68.7 (C4'), 67.4 (C3'). ESI-MS: m/z: 244,09 $[M + H]^+$ Elemental Analysis for $C_9H_{13}N_3O_5$ calculated: C, 44.45; H, 5.39; N, 17.28; O, 32.89 found: 44.40; H, 5.34; N, 17.23; O, 32.84.

**1-(α-D-ribofuranosyl) cytosine 10fα.** White solid $^1$H-NMR (400 MHz, DMSO, ppm): δ 7.52 (d, *J* = 7.4 Hz, CH, H6), 7.05-6.96 ($NH_2$), 6.01 (d, *J* = 3.7 Hz, CH, H1'), 5.66 (d, *J* = 7.4 Hz, CH, H5), 5.27 (OH), 4.97 (OH), 4.77 (OH), 4.07 – 4.01 (m, CH, H2', H3'), 3.98 – 3.92 (m, CH, H4'), 3.61 (dd, *J* = 12.1 Hz, 2.6 Hz, CH, $H_a$5'), 3.42 (dd, *J* = 12.2 Hz, 4.6 Hz, CH, $H_b$5'). $^{13}$C NMR (100 MHz, DMSO, ppm): δ 165.6 (C4), 155.2 (C2), 143.1 (C6), 92.3 (C5), 85.6 (C1'), 83.1 (C4'), 70.6 (C2'), 70.1 (C3'), 61.1 (C5'). ESI-MS: m/z: 244,09 $[M + H]^+$ Elemental Analysis for $C_9H_{13}N_3O_5$ calculated: C, 44.45; H, 5.39; N, 17.28; O, 32.89 found: C, 44.39; H, 5.32; N, 17.23; O, 32.83.

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