Experimental procedures

5-(Phenylthiomethyl)-2'-deoxyuridine (8). This thionucleoside was synthesized using the multi-step procedure developed by Suzuki *et al.*[10] (13% yield). FAB-MS (positive mode): m/z 373.0 ± 0.1 Da $[M + Na]^+$, 351.0 ± 0.1 Da $[M + H]^+$. ^{1}H NMR (200 MHz, DMSO-d_6): δ 10.74 (bs, 1H, N*H*), 7.79 (s, 1H, H-6), 7.46-7.31 (m, 5H, aromatic H of PhS), 6.21 (t, $J_{1'2'}$ = 7.3 Hz, $J_{1'2''}$ = 6.2 Hz, 1H, H-1'), 5.35 (d, $J_{OH\text{-}3'}$ = 4.1 Hz, 1H, O*H*-3'), 5.13 (t, $J_{OH\text{-}5'}$ = 4.7 Hz, $J_{OH\text{-}5''}$ = 5.3 Hz, 1H, O*H*-5'), 4.26 (m, 1H, H-3'), 3.92 (s, 2H, CH_2-SPh), 3.84 (m, 1H , H-4'), 3.60 (m, 2H, H-5' and H-5''), 2.12 (m, 1H, H-2'), 2.05-1.83 (m, 1H, H-2'').

5-(Phenylthiomethyl)-2'-deoxyuridine Phosphoramidite Derivative (9). Compound **8** (0.522 g, 1.49 mmol) was dissolved in dry pyridine (5 mL), and the resulting solution was evaporated to dryness. The operation was repeated twice. The resulting residue was dissolved in 10 mL of dry pyridine, and DMTrCl (0.795 g, 2.34 mmol) was added subsequently. The reaction mixture was stirred at room temperature for 24 h. The reaction was checked for completion by TLC (95/5 $CHCl_3$/CH_3OH, v/v). The solution was cooled at 5°C, and methanol (0.5 mL) was added. After 10 min, the mixture was evaporated to dryness. The resulting residue was purified by chromatography on a silica gel column with a step gradient of methanol (0 to 5%) in $CHCl_3$/TEA (99/1, v/v) as the mobile phase. The appropriate fractions were pooled and then concentrated to dryness giving 0.620 g (0.95 mmol) of 5'-*O*-(4,4'-dimethoxytrityl)-5-(phenylthiomethyl)-2'-deoxyuridine as a white foam (64% yield). FAB-MS (positive mode): m/z 675.0 ± 0.1 Da $[M + Na]^+$, 653.0 ± 0.1 Da $[M + H]^+$, 543.0 ± 0.1 Da $[M\text{-PhS} + H]^+$, 303.0 ± 0.1 Da $[DMTr]^+$. ^{1}H NMR (200 MHz, DMSO-d_6): δ 10.70 (bs, 1H, N*H*), 7.51-6.97 (m, 19H, H-6 and aromatic H of DMTr and PhS), 6.21 (t, $J_{1'2'}$ = $J_{1'2''}$ = 6.5 Hz, 1H, H-1'), 5.47 (d, $J_{OH\text{-}3'}$ = 4.1 Hz, 1H, O*H*-3'), 4.25 (m, 1H, H-3'), 3.97-3.83 (m, 3H, H-4' and CH_2-SPh), 3.84 (s, 6H, CH_3O-DMTr), 3.23 (m, 2H, H-5' and H-5''), 2.28-1.99 (m, 2H, H-2' and H-2''). The latter compound (0.300 g, 0.46 mmol) was dissolved in dry dichloromethane (10 mL) and the resulting solution was evaporated to dryness. The operation was repeated twice. The resulting residue was the dissolved in 7 mL of dry dichloromethane and kept under an argon atmosphere. The dry DIEA (183 μL, 1.05 mmol) was added, followed by dropwise addition of 2-cyanoethyl *N*,*N*-diisopropylchlorophosphoramidite (120 μL, 0.53 mmol). The reaction mixture was stirred for 30 min. The desired product was checked by TLC (96/4/1 $CHCl_3$/CH_3OH/TEA, v/v/v). The solution was cooled to 5°C with an ice bath, and more DIEA (183 μL) and methanol (200 μL) were added. After 10 min, the

mixture was evaporated to dryness. The resulting residue was purified by chromatography on a silica gel column with a step gradient of methanol (0 to 4%) in $CHCl_3$/TEA (99/1, v/v) as the mobile phase. The appropriate fractions were pooled and then concentrated to dryness giving 0.380 g (0.44 mmol) of the phosphoramidite synthon **9** as a white foam (95% yield). FAB-MS (positive mode): m/z 875.1 ± 0.1 Da $[M + Na]^+$, 743.0 ± 0.1 Da $[M\text{-}PhS + H]^+$, 303.0 ± 0.1 Da $[DMTr]^+$. ^{1}H NMR (200 MHz, DMSO-d_6, two diastereoisomers): δ 7.58-6.96 (m, 19H, H-6 and aromatic H of DMTr and PhS), 6.20 (m, 1H, H-1'), 4.61-4.47 (m, 1H, H-3'), 4.20-3.55 (m, 7H, H-4', CH_2-SPh, CH-^{i}Pr and CH_2-OP), 3.83 (s, 6H, CH_3O-DMTr), 3.35-3.25 (m, 2H, H-5' and H-5"), 2.88 and 2.77 (t, $J_{CH2CH2CN}$ = 5.9 Hz, 2H, CH_2CN), 2.41-2.21 (m, 2H, H-2' and H-2"), 1.34-1.02 (m, 12H, CH_3-^{i}Pr).

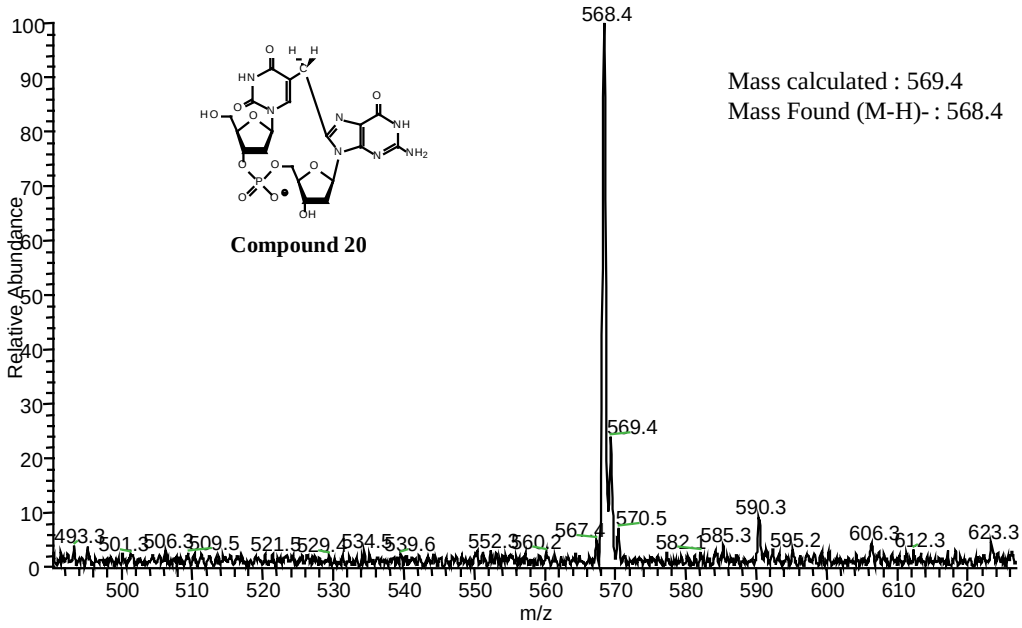
Solid-Phase Synthesis, Deprotection and Purification of Oligodeoxynucleotides. Oligodeoxynucleotides containing $d^{PhS}U$ **8** were prepared by means of phosphoramidite solid-phase synthesis using the acetyl group for dC, and the PAC group for dA and dG. The synthesized phosphoramidite **9** (100 mg, 0.11 mmol) was dissolved in 1 mL of dry dichloromethane and placed in the additional port of an ABI Model 392 DNA synthesizer. The standard 1 and 10 μmol synthesis scales with retention of the 5'-terminal DMTr group (trityl-on mode) were used, with the modification that the duration of the condensation of the modified monomer **9** was extended in comparison with the time allowed with standard monomers (5 min instead of 40 s for normal nucleoside phosphoramidites). Following the synthesis, the solid supports were placed in concentrated aqueous ammonia (30%) in sealed vials for 4 h. The crude 5'-DMTr oligomers were purified and detritylated on-line by reverse-phase HPLC following the previously reported method.[7]

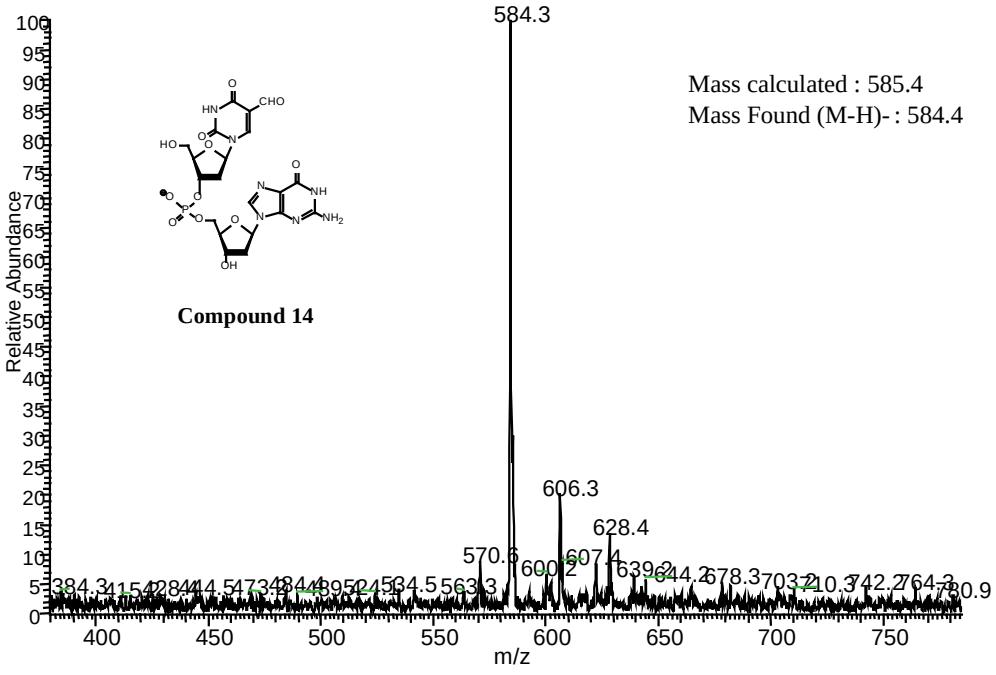
Photoirradiation of Modified Oligodeoxynucleotides.

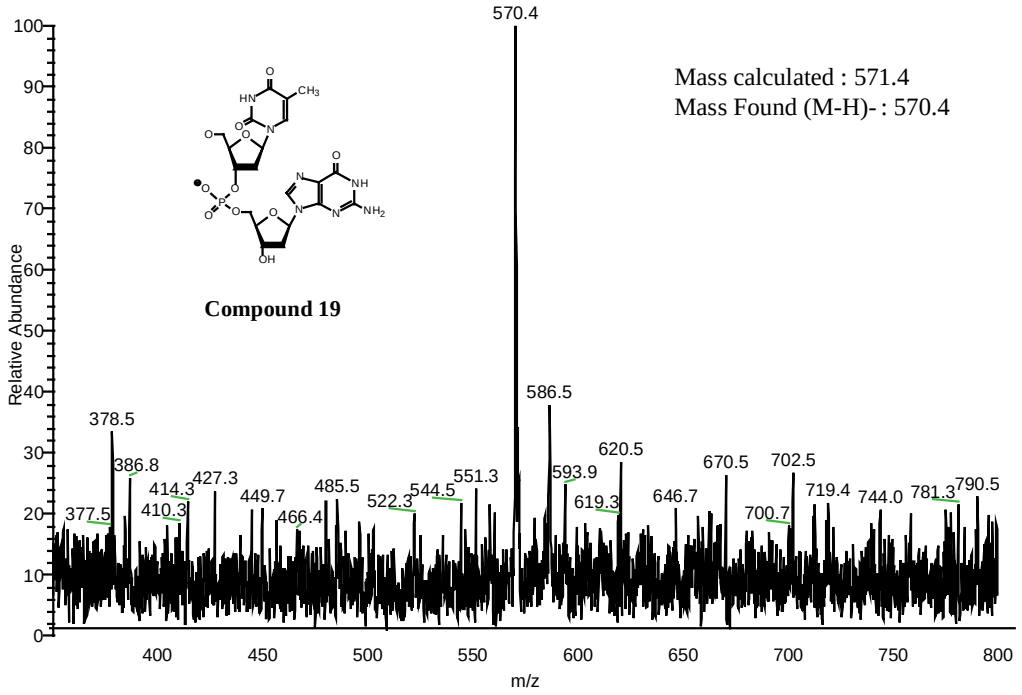
All photolyses of oligodeoxynucleotides **10**-**12** were carried out in quartz cell using a Rayonet photoreactor equipped with 8 lamps having a maximum output at 254 nm. Samples of 2.0 AU_{260nm} of **10**-**12** were dissolved in 500 μL of 10 mM phosphate buffer (pH 7.0) and 100 mM NaCl. The samples were irradiated under either atmospheric O_2 or a stream of N_2 for 10 min. After lyophilization, the residues obtained were dissolved in 100 μL of ammonium formate buffer (25 mM, pH 6.2) and analyzed by reverse-phase HPLC (Hypersil C_{18} column, 5 μm, 4.6 mm x 250 mm, flow rate 1 mL/min). Eluent A was 25 mM ammonium formate (pH 6.2) and eluent B was acetonitrile [100% A (5 min), linear gradient from 0 to 15% of B (50 min)]. Detection was achieved at λ = 260 nm.

Supporting informations

Figure A : ESI-MS (negative mode) of the modified dinucleoside monophosphates **10, 13, 14, 19, 20** and **21.**






Mass calculated : 571.4
Mass Found (M-H)- : 570.4
Compound 19
Relative Abundance
m/z
570.4
586.5
378.5
386.8
414.3
427.3
410.3
449.7
485.5
466.4
522.3
544.5
551.3
593.9
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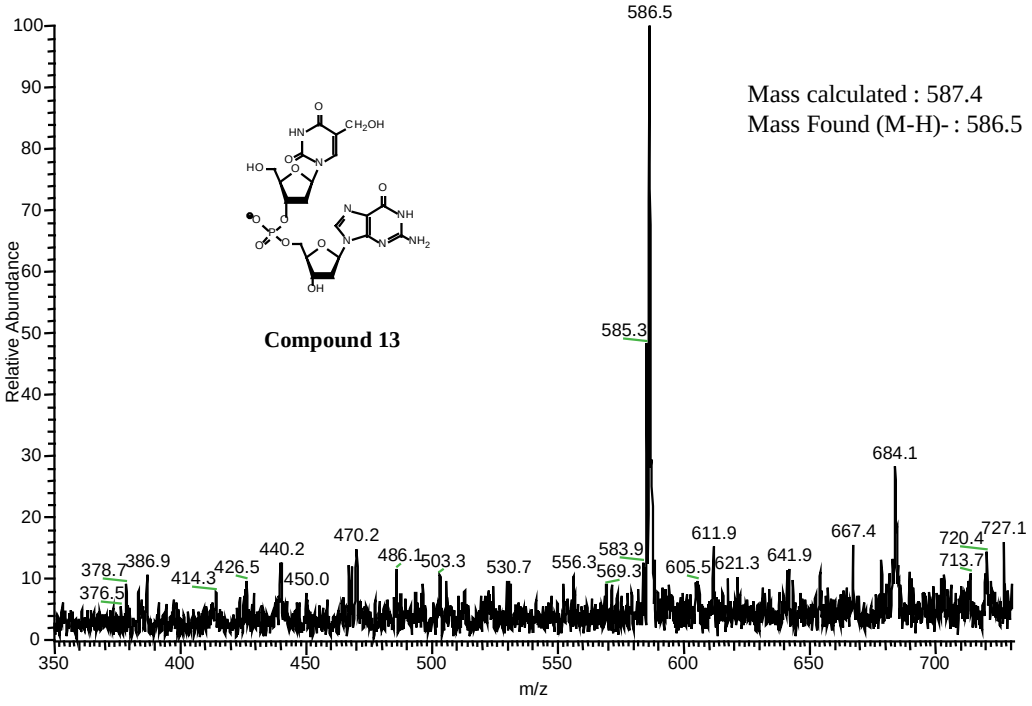
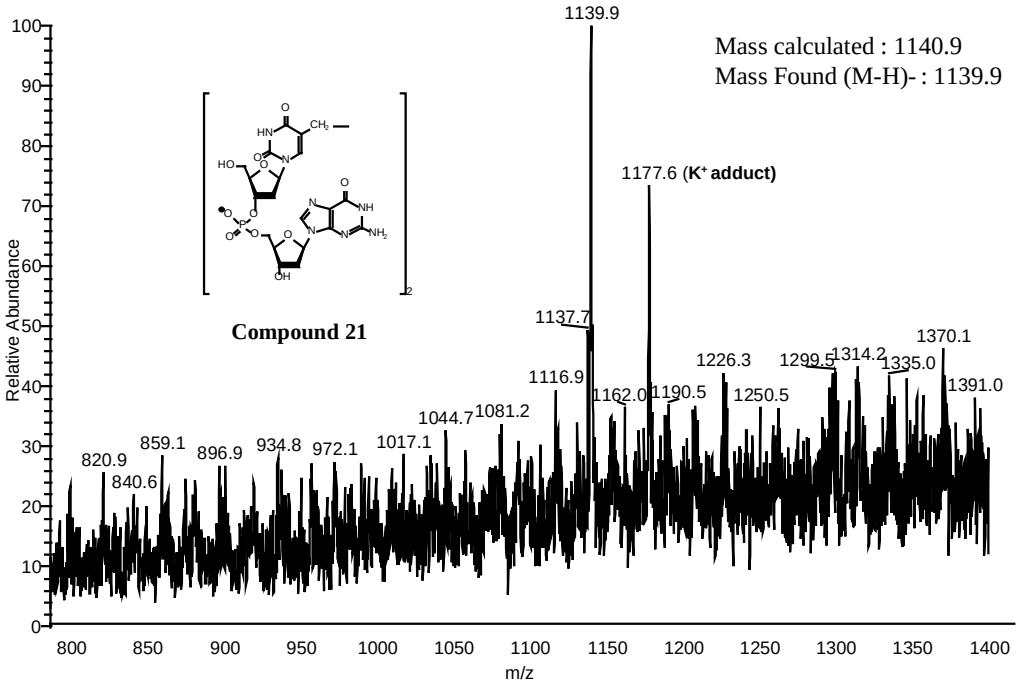
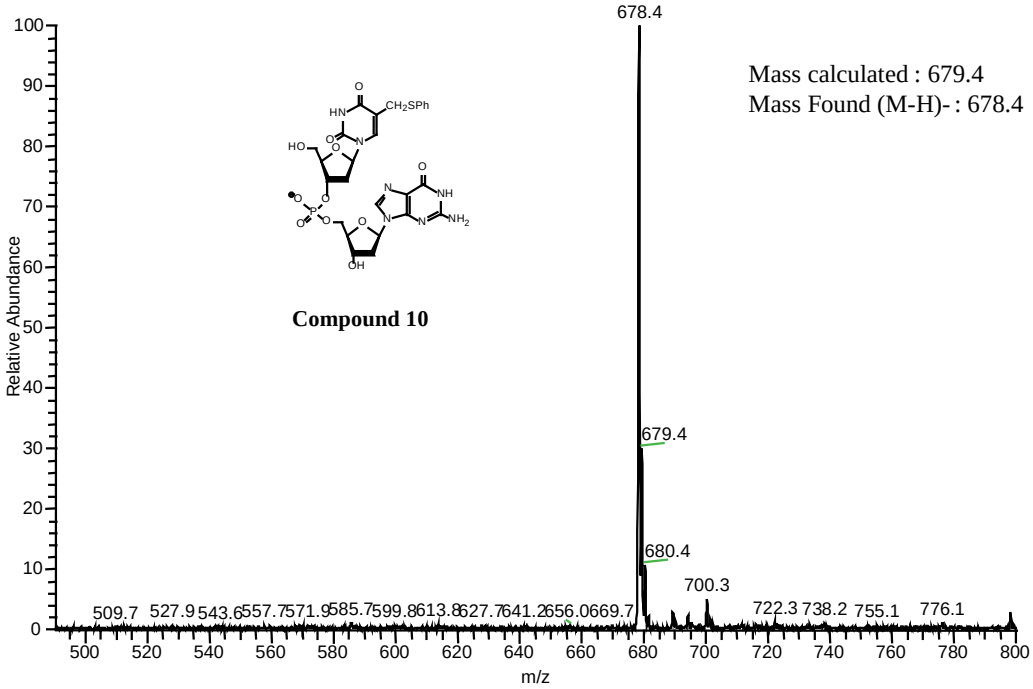
719.4
744.0
781.3
790.5
377.5

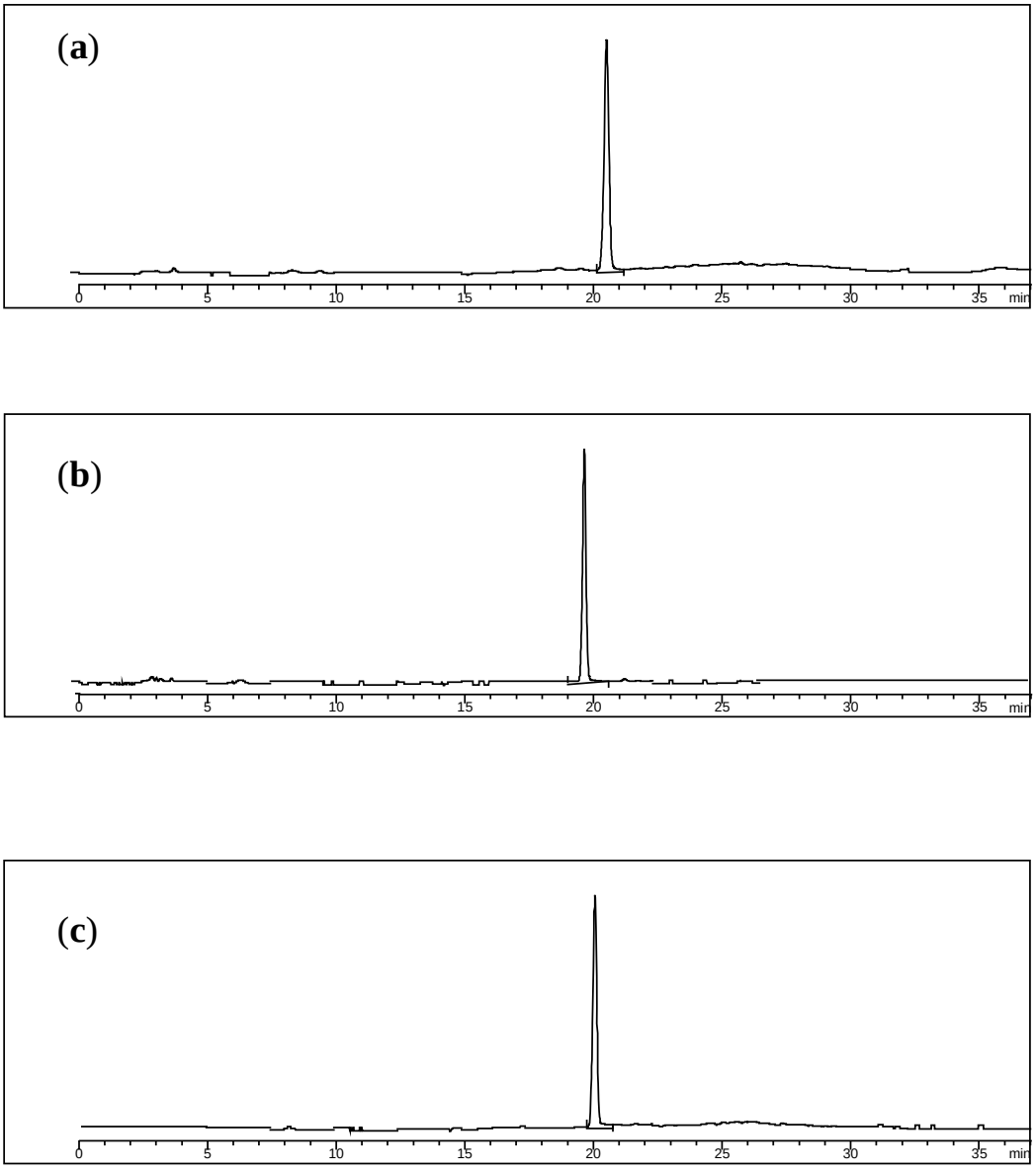

Mass calculated : 587.4
Mass Found (M-H)- : 586.5
Compound 13
Relative Abundance
m/z
586.5
585.3
684.1
470.2
440.2
611.9
667.4
727.1
720.4
713.7
583.9
569.3
556.3
605.5
621.3
641.9
530.7
503.3
486.1
450.0
426.5
414.3
386.9
378.7
376.5


Mass calculated : 1140.9
Mass Found (M-H)- : 1139.9
Compound 21
Relative Abundance
m/z
1139.9
1177.6 (K+ adduct)
1137.7
1116.9
1162.0
1190.5
1226.3
1250.5
1299.5
1314.2
1335.0
1370.1
1391.0
1044.7
1081.2
1017.1
820.9
840.6
859.1
896.9
934.8
972.1


Mass calculated : 679.4
Mass Found (M-H)- : 678.4
Compound 10
Relative Abundance
m/z
678.4
679.4
680.4
700.3
509.7
527.9
543.6
557.7
571.9
585.7
599.8
613.8
627.7
641.2
656.0
669.7
722.3
738.2
755.1
776.1

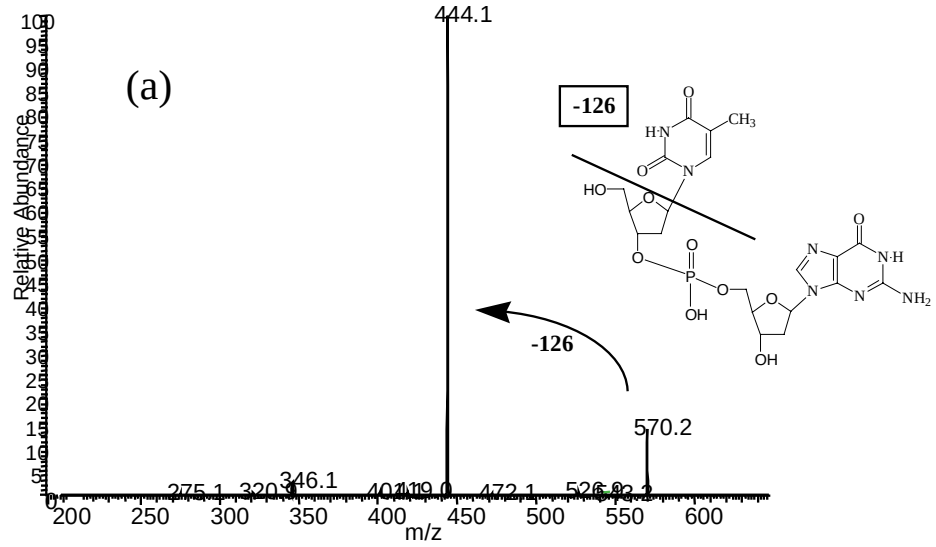
Supporting informations

Figure B : RP-HPLC elution profiles (detection at 260 nm) of the enzymatic digestion mixture of the modified dinucleoside monophosphate **20** (a) untreated compound **20** (b) After nuclease P1 and phosphatase akaline treatment (c) After 5'-*exo* phosphodiesterase treatment
(It should be noted that under the enzymatic digestions conditions (b) and (c), unmodified dinucleoside monophosphate **19** was totally hydrolyzed).



Supporting informations

Figure C : ESI-MS/MS spectra in the negative mode (a) compound **19** and (b) compound **20**.



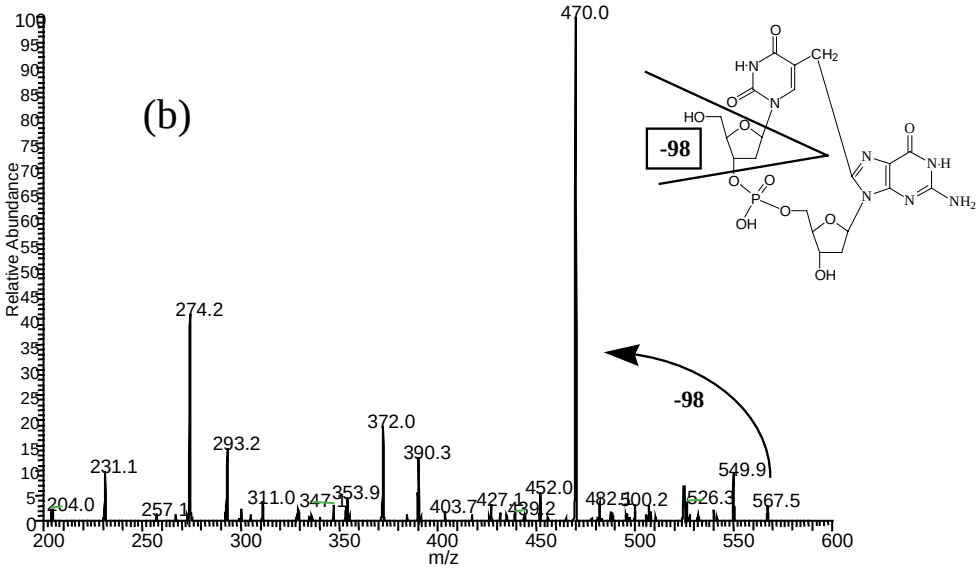


Figure D : ESI-MS/MS/MS spectra in the negative mode of compound **20**.