Electronic Supplementary Information

Synthesis and hybridization studies of α-configured arabino nucleic acids

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S1. Experimental data of α-D-arabino configured nucleosides.

S1. Experimental

S1.1. 9-(α-D-Arabinofuranosyl)-6-*N*-benzoyladenine (5D).[1] The nucleoside **5D** was obtained as a white solid material (80% yield). $[\alpha]_D^{32}$ = + 5.2 (*c* 0.1, MeOH). MALDI-HRMS *m/z* 394.1116 ($[M+Na]^+$, calculated for $C_{17}H_{17}N_5O_5Na$ 394.1121). NMR data were identical with reported data.[1]

S1.2. 1-(α-D-Arabinofuranosyl)-4-*N*-benzoylcytosine (6D). The nucleoside **3D** (2.00 g, 7.49 mmol) was co-evaporated with pyridine (2 x 50 mL) and then dissolved in pyridine (50 mL). Trimethylsilyl chloride (TMSCl) (3.70 mL, 29.24 mmol) was added and the resulting mixture was stirred at RT for 1 h under an atmosphere of nitrogen whereupon benzoyl chloride (1.16 mL, 8.98 mmol) was added dropwise and stirring was continued for 4 h. H_2O (10 mL) was added and stirring was continued for 5 min whereupon aqueous ammonia (18 mL, ~29% w/w) was added and stirring continued for 15 min. The mixture was evaporated to dryness under reduced pressure and the residue purified by column chromatography over silica gel (0-7% methanol in dichloromethane, v/v) to give nucleoside **6D** as a white solid material (2.00 g, 72%). R_f = 0.2 (10% MeOH in CH_2Cl_2, v/v). $[\alpha]_D^{32}$ = +24.4 (*c* 0.1, MeOH). IR (KBr) ν_{max}: 3441, 1703, 1615, 1468, 1469, 1402, 1317, 1267, 1168, 1136, 1063, 963, 853, 796, 707 and 640 cm^{-1}. ^1H NMR **(**DMSO-d_6) δ 3.40-3.69 (2H, m, H-5'), 4.13 (1H, q, *J* = 5.4 Hz, H-3'), 4.24-4.29 (1H, m, H-4'), 4.75 (1H, q, *J* = 5.4 Hz, H-2'), 4.96 (1H, t, *J* = 5.7 Hz, OH-5'), 5.69 (1H, d, *J* = 4.8 Hz, OH-3'), 5.88 (1H, d, *J* = 5.1 Hz, OH-2'), 6.02 (1H, d, *J* = 5.1 Hz, H-1'), 7.52-7.69 (3H, m, H-3'', H-4'' and H-5''), 8.04-8.07 (2H, m, H-2'' and H-6''), 8.70 (1H, s, H-2) and 8.78 (1H, s, H-8), 11.2 (1H, br s, NH). ^{13}C NMR(DMSO-d_6) δ 61.13 (C-5'), 75.98 (C-3'), 79.29 (C-2'), 85.60 (C-4'), 88.67 (C-1'), 125.95 (C-5), 128.53, 132.52, 133.40 (Ar-Bz), 143.66 (C-8), 150.38 (C-4), 151.69 (C-2), 152.18 (C-6) and 165.69 (*C*OPh). MALDI-HRMS *m/z* 370.0998 ($[M+Na]^+$, calculated for $C_{16}H_{17}N_3O_6Na$ 370.1009).

S1.3. 9-(α-D-Arabinofuranosyl)-2-*N*-isobutyrylguanine (7D). The nucleoside **7D** was obtained as a white solid material (75% yield). $[\alpha]_D^{32}$ = +19.6 (*c* 0.1, MeOH). MALDI-HRMS *m/z* 376.1218 ($[M+Na]^+$, calculated for $C_{14}H_{19}N_5O_6Na$ 376.1227).

S1.4. 1-(3',5'-*O*-(1,1,3,3-Tetraisopropyldisiloxane-1,3-diyl)-α-D-arabinofuranosyl) thymine (8D).[2] The nucleoside **8D** was obtained as a white solid material (69% yield). $[\alpha]_D^{32}$ = +14.2 (*c* 0.1, MeOH). MALDI-HRMS *m/z* 523.2261 ($[M+Na]^+$, calculated for $C_{22}H_{40}N_2O_7Si_2Na$ 523.2266). NMR data were identical with reported data.[2]

S1.5. 9-(3',5'-*O*-(1,1,3,3-Tetraisopropylidisiloxane-1,3-diyl)-α-D-arabinofuranosyl)-6-*N*-benzoyladenine (9D). The nucleoside **9D** was obtained as a white solid material (50% yield). $[\alpha]_D^{32}$ = +25.6 (*c* 0.1, MeOH). MALDI-HRMS *m/z* 636.2650 ($[M+Na]^+$, calculated for $C_{29}H_{43}N_5O_6Si_2Na$ 636.2644).

S1.6. 1-(3',5'-*O*-(1,1,3,3-Tetraisopropylidisiloxane-1,3-diyl)-α-D-arabinofuranosyl)-4-*N*-benzoylcytosine (10D). The nucleoside **10D** was obtained as a white solid material (68% yield). $[\alpha]_D^{32}$ = -18.9 (*c* 0.1, MeOH). MALDI-HRMS *m/z* 612.2512 ($[M+Na]^+$, calculated for $C_{28}H_{43}N_3O_7Si_2Na$ 612.2531).

S1.7. 9-(3',5'-*O*-(1,1,3,3-Tetraisopropyldisiloxane-1,3-diyl)-α-D-arabinofuranosyl)-2-*N*-isobutyrylguanine (11D). The nucleoside **11D** was obtained as a white solid material (70% yield). $[\alpha]_D^{32}$ = -18.2 (*c* 0.1, MeOH). MALDI-HRMS *m/z* 596.3019 ($[M+H]^+$, calculated for $C_{26}H_{46}N_5O_7Si_2$ 596.2930).

S1.8. 1-(2'-*O*-Acetyl-3',5'-*O*-(1,1,3,3-tetraisopropyldisiloxane-1,3-diyl)-α-D-arabinofuranosyl)thymine (12D). The nucleoside **12D** was obtained as a white solid material (88% yield). $[\alpha]_D^{32}$ = +8.9 (*c* 0.1, MeOH). MALDI-HRMS *m/z* 565.2375 ($[M+Na]^+$, calculated for $C_{24}H_{42}N_2O_8Si_2Na$ 565.2371).

S1.9. 9-(2'-*O*-Acetyl-3',5'-*O*-(1,1,3,3-tetraisopropyldisiloxane-1,3-diyl)-α-D-arabinofuranosyl)-6-*N*-benzoyladenine (13D). The nucleoside **13D** was obtained as a white solid material (88% yield). $[\alpha]_D^{32}$ = +12.7 (*c* 0.1, MeOH). MALDI-HRMS *m/z* 678.2750 ($[M+Na]^+$, calculated for $C_{31}H_{45}N_5O_7Si_2Na$ 678.2749).

S1.10. 1-(2'-*O*-Acetyl-3',5'-*O*-(1,1,3,3-tetraisopropyldisiloxane-1,3-diyl)-α-D-arabino furanosyl)-4-*N*-benzoylcytosine (14D). The nucleoside **14D** was obtained as a white solid material (80% yield). $[\alpha]_D^{32}$ = +18.5 (*c* 0.1, MeOH). MALDI-HRMS *m/z* 654.2637 ($[M+Na]^+$, calculated for $C_{30}H_{45}N_3O_8Si_2Na$ 654.2637).

S1.11. 9-(2'-*O*-Acetyl-3',5'-*O*-(1,1,3,3-tetraisopropyldisiloxane-1,3-diyl)-α-D-arabino furanosyl)-2-*N*-isobutyrylguanine (15D). The nucleoside **15D** was obtained as a white solid material (85% yield). $[\alpha]_D^{32}$ = +42.3 (*c* 0.1, MeOH). MALDI-HRMS *m/z* 638.3109 ($[M+H]^+$, calculated for $C_{28}H_{48}N_5O_8Si_2$ 638.3035).

S1.12. 1-(2'-*O*-Acetyl-α-D-arabinofuranosyl)thymine (16D). The nucleoside **16D** was obtained as a white solid material (90% yield). $[\alpha]_D^{32}$ = +6.9 (*c* 0.1, MeOH). MALDI-HRMS *m/z* 323.0853 ($[M+Na]^+$, calculated for $C_{12}H_{16}N_2O_7Na$ 323.0849).

S1.13. 9-(2'-*O*-Acetyl-α-D-arabinofuranosyl)-6-*N*-benzoyladenine (17D). The nucleoside **17D** was obtained as a white solid (95% yield). $[\alpha]_D^{32}$ = +34.0 (*c* 0.1, MeOH) MALDI-HRMS *m/z* 436.1216 ($[M+Na]^+$, calculated for $C_{19}H_{19}N_5O_6Na$ 436.1227).

S1.14. 1-(2'-*O*-Acetyl-α-D-arabinofuranosyl)-4-*N*-benzoylcytosine (18D). The nucleoside **18D** was obtained as a white solid material (85% yield). $[\alpha]_D^{32}$ = +34.0 (*c* 0.1, MeOH). MALDI-HRMS *m/z* 412.1126 ($[M+Na]^+$, calculated for $C_{18}H_{19}N_3O_7Na$ 412.1115).

S1.15. 9-(2'-*O*-Acetyl-α-D-arabinofuranosyl)-2-*N*-isobutyrylguanine (19D). The nucleoside **19D** was obtained as a white solid material (75% yield). $[\alpha]_D^{32}$ = +30.8 (*c* 0.1, MeOH). MALDI-HRMS *m/z* 418.1320 ($[M+Na]^+$, calculated for $C_{16}H_{21}N_5O_7Na$ 418.1333).

S1.16. 1-(2'-*O*-Acetyl- 5'-*O*-(4,4'-dimethoxytrityl)-α-D-arabinofuranosyl)thymine (20D). The nucleoside **20D** was obtained as a white solid material (69% yield). MALDI-HRMS *m/z* 625.2152 ($[M+Na]^+$, calculated for $C_{33}H_{34}N_2O_9Na$ 625.2156).

S1.17. 9-(2'-*O*-Acetyl- 5'-*O*-(4,4'-dimethoxytrityl)-α-D-arabinofuranosyl)-6-*N*-benzoyladenine (21D). The nucleoside **21D** was obtained was a white solid material (78% yield). MALDI-HRMS *m/z* 738.2560 ($[M+Na]^+$, calculated for $C_{40}H_{37}N_5O_8Na$ 738.2534).

S1.18. 9-(2'-*O*-Acetyl- 5'-*O*-(4,4'-dimethoxytrityl)-α-D-arabinofuranosyl)-4-*N*-benzoylcytosine (22D). The nucleoside **22D** was obtained as a white solid material (75% yield). MALDI-HRMS *m/z* 714.2407 ($[M+Na]^+$, calculated for $C_{39}H_{37}N_3O_9Na$ 714.2421).

S1.19. 9-(2'-*O*-Acetyl-5'-*O*-(4,4'-dimethoxytrityl)-α-D-arabinofuranosyl)-2-*N*-isobutyrylguanine (23D). The nucleoside **23D** was obtained as a white solid material (48% yield). MALDI-HRMS *m/z* 720.2611 ($[M+Na]^+$, calculated for $C_{37}H_{39}N_5O_9Na$ 720.2639).

S1.20. 1-(2'-*O*-Acetyl-3'-(2-cyanoethoxy(diisopropylamino)phosphino)-5-*O*-(4,4'-di methoxytrityl)-α-D-arabinofuranosyl)thymine (24D). The nucleoside **24D** was obtained as a white solid material (68% yield). MALDI-HRMS *m/z* 825.3201 ($[M+Na]^+$, calculated for $C_{42}H_{51}N_4O_{10}PNa$ 825.3235).

S1.21. 9-(2'-*O*-Acetyl-3'-*O*-(2-cyanoethoxy(diisopropylamino)phosphino)-5'-*O*-(4,4'-dimethoxytrityl)-α-D-arabinofuranosyl)-6-*N*-benzoyladenine (25D). The nucleoside **25D** was obtained as a white solid material (65% yield). MALDI-HRMS *m/z* 938.3576 ($[M+Na]^+$, calculated for $C_{49}H_{54}N_7O_9PNa$ 938.3612).

S1.22. 9-(2'-*O*-Acetyl-3'-*O*-(2-cyanoethoxy(diisopropylamino)phosphino)-5'-*O*-(4,4'-dimethoxytrityl)-α-D-arabinofuranosyl)-4-*N*-benzoylcytosine (26D). The nucleoside

26D was obtained as a white solid material (69% yield). MALDI-HRMS *m/z* 914.3536 ([M+Na]$^+$, calculated for $C_{48}H_{54}N_5O_{10}PNa$ 914.3500).

S1.23. 9-(2'-*O*-Acetyl-3'-*O*-(2-cyanoethoxy(diisopropylamino)phosphino)-5'-*O*-(4,4'-dimethoxytrityl)-α-D-arabinofuranosyl)-2-*N*-isobutyrylguanine (27D). The nucleoside **27D** was obtained as a white solid material (45% yield). MALDI-HRMS *m/z* 920.3723 ([M+Na]$^+$, calculated for $C_{46}H_{56}N_7O_{10}PNa$ 920.3718).

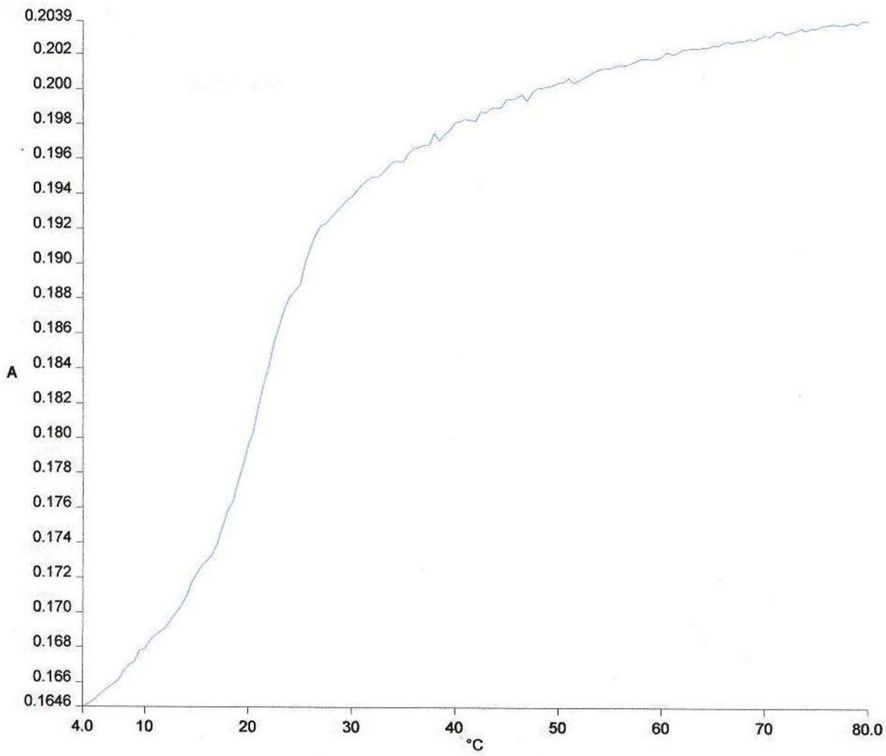

Figure S1. Thermal denaturation curve of partly α-L-ara-modified **ON9**, against DNA complement recorded in medium salt buffer at 260 nm. (Table 2. entry 5).

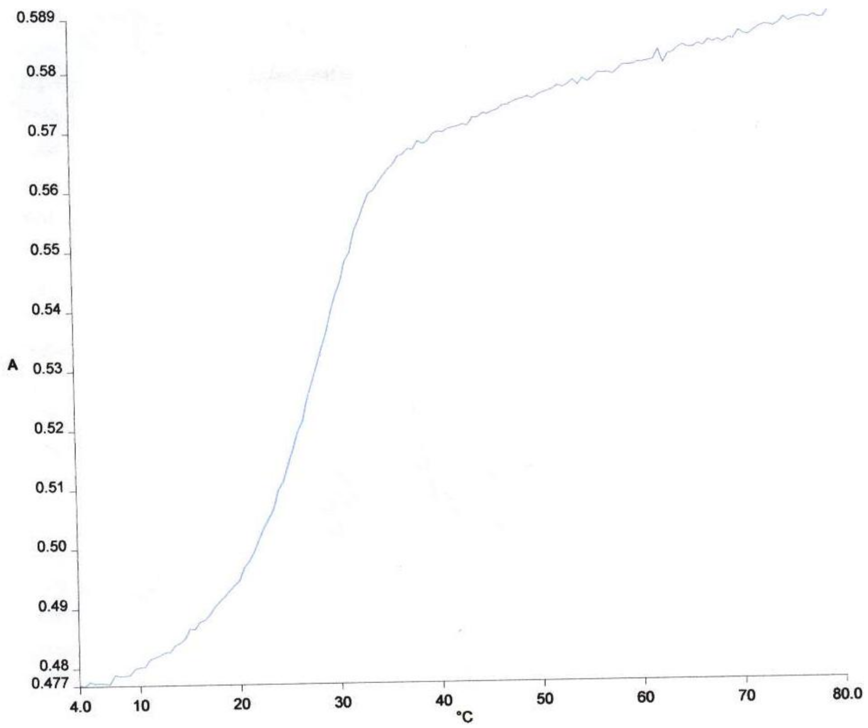

Figure S3. Thermal denaturation curve of partly α-L-ara-modified **ON9**, against partly α-L-ara-modified **ON13** recorded in medium salt buffer at 260 nm. (Table 2. entry 17).

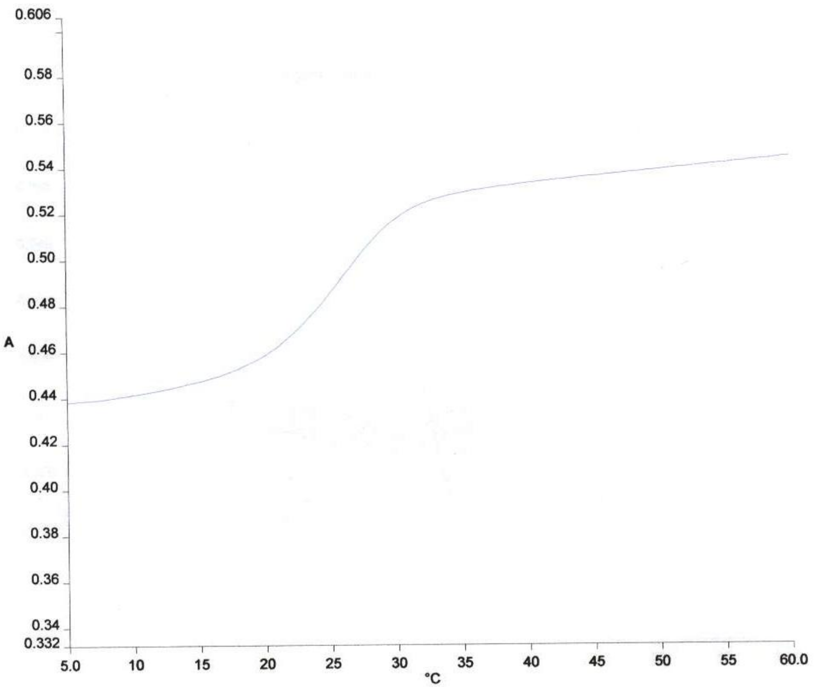

Figure S8. Thermal denaturation curve of partly 2'-amino-α-L-ara-modified **ON17**, against partly 2'-amino-α-L-ara-modified **ON19** recorded in medium salt buffer at 260 nm. (Table 3. entry 28).

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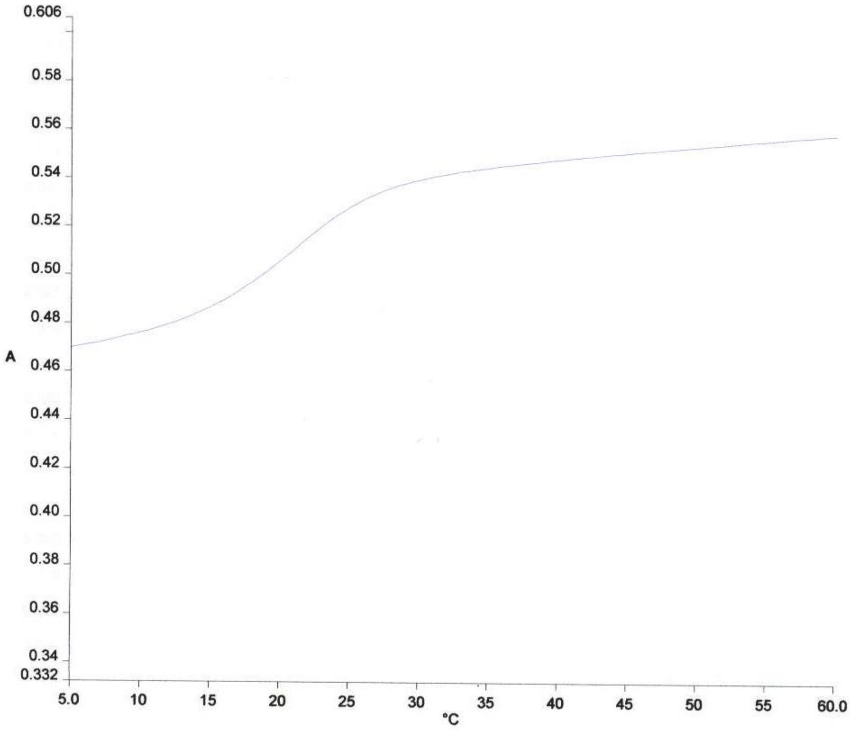

Figure S9. Thermal denaturation curve of partly 2'-amino-α-L-ara-modified **ON18**, against partly 2'-amino-α-L-ara-modified **ON20** recorded in medium salt buffer at 260 nm. (Table 3. entry 29).

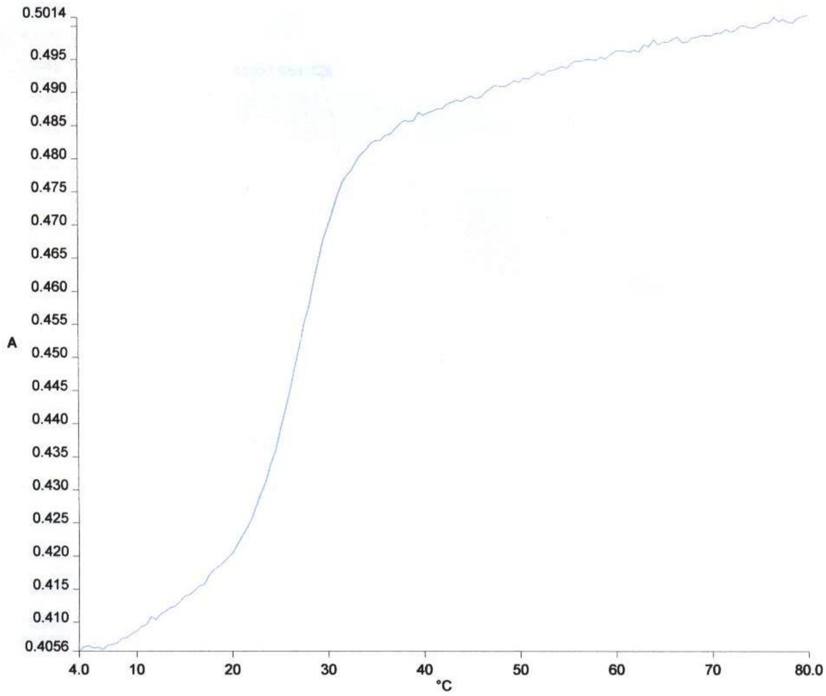

Figure S12. Thermal denaturation curve of partly α-D-ara-modified **ON11**, against partly α-D-ara-modified **ON15** recorded in medium salt buffer at 260 nm. (Table 4. entry 42).

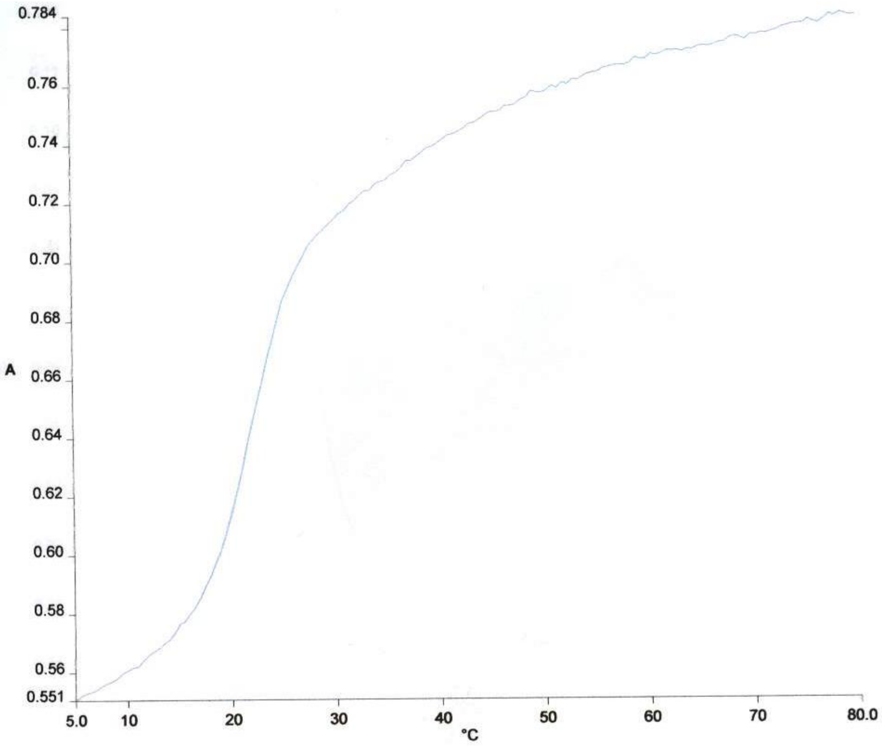

Figure S14. Thermal denaturation curve of fully α-D-ara-modified **ON23**, against fully α-D-ara-modified **ON24** recorded in medium salt buffer at 260 nm. (Table 4. entry 44).

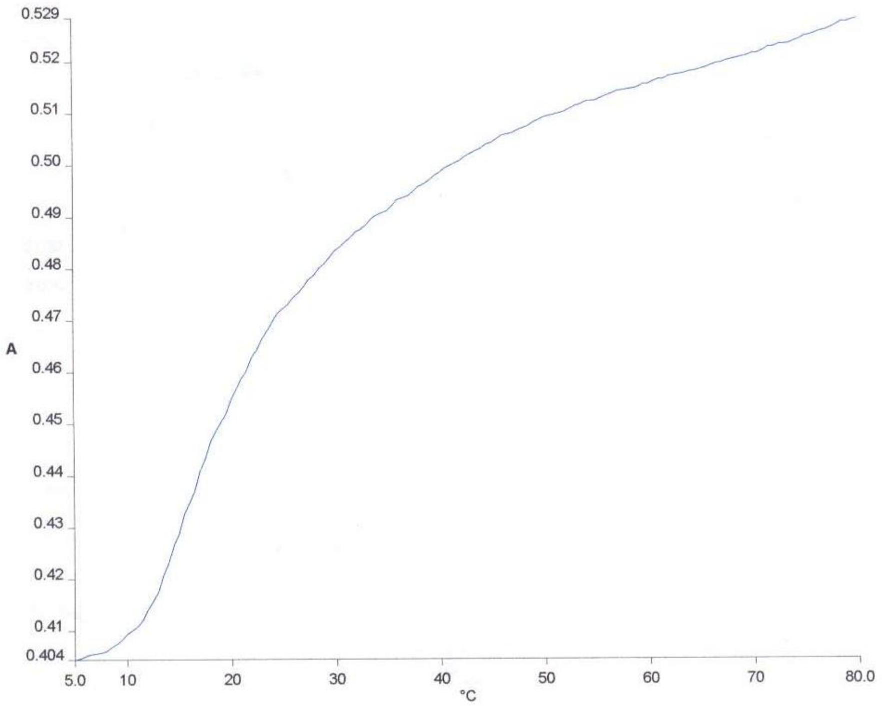

Figure S15. Thermal denaturation curve of fully α-D-ara-modified **ON24**, against DNA recorded in medium salt buffer at 260 nm. (Table 5. entry 53).

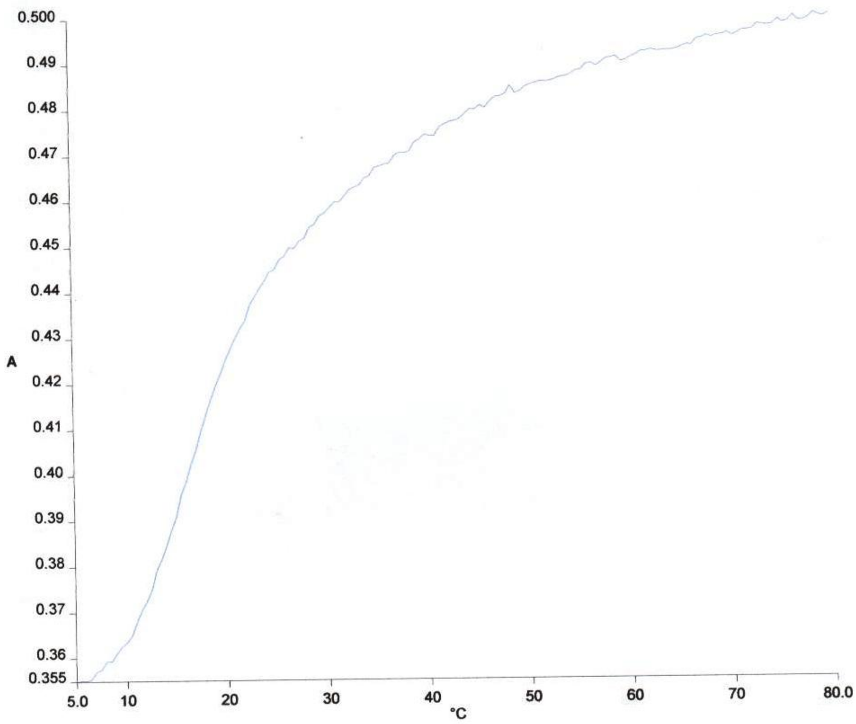

Figure S16. Thermal denaturation curve of fully α-D-ara-modified **ON24**, against RNA recorded in medium salt buffer at 260 nm. (Table 5. entry 54).

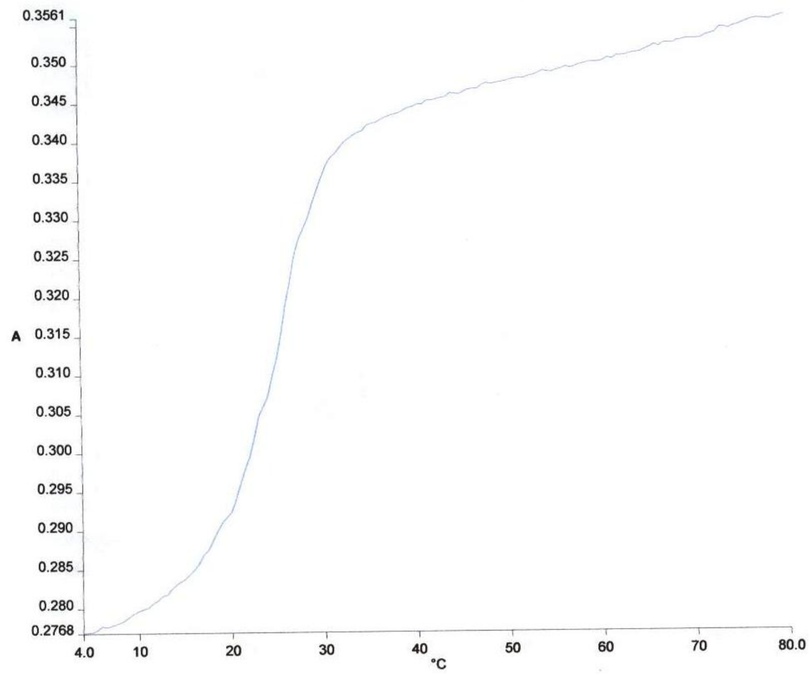

Figure S17. Thermal denaturation curve of partly α-D-ara-modified **ON11**, against partly α-L-ara-modified **ON13** recorded in medium salt buffer at 260 nm. (Table 6. entry 56).

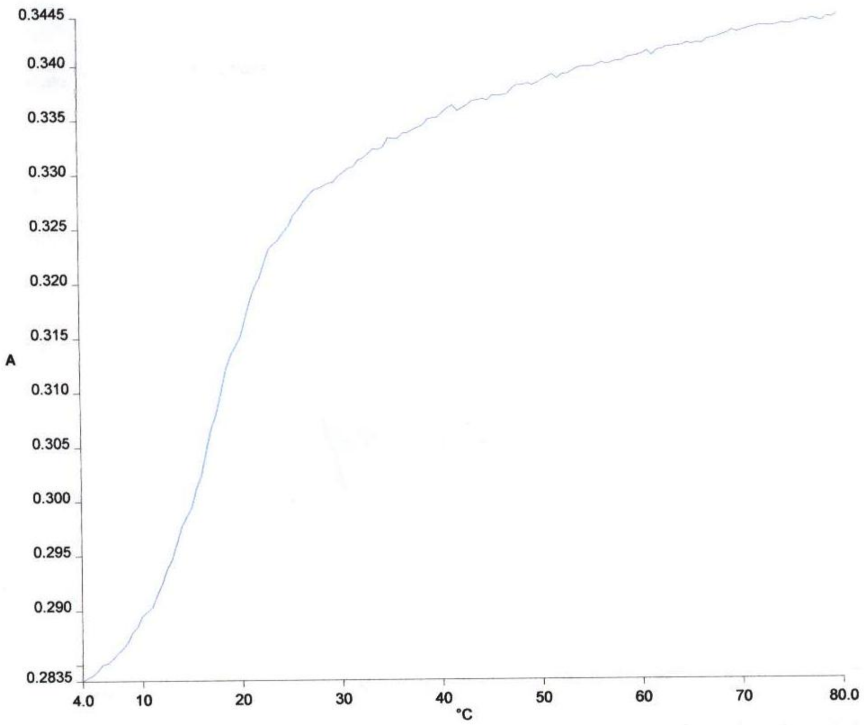

Figure S18. Thermal denaturation curve of partly α-L-ara-modified **ON10**, against partly α-D-ara-modified **ON16** recorded in medium salt buffer at 260 nm. (Table 6. entry 57).

S3. References:

1. C. Genu-Dellac, G. Gosselin, F. Puech, J. Henry, A. Aubertin, G. Obert, A. Kirn and J.-L. Imbach, *Nucleosides Nucleotides*, 1991, **10**, 1345-1376.
2. US Pat., 5177196, 1992.