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APPENDICES

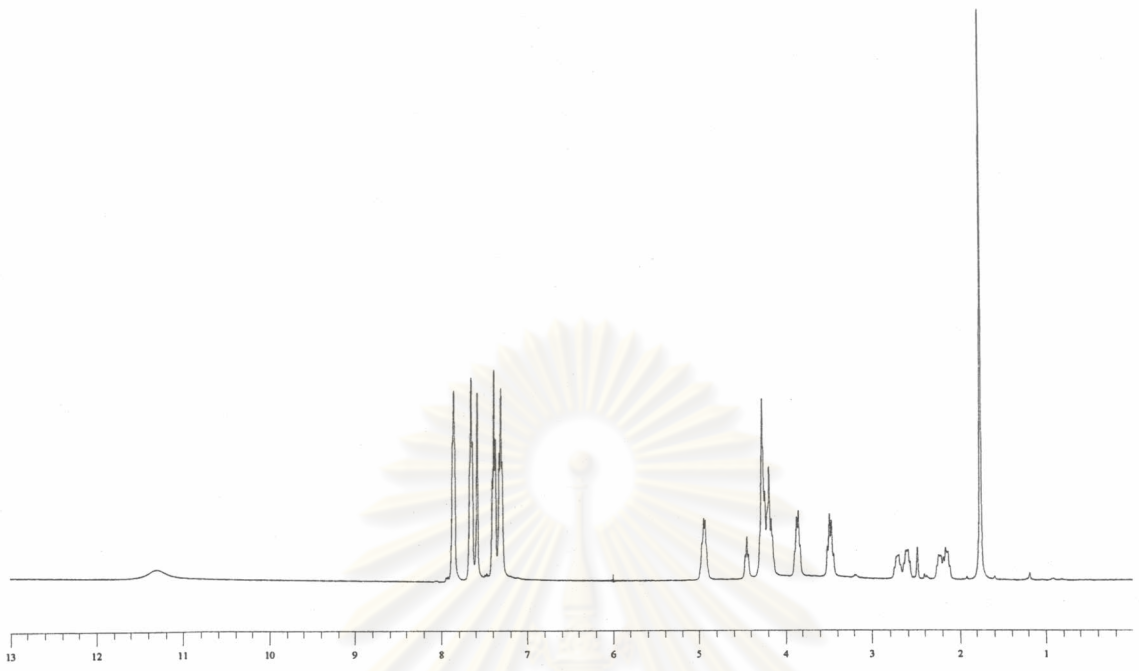

Figure A.1: ^{1}H spectrum of (*N*-fluoren-9-ylmethoxycarbonyl)-*cis*-4-(thymin-1-yl)-D-proline (**25**)

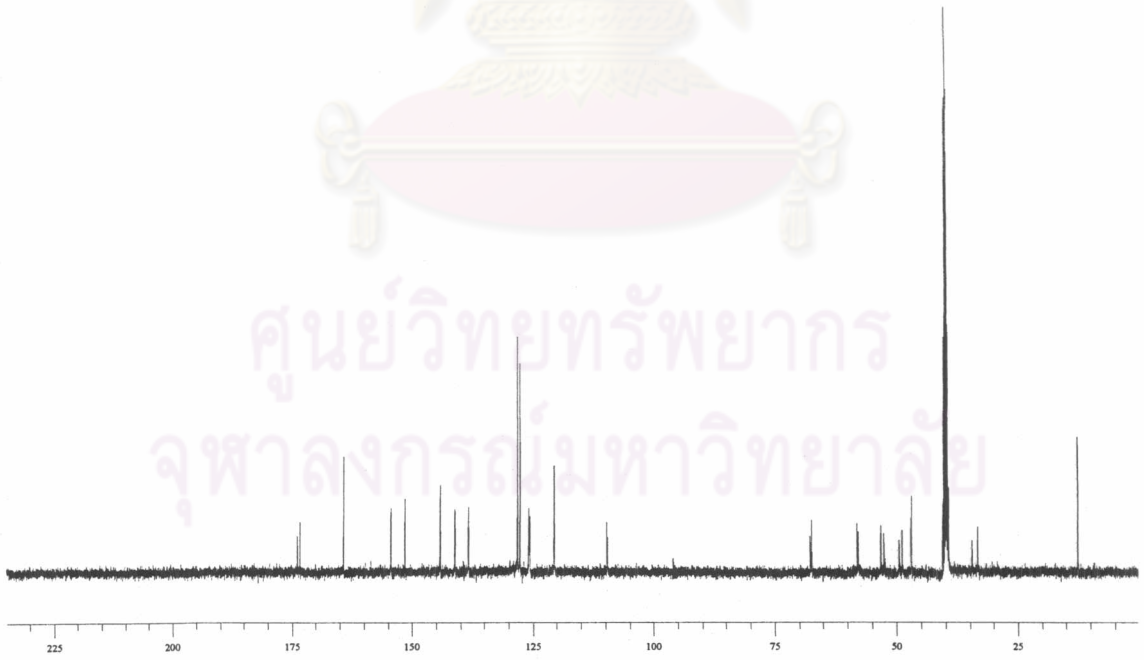

Figure A.2: ^{13}C NMR spectrum of (*N*-fluoren-9-ylmethoxycarbonyl)-*cis*-4-(thymin-1-yl)-D-proline (**25**)

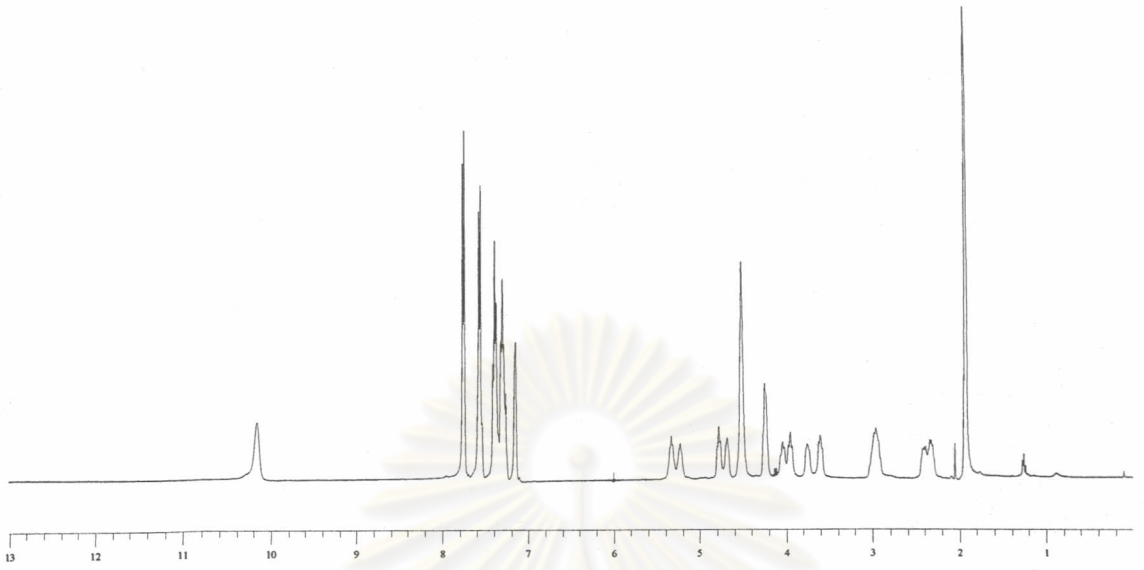

Figure A.3: ^{1}H NMR spectrum of (*N*-fluoren-9-ylmethoxycarbonyl)-*cis*-4-(thymin-1-yl)-D-proline pentafluorophenyl ester (**26**)

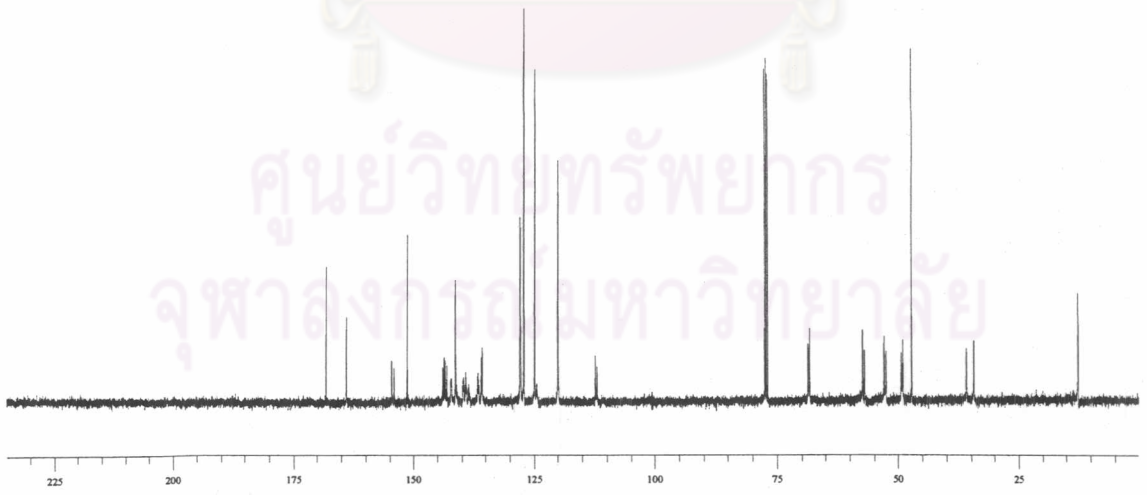

Figure A.4: ^{13}C NMR spectrum of (*N*-fluoren-9-ylmethoxycarbonyl)-*cis*-4-(thymin-1-yl)-D-proline pentafluorophenyl ester (**26**)

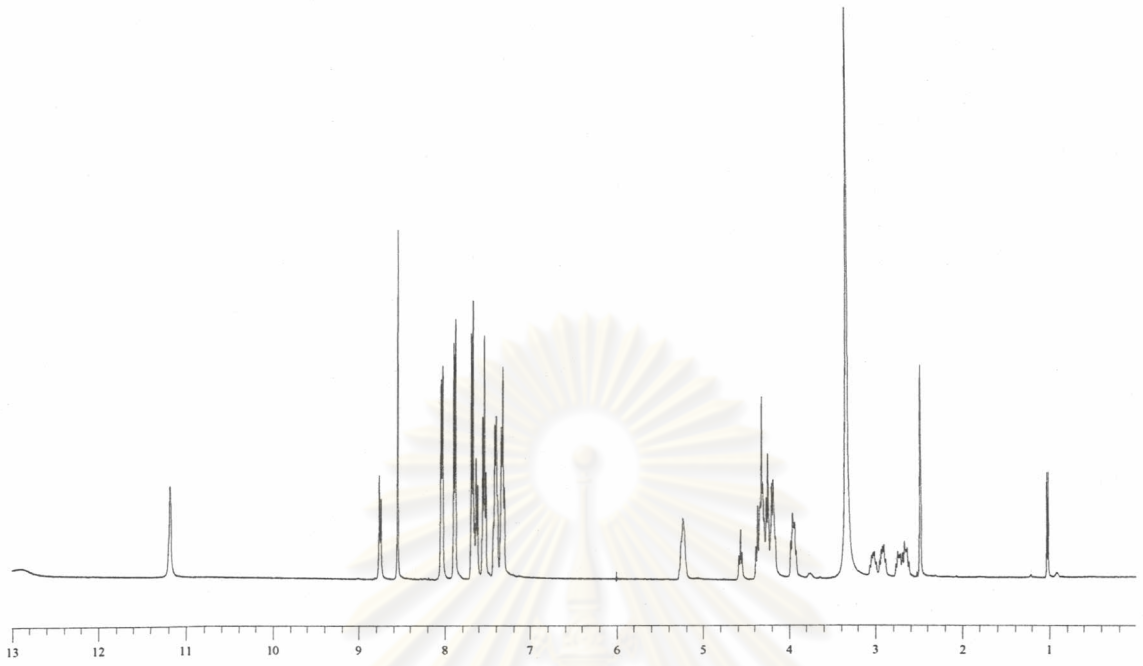

Figure A.5: ^{1}H NMR spectrum of (*N*-fuoren-9-ylmethoxycarbonyl)-*cis*-4-(N^4-benzoyladenin-9-yl)-D-proline (**27**)

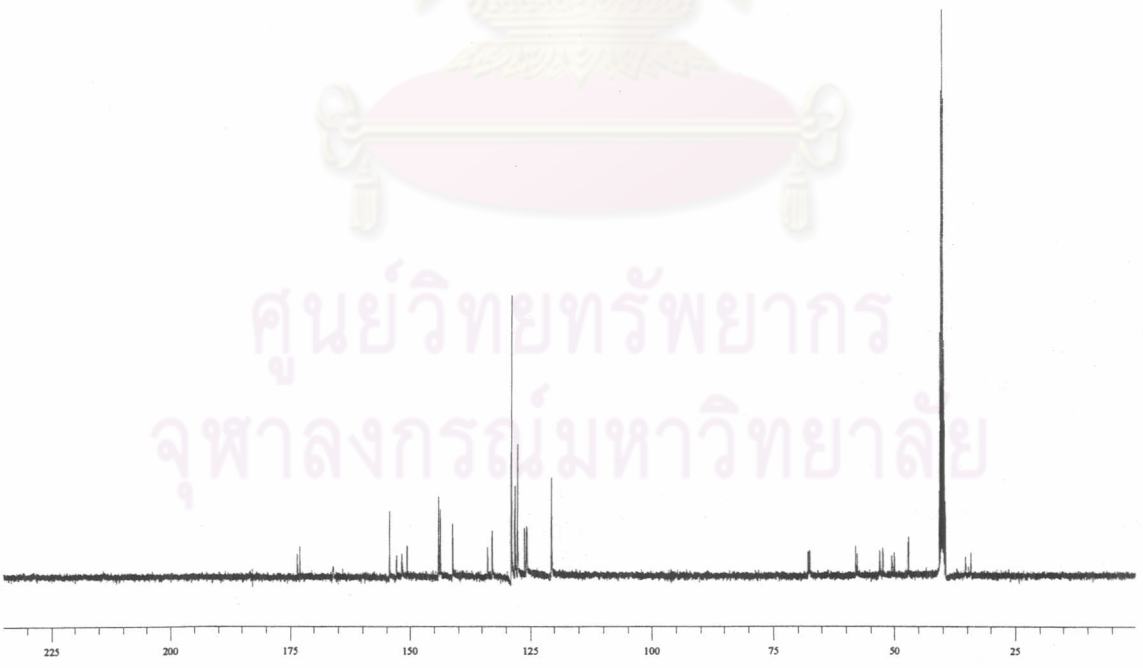

Figure A.6: ^{13}C NMR spectrum of (*N*-fuoren-9-ylmethoxycarbonyl)-*cis*-4-(N^4-benzoyladenin-9-yl)-D-proline (**27**)

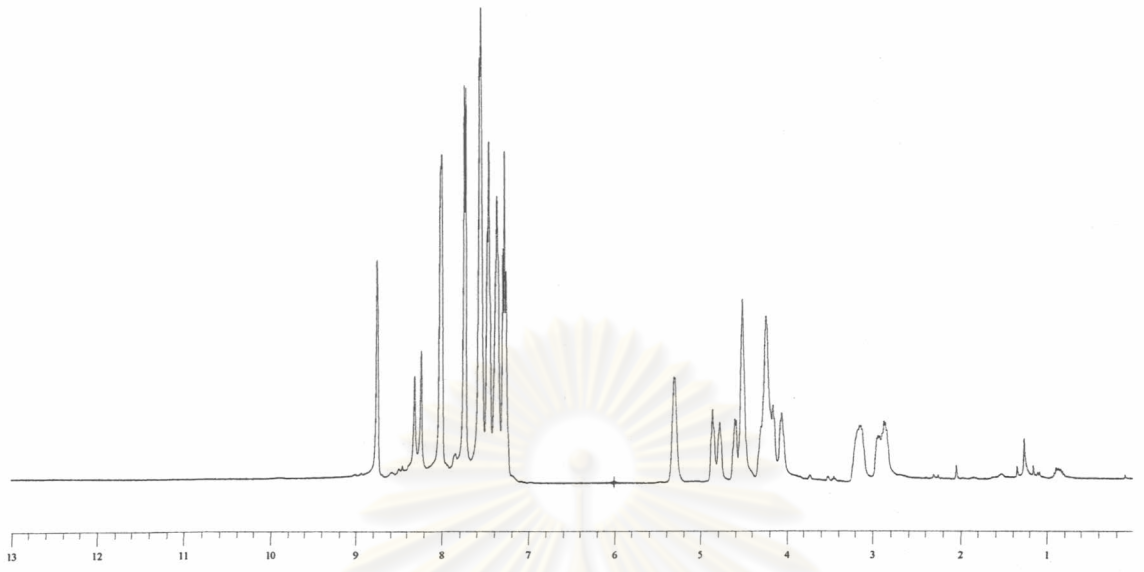

Figure A.7: ^{1}H NMR spectrum of (*N*-fluoren-9-ylmethoxycarbonyl)-*cis*-4-(N^4-benzoyladenin-9-yl)-D-proline pentafluorophenyl ester (**28**)

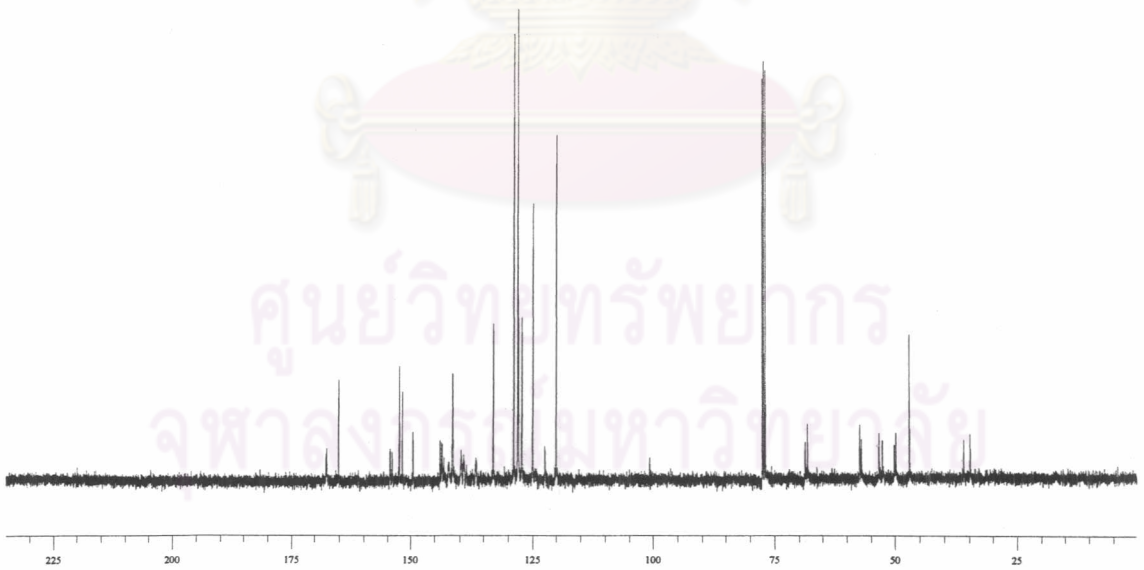

Figure A.8: ^{13}C NMR spectrum of (*N*-fluoren-9-ylmethoxycarbonyl)-*cis*-4-(N^4-benzoyladenin-9-yl)-D-proline pentafluorophenyl ester (**28**)

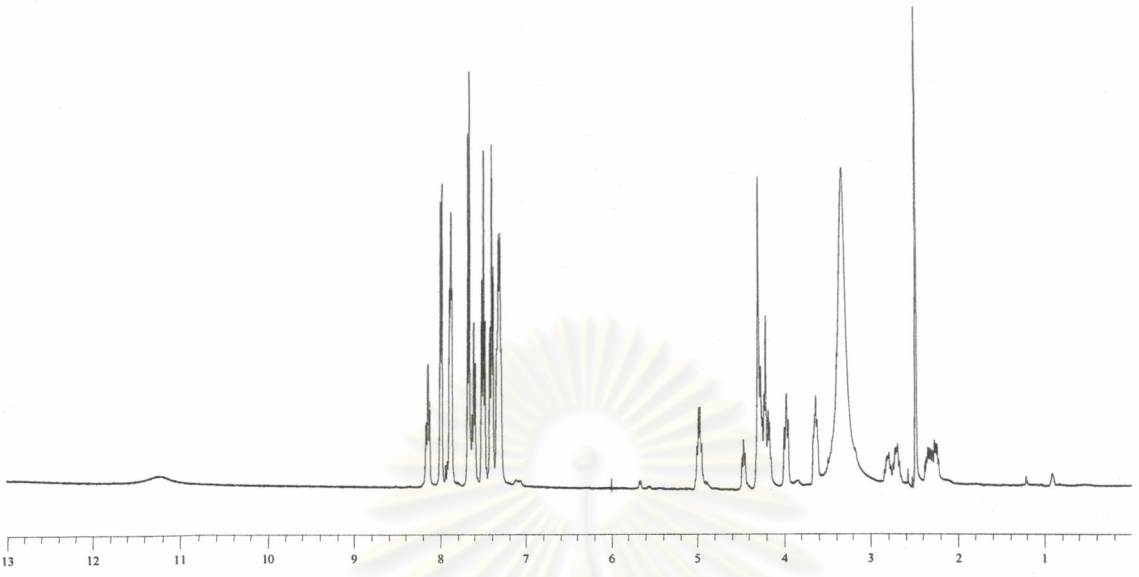

Figure A.9: ^{1}H NMR spectrum of (*N*-fluoren-9-ylmethoxycarbonyl)-*cis*-4-(N^4-benzoylcytosin-1-yl)-D-proline (**29**)

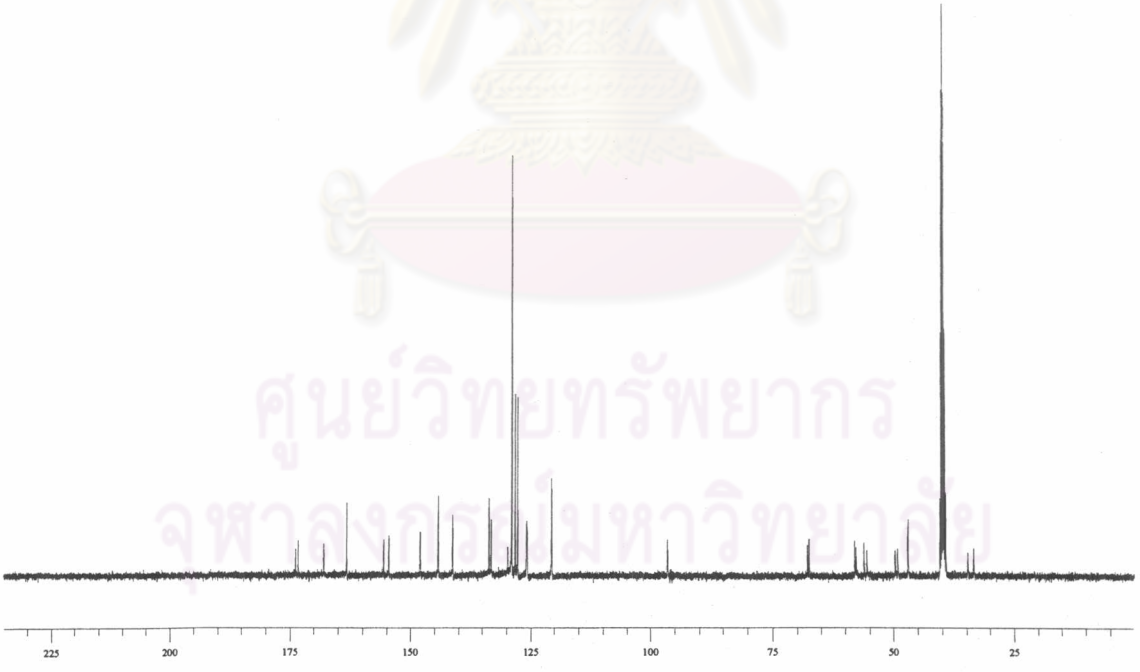

Figure A.10: ^{13}C NMR spectrum of (*N*-fluoren-9-ylmethoxycarbonyl)-*cis*-4-(N^4-benzoylcytosin-1-yl)-D-proline (**29**)

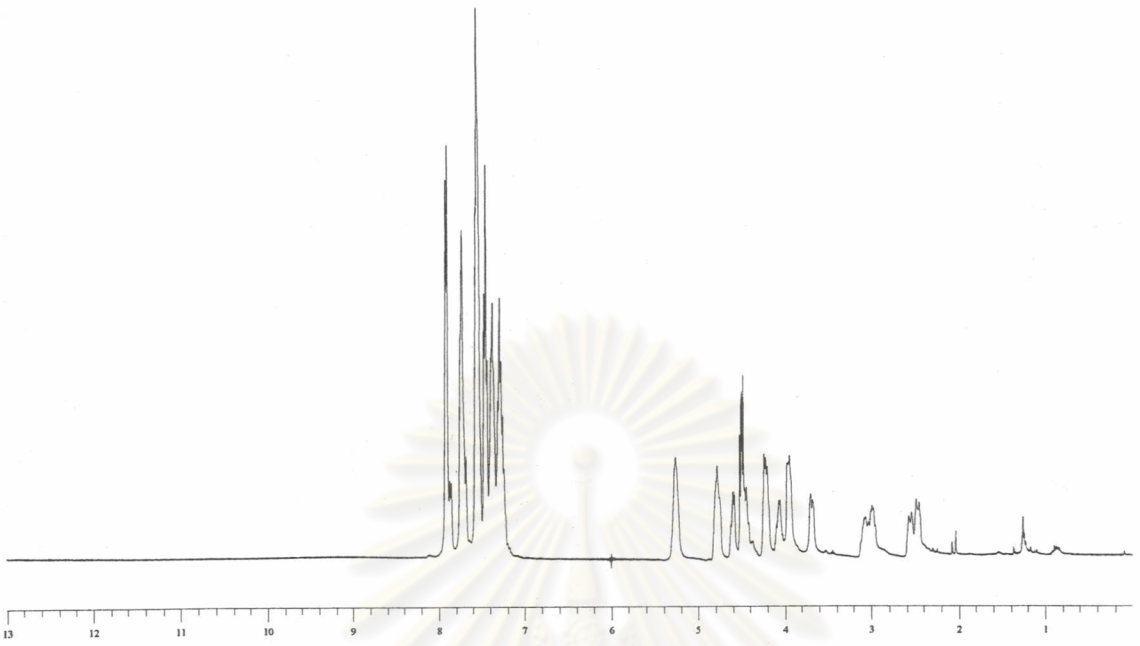

Figure A.11: ^{1}H NMR spectrum of (*N*-fluoren-9-ylmethoxycarbonyl)-*cis*-4-(N^4-benzoylcytosin-1-yl)-D-proline pentafluorophenyl ester (**30**)

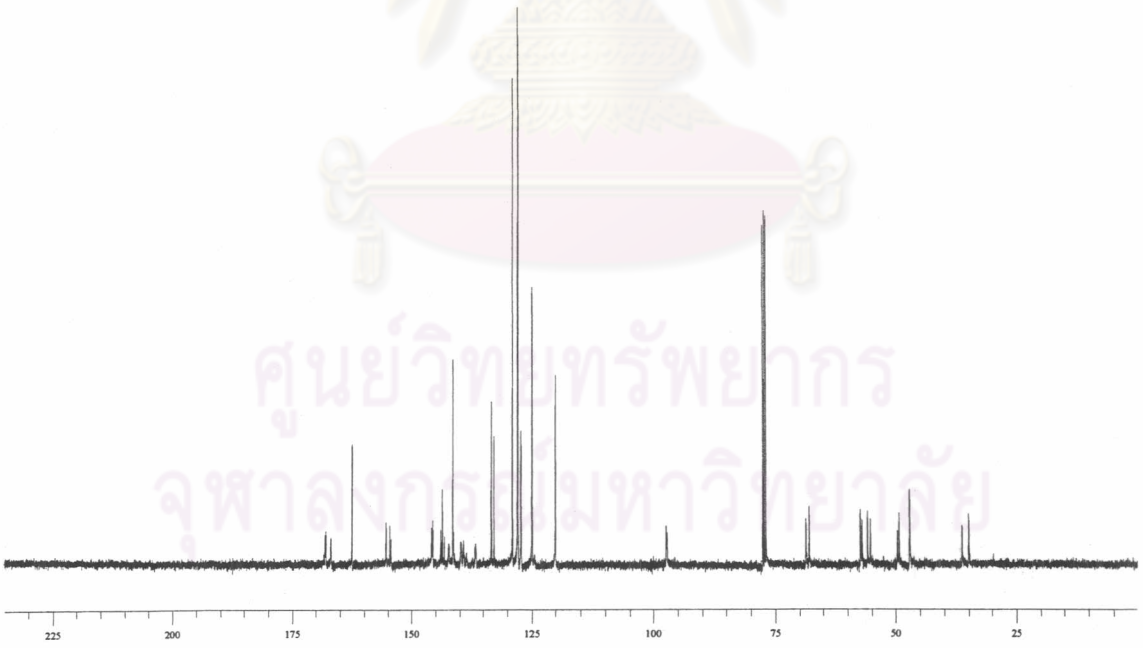

Figure A.12: ^{13}C NMR spectrum of (*N*-fluoren-9-ylmethoxycarbonyl)-*cis*-4-(N^4-benzoylcytosin-1-yl)-D-proline pentafluorophenyl ester (**30**)

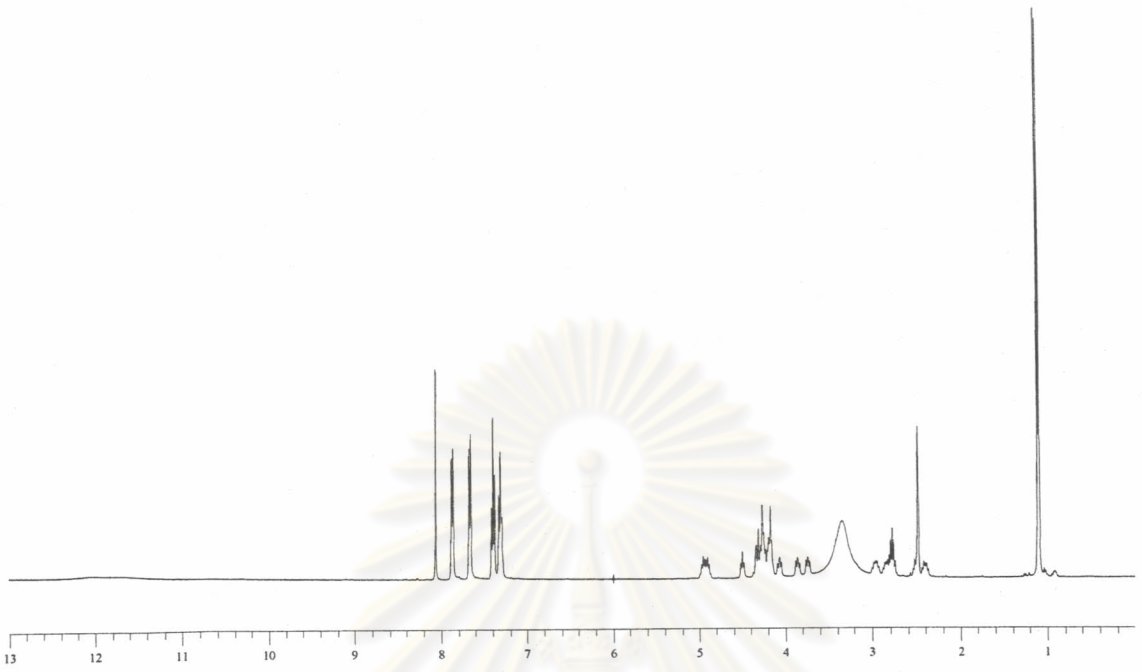

Figure A.13: ^{1}H NMR spectrum of (*N*-fluoren-9-ylmethoxycarbonyl)-*cis*-4-(N^2-isobutyrylguanin-9-yl)-D-proline (**31**)

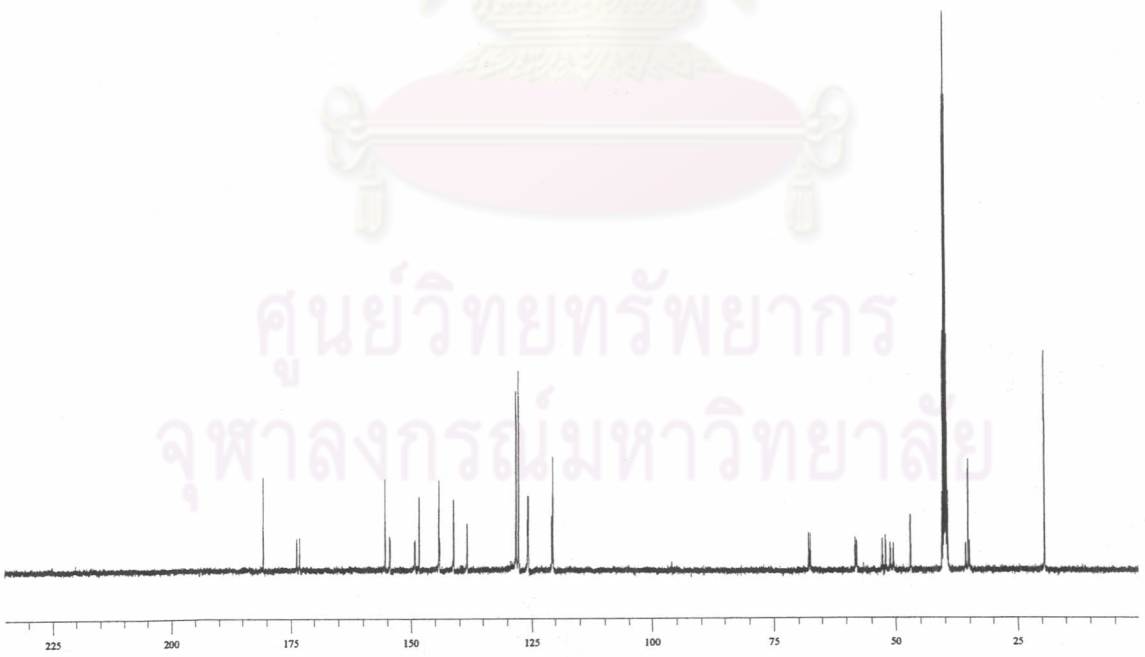

Figure A.14: ^{13}C NMR spectrum of (*N*-fluoren-9-ylmethoxycarbonyl)-*cis*-4-(N^2-isobutyrylguanin-9-yl)-D-proline (**31**)

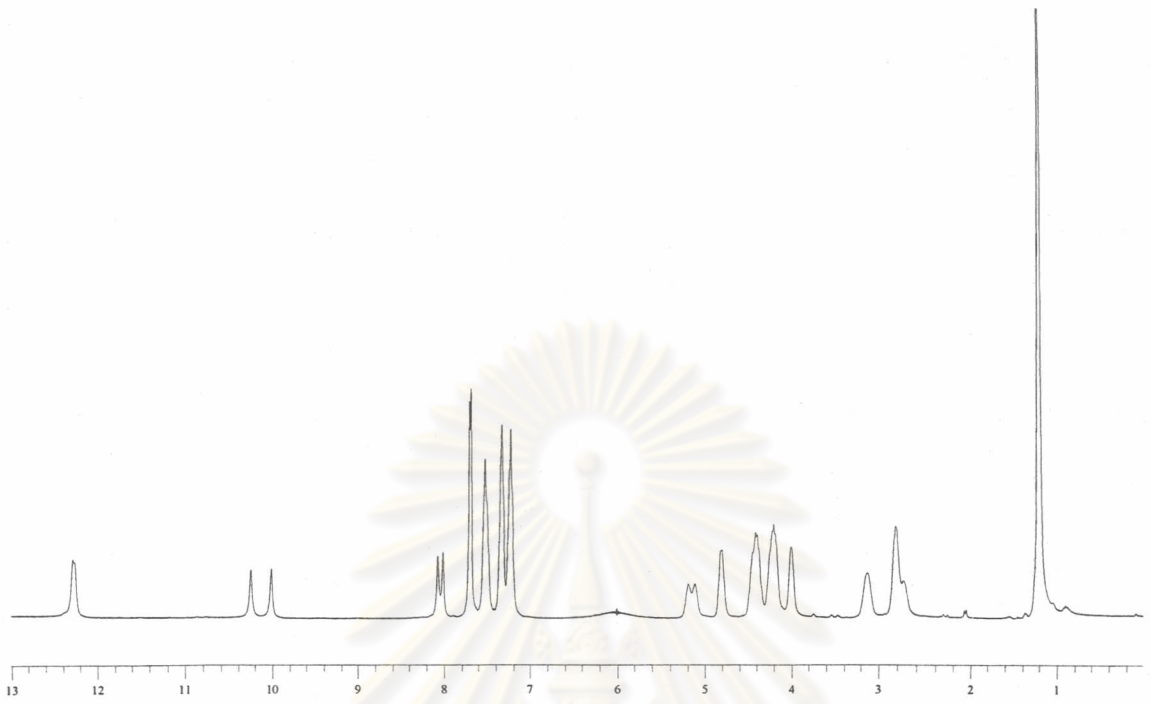

Figure A.15: ^{1}H NMR spectrum of (*N*-fluoren-9-ylmethoxycarbonylamino)-*cis*-4-(N^2-isobutyrylguanin-9-yl)-D-proline pentafluorophenyl ester (**32**)

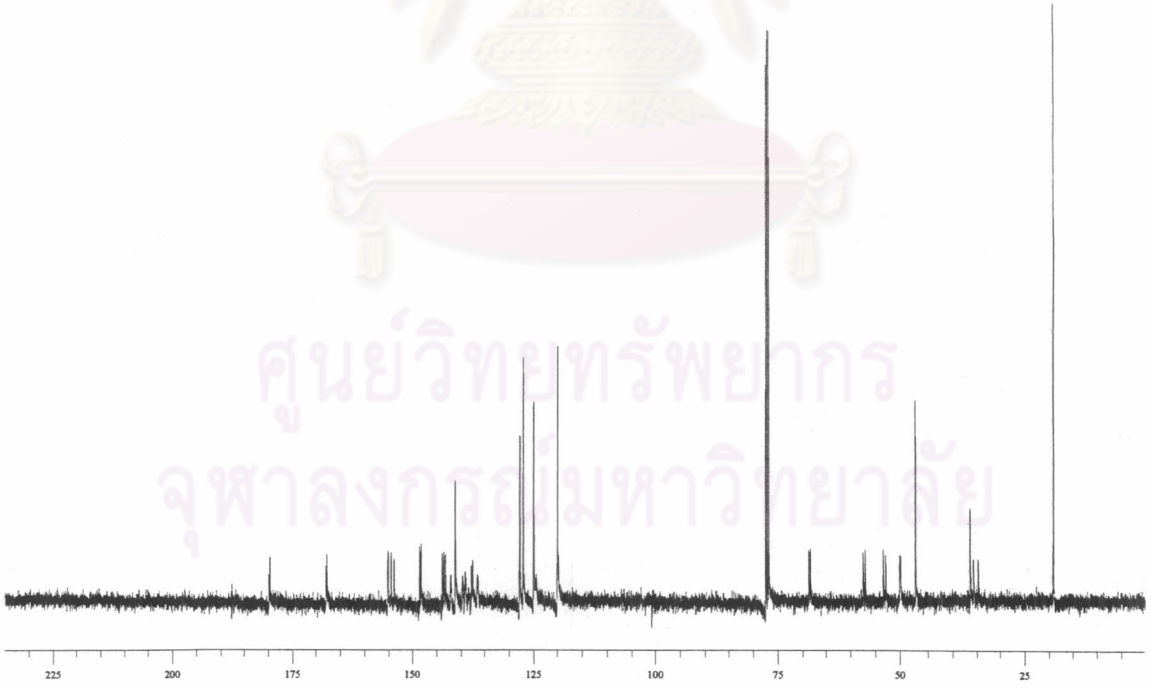

Figure A.16: ^{13}C NMR spectrum of (*N*-fluoren-9-ylmethoxycarbonylamino)-*cis*-4-(N^2-isobutyrylguanin-9-yl)-D-proline pentafluorophenyl ester (**32**)

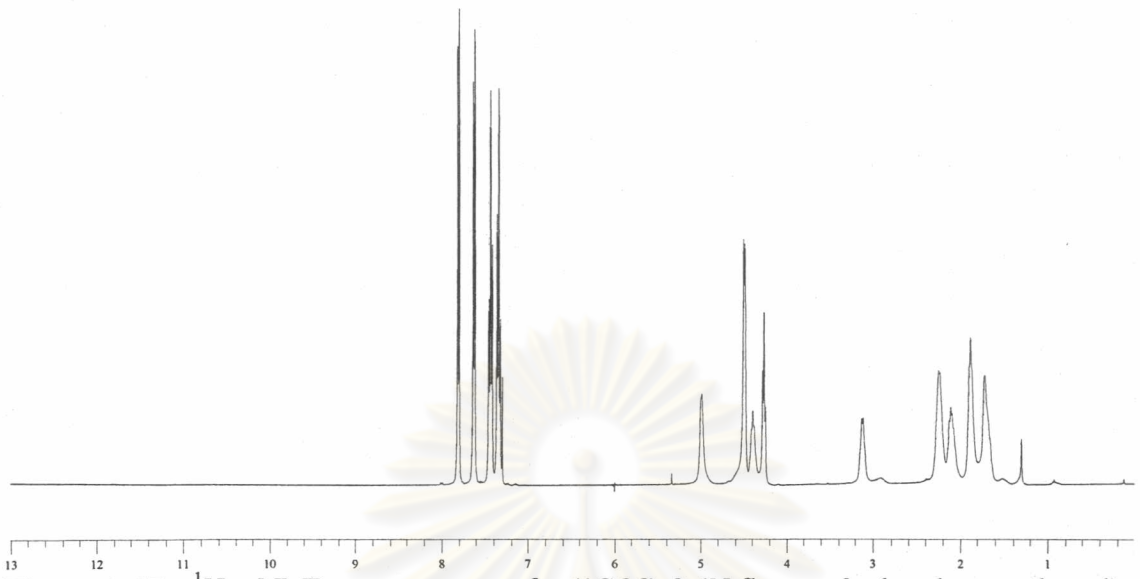

Figure A.17: ^{1}H NMR spectrum of (1*S*,2*S*)-2-(*N*-fluoren-9-ylmethoxycarbonyl)-aminocyclopentane pentafluorophenyl ester (**38**)

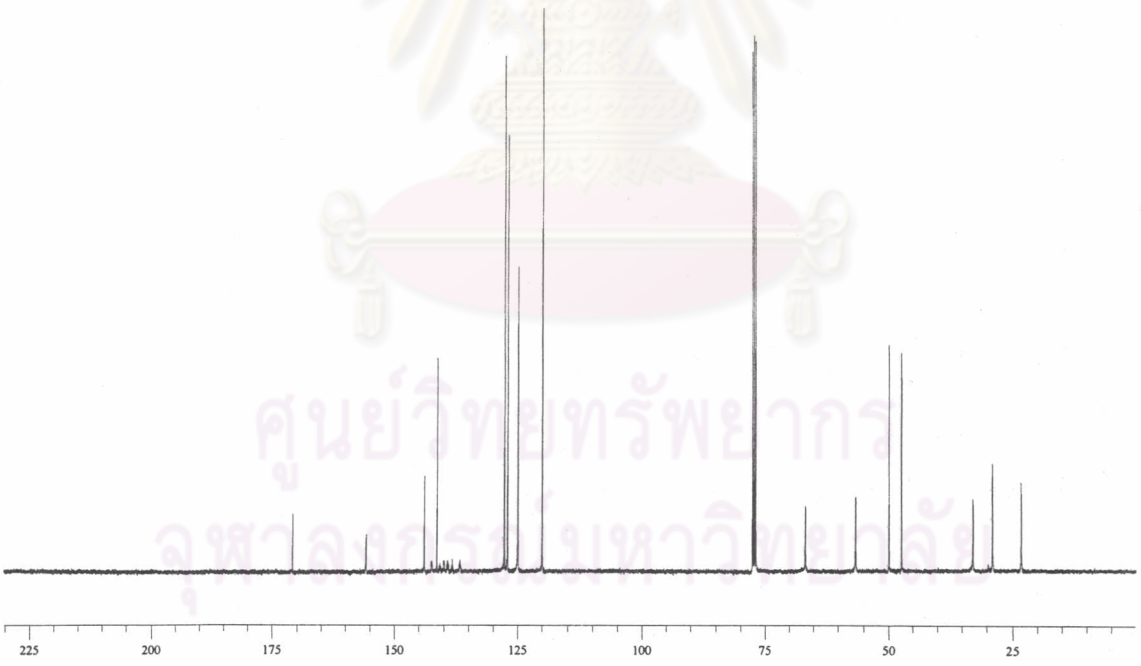

Figure A.18: ^{13}C NMR spectrum of (1*S*,2*S*)-2-(*N*-fluoren-9-ylmethoxycarbonyl)-aminocyclopentane pentafluorophenyl ester (**38**)

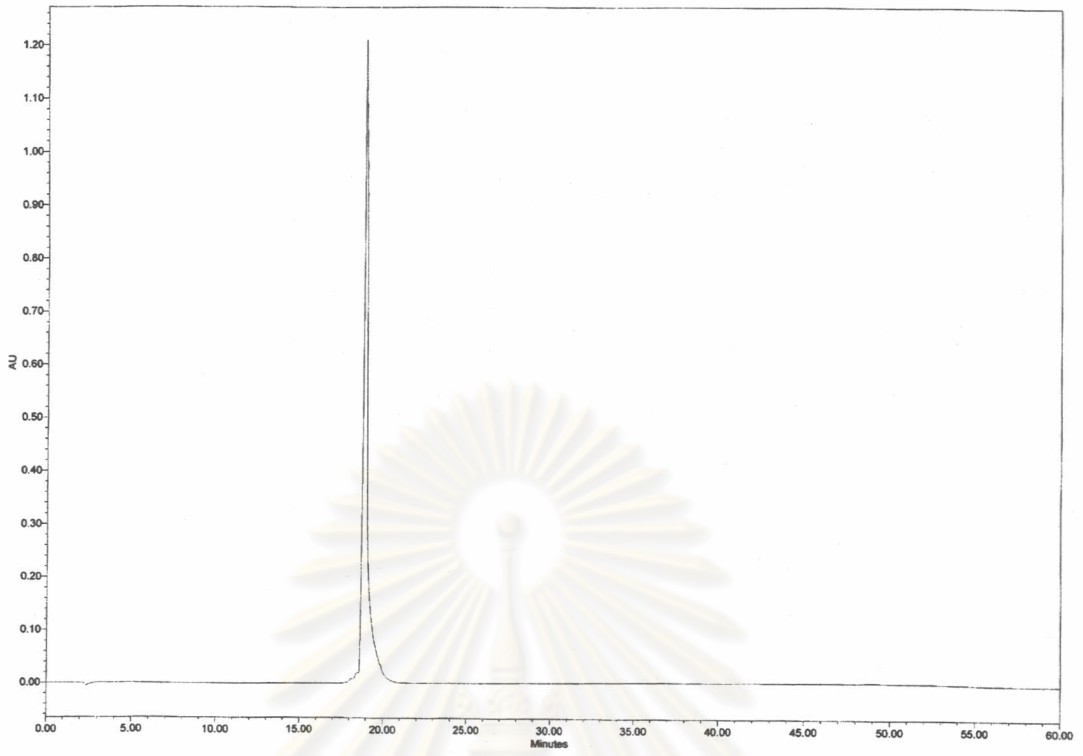

Figure A.19 : HPLC chromatogram of Ac-T_5-LysNH_2 (**12c**)

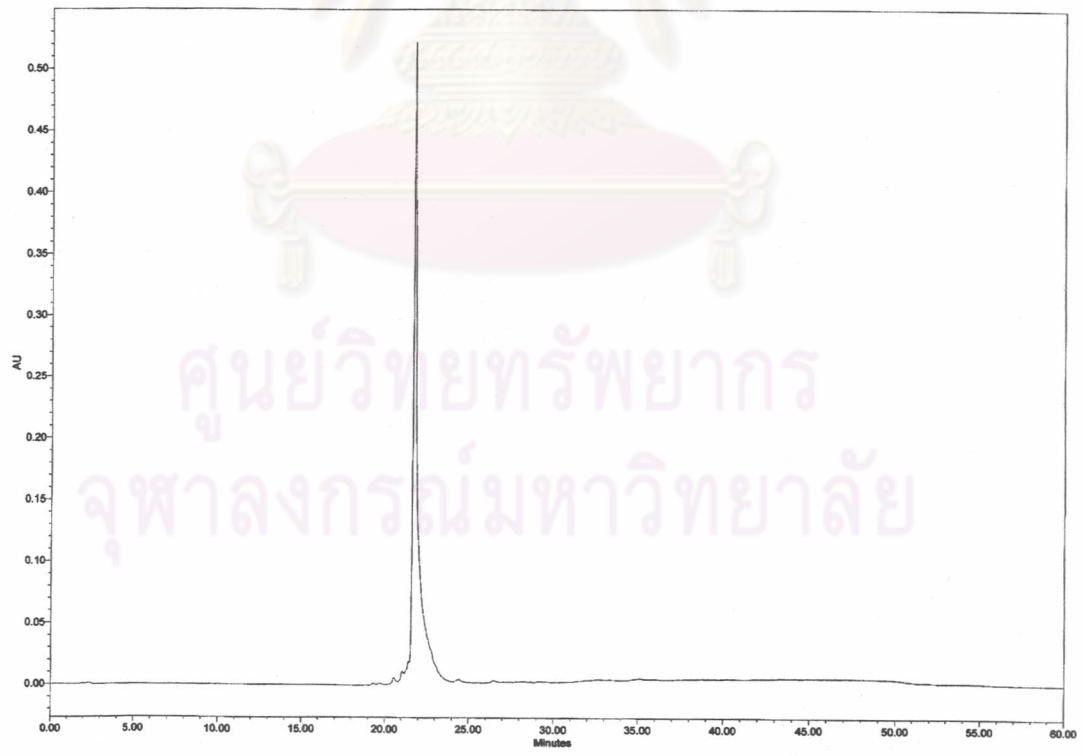

Figure A.20 : HPLC chromatogram of Ac-A_5-LysNH_2 (**12d**)

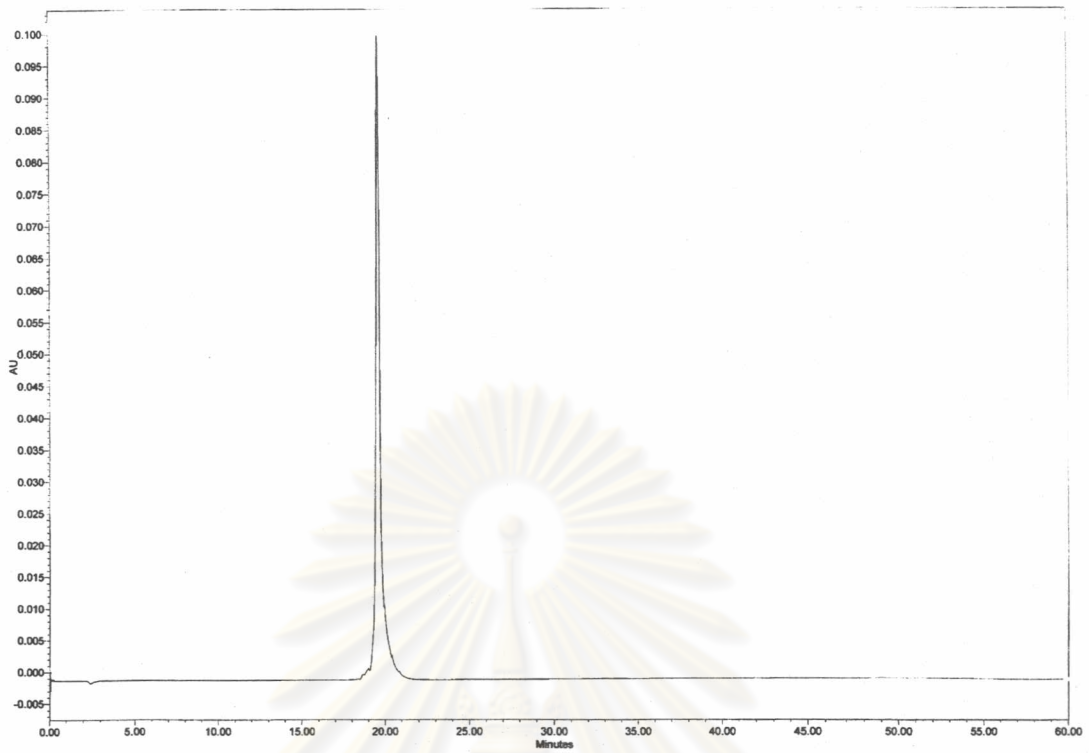

Figure A.21 : HPLC chromatogram of Ac-T_7-LysNH_2 (**12e**)

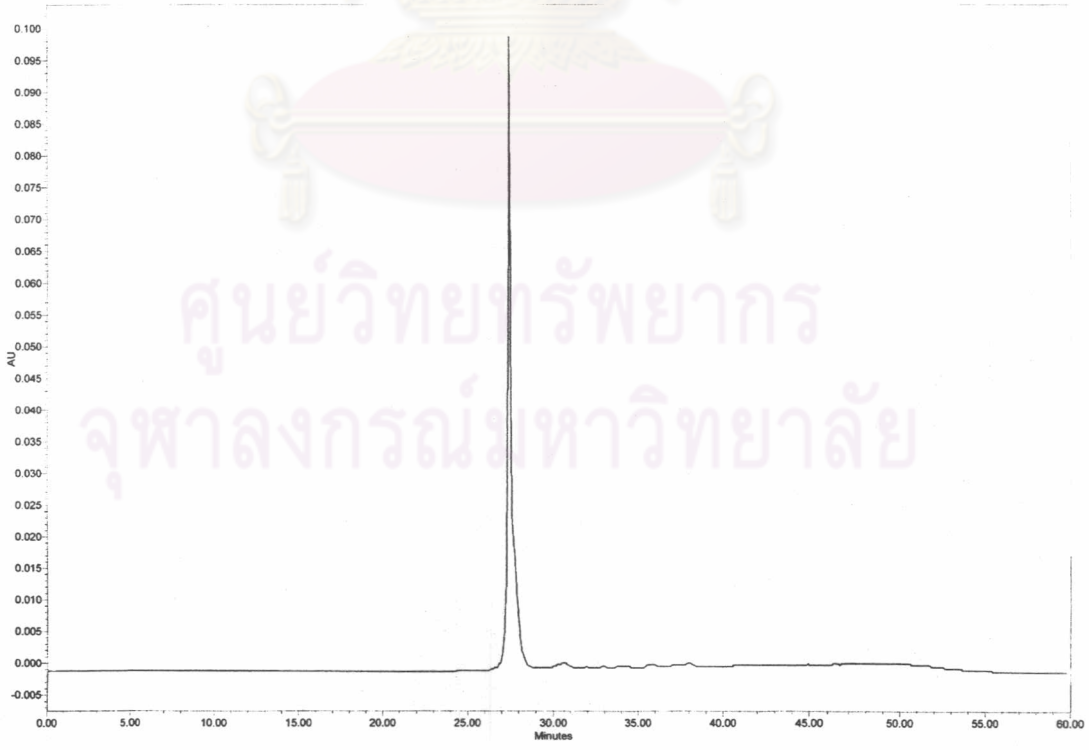

Figure A.22 : HPLC chromatogram of Ac-T_9-LysNH_2 (**12f**)

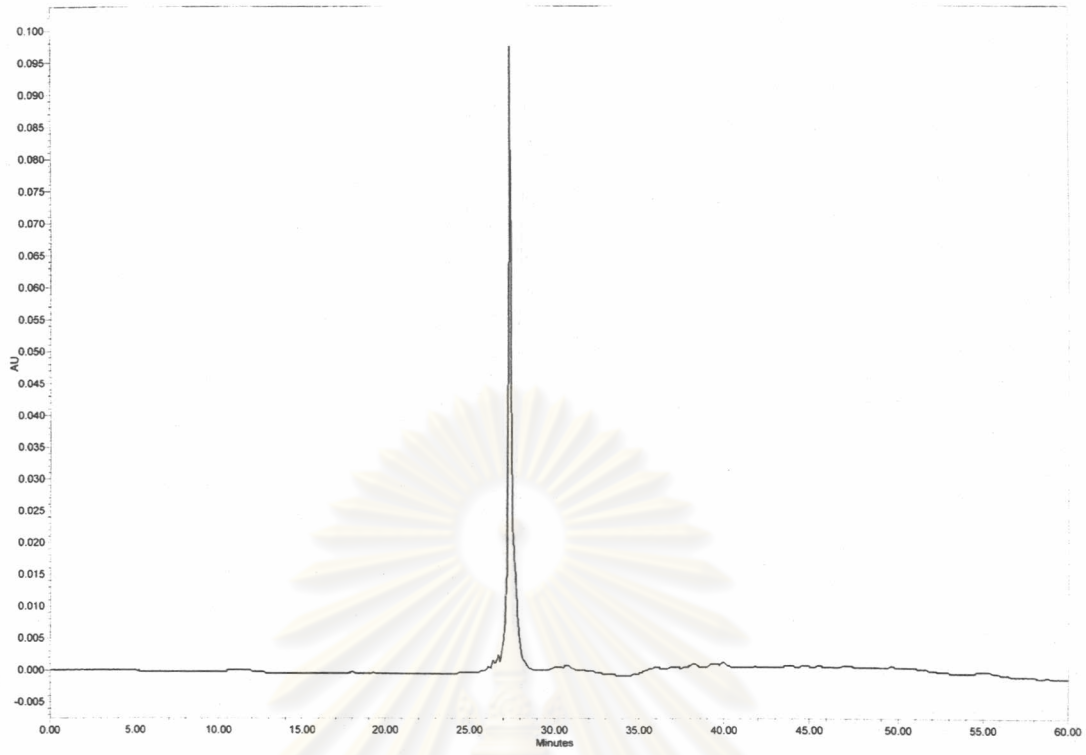

Figure A.23 : HPLC chromatogram of Ac-T_4AT_4-LysNH_2 (**12g**)

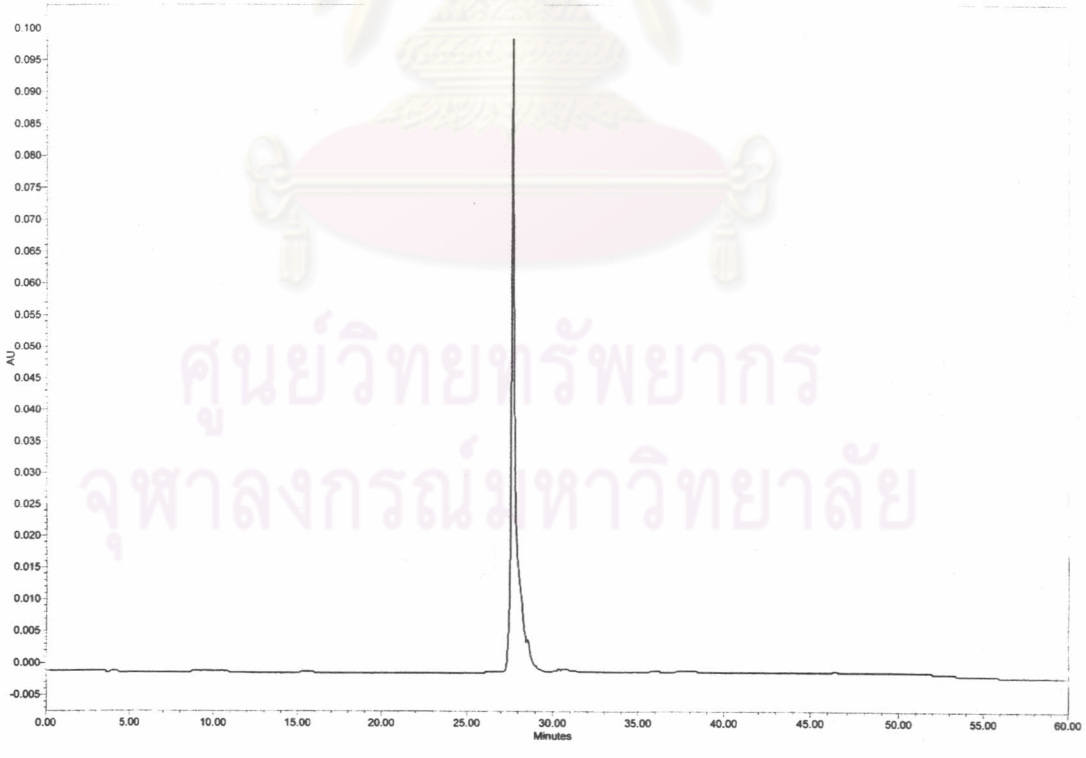

Figure A.24 : HPLC chromatogram of Ac-T_4GT_4-LysNH_2 (**12h**)

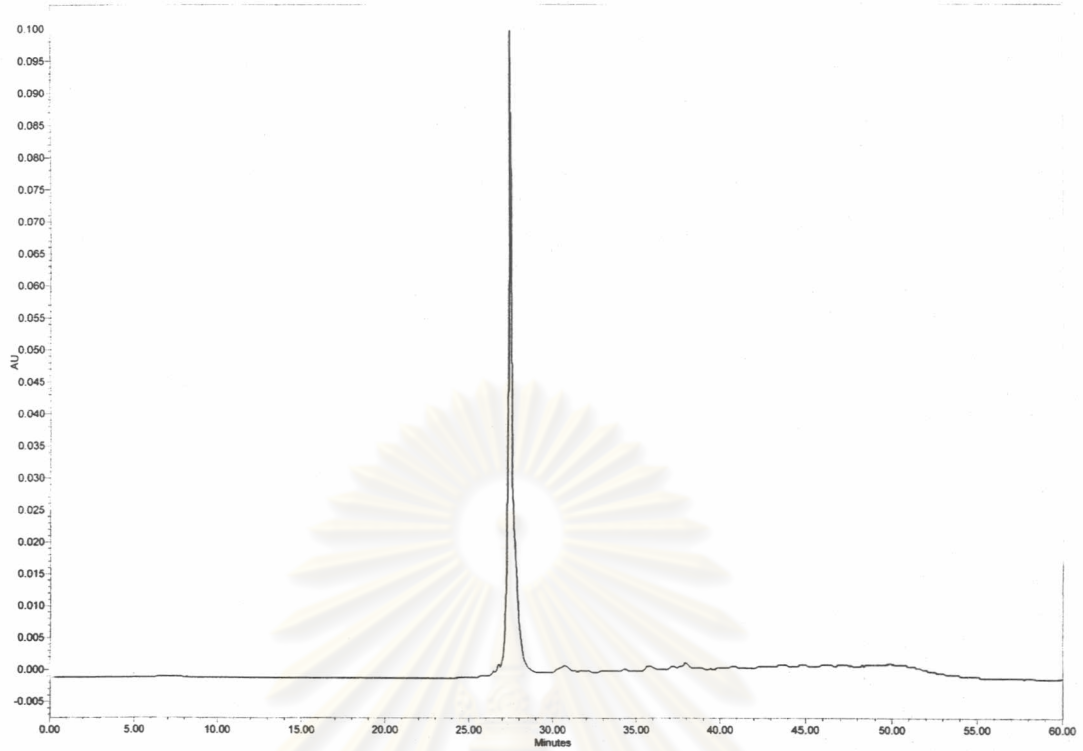

Figure A.25 : HPLC chromatogram of Ac-T_4CT_4-$LysNH_2$ (**12i**)

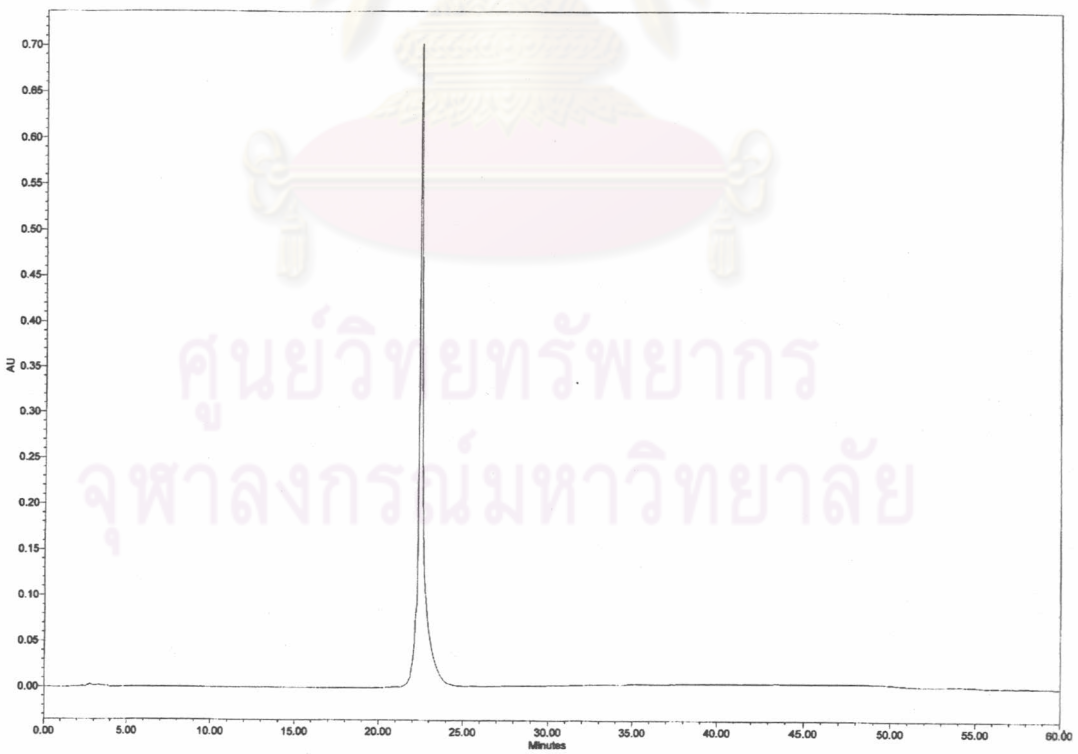

Figure A.26 : HPLC chromatogram of Ac-A_4TA_4-$LysNH_2$ (**12j**)

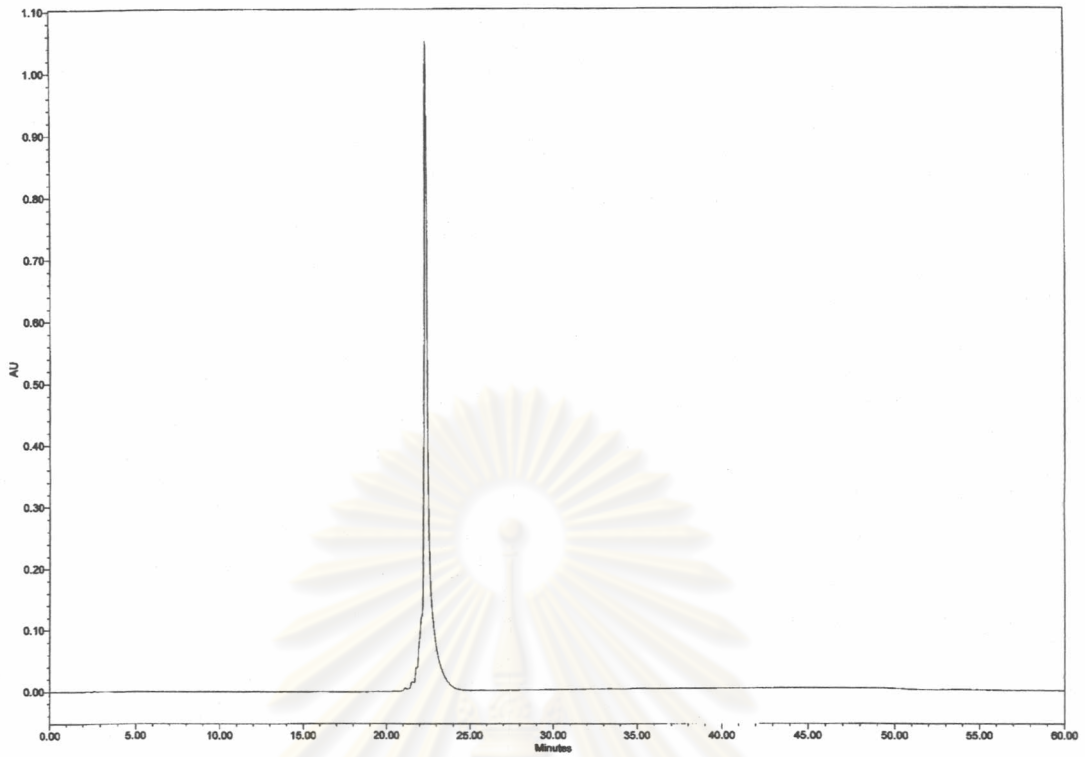

Figure A.27 : HPLC chromatogram of Ac-A_9-LysNH_2 (**12k**)

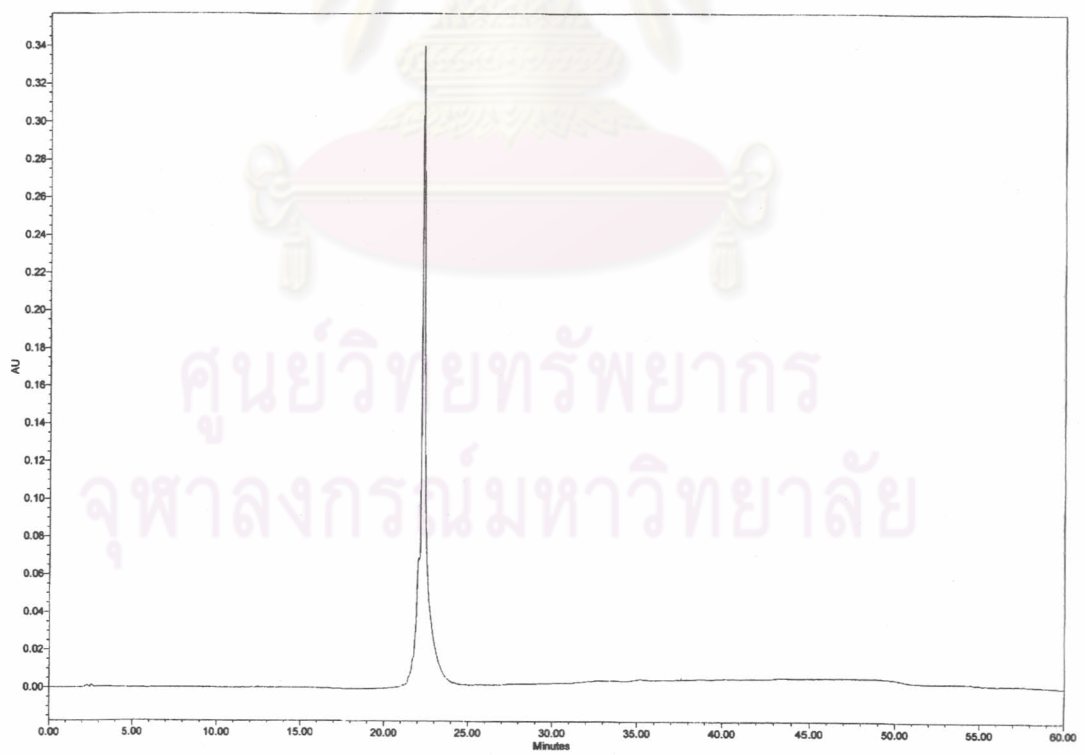

Figure A.28 : HPLC chromatogram of Ac-A_4GA_4-LysNH_2 (**12l**)

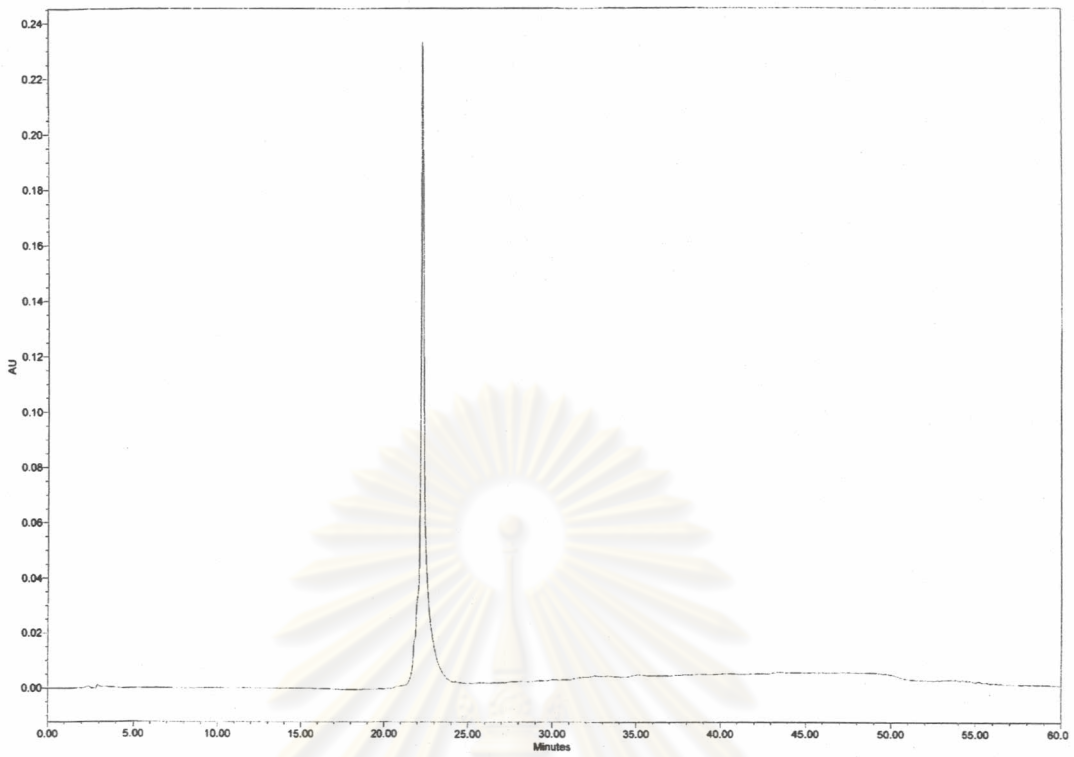

Figure A.29 : HPLC chromatogram of Ac-A_4CA_4-LysNH_2 (**12m**)

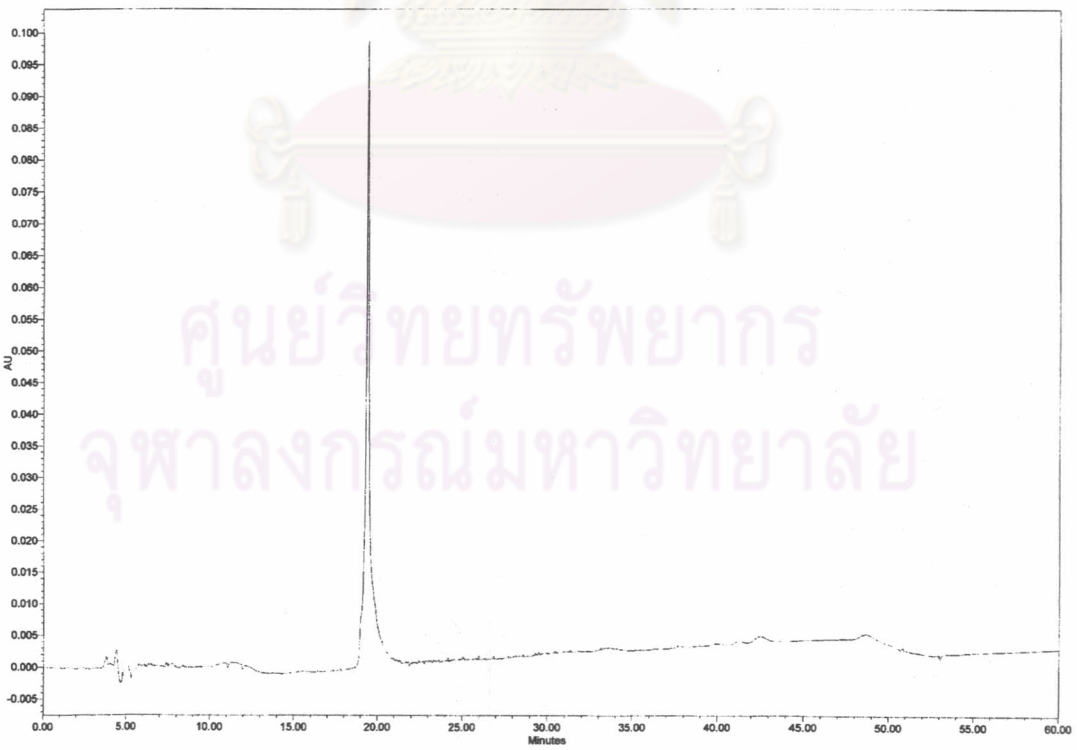

Figure A.30 : HPLC chromatogram of Ac-TCACTACTA-LysNH_2 (**12n**)

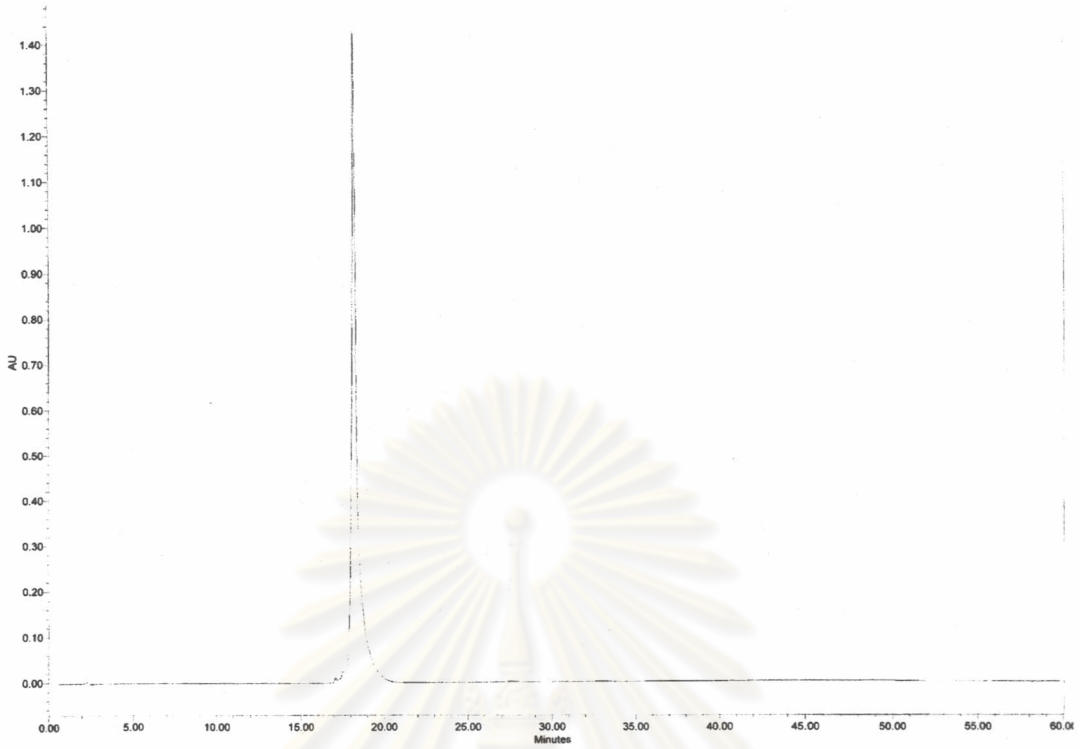

Figure A.31 : HPLC chromatogram of Ac-TCACAACTA-LysNH_2 (**12o**)

Figure A.32 : HPLC chromatogram of Ac-TCACGACTA-LysNH_2 (**12p**)

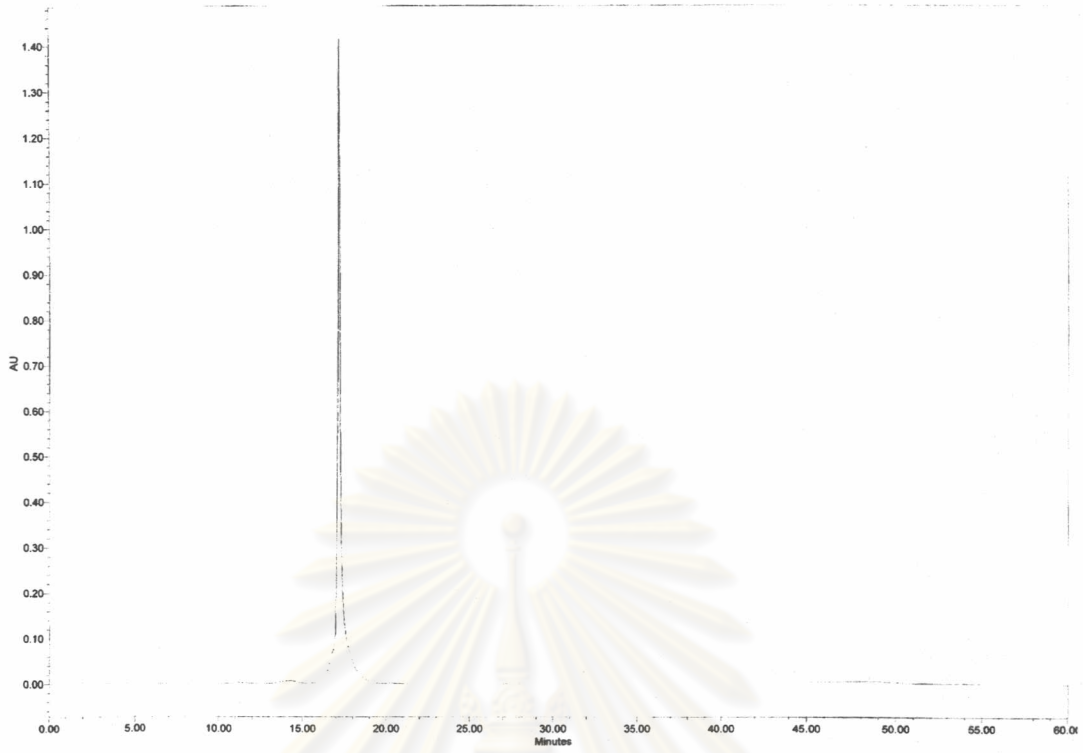

Figure A.33 : HPLC chromatogram of Ac-TCACCACTA-LysNH_2 (**12q**)

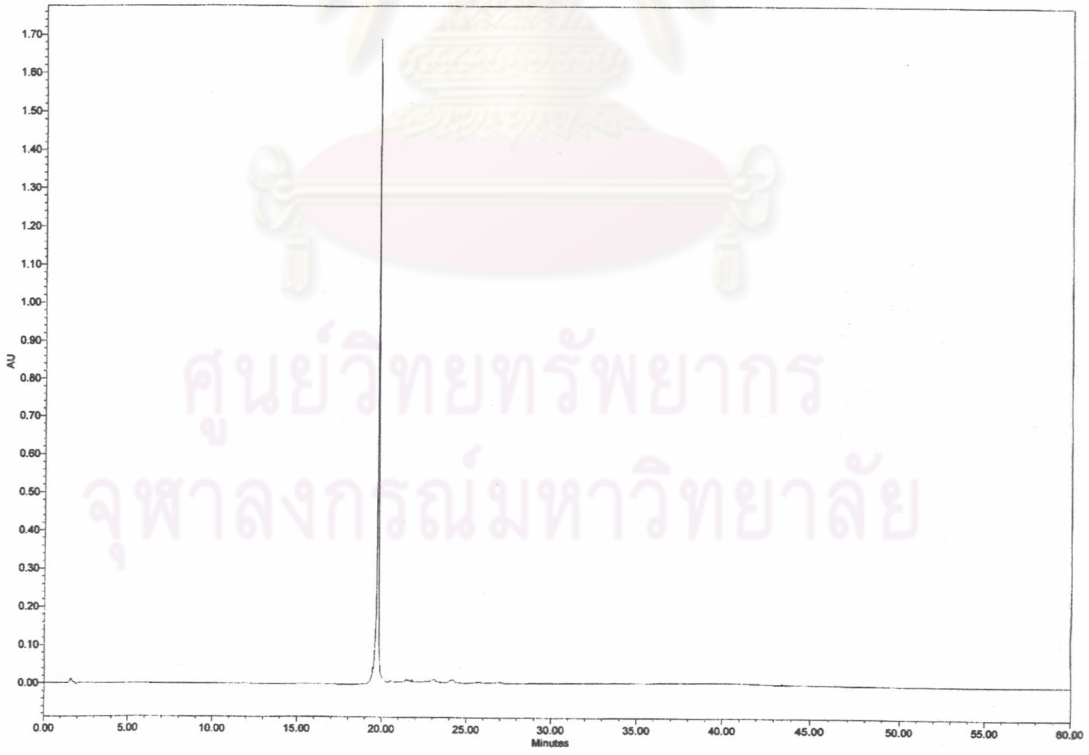

Figure A.34 : HPLC chromatogram of Ac-GTAGATCACT-LysNH_2 (**12r**)

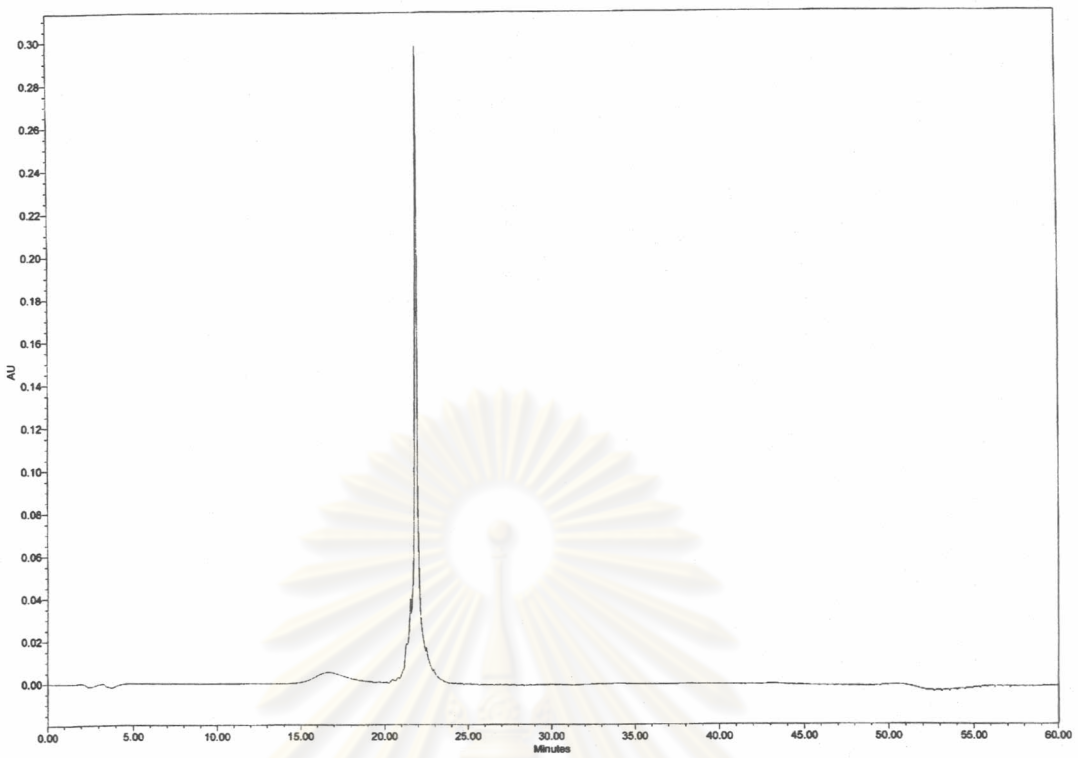

Figure A.35 : HPLC chromatogram of Ac-AGTGATCTAC-LysNH_2 (**12s**)

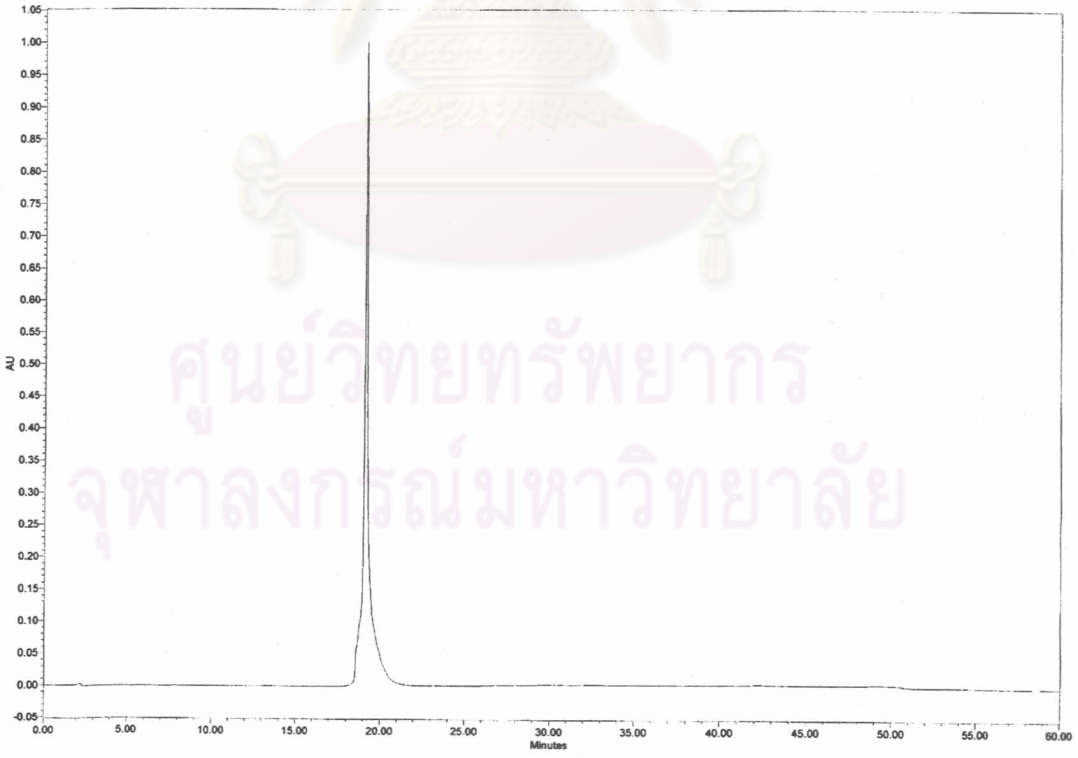

Figure A.36 : HPLC chromatogram of Ac-CATCTAGTGA-LysNH_2 (**12t**)

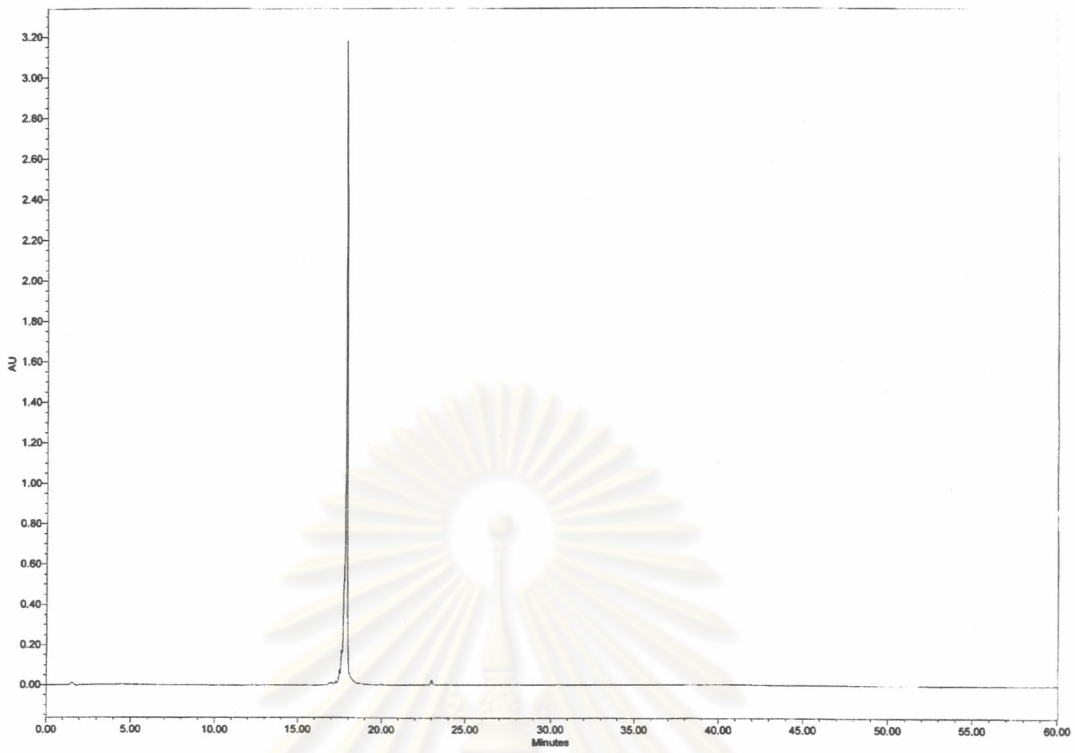

Figure A.37 : HPLC chromatogram of Ac-GACATGACAT-LysNH_2 (**12u**)

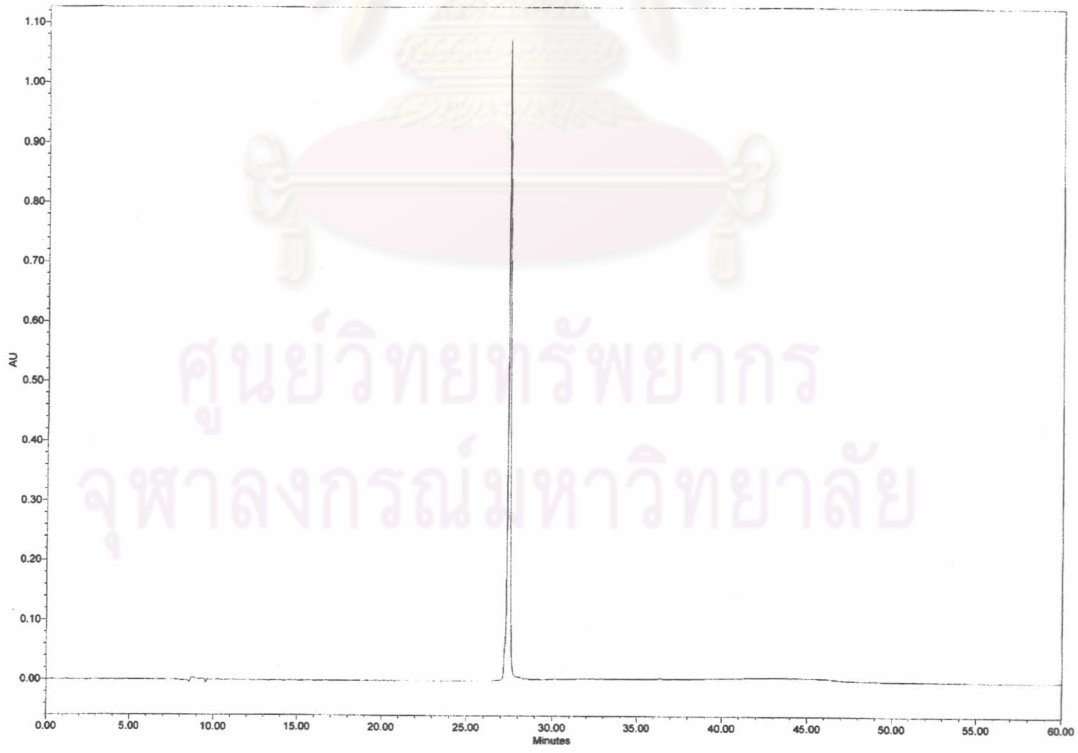

Figure A.38 : HPLC chromatogram of Ac-TATGTACTAT-LysNH_2 (**12v**)

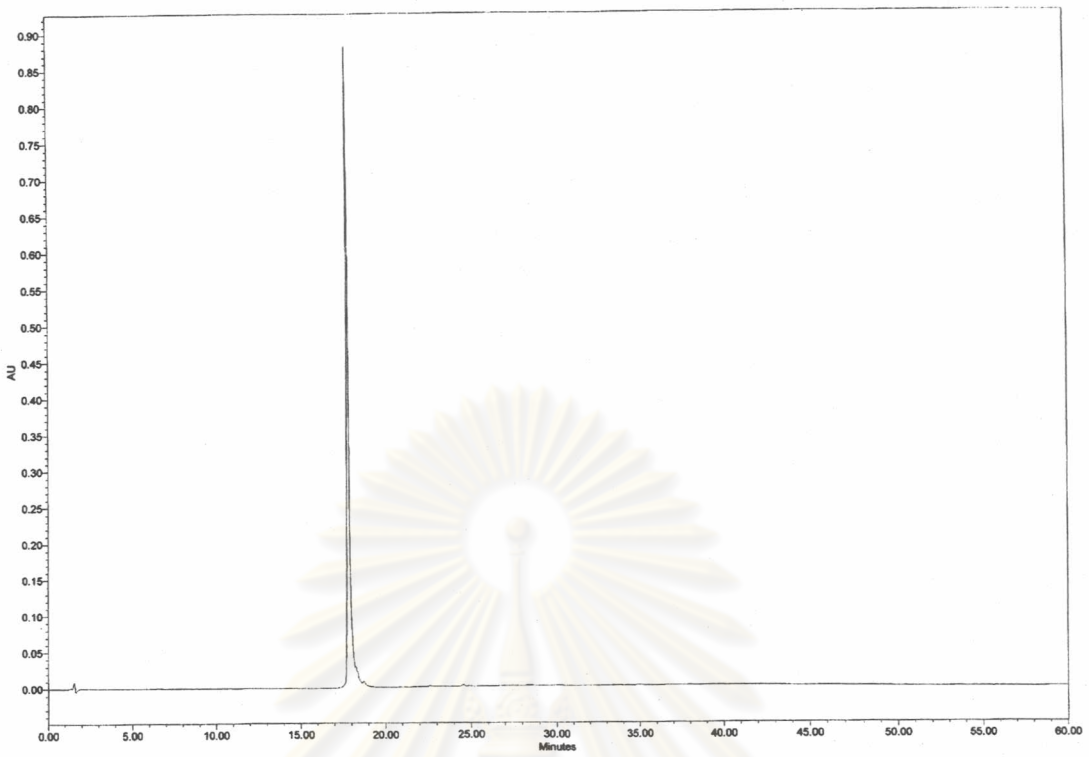

Figure A.39 : HPLC chromatogram of AcLys-GCTACGTCGC-NH_2 (**12w**)

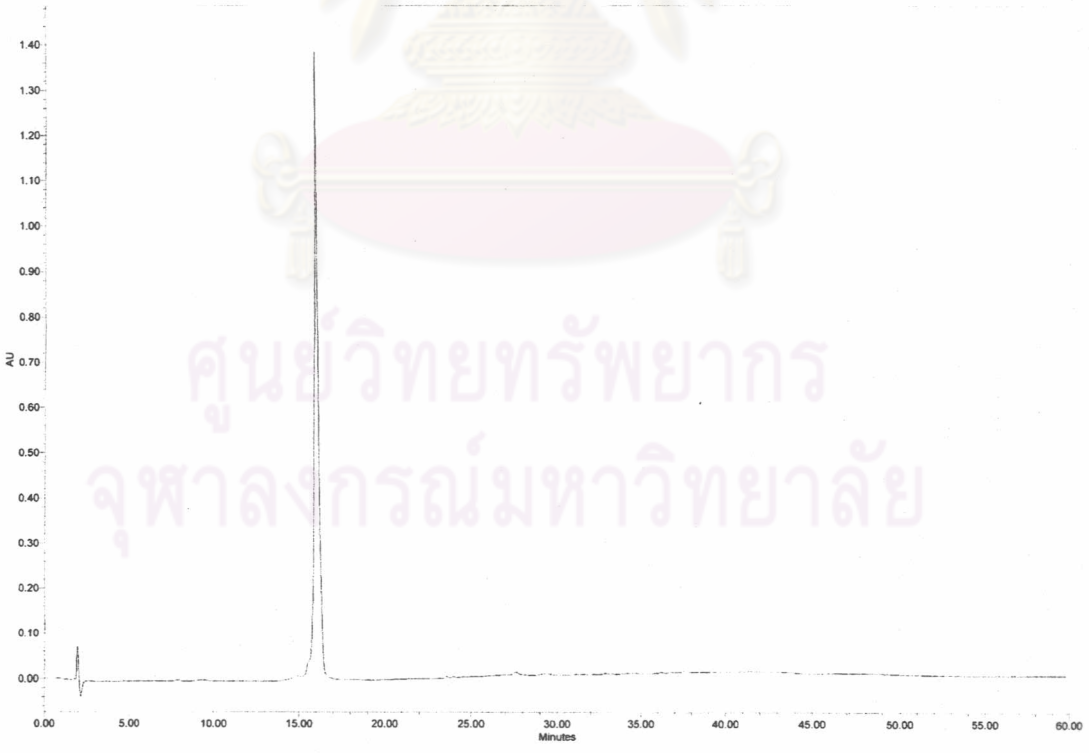

Figure A.40 : HPLC chromatogram of AcLys-TGTACGTCACAACTA-NH_2 (**12x**)

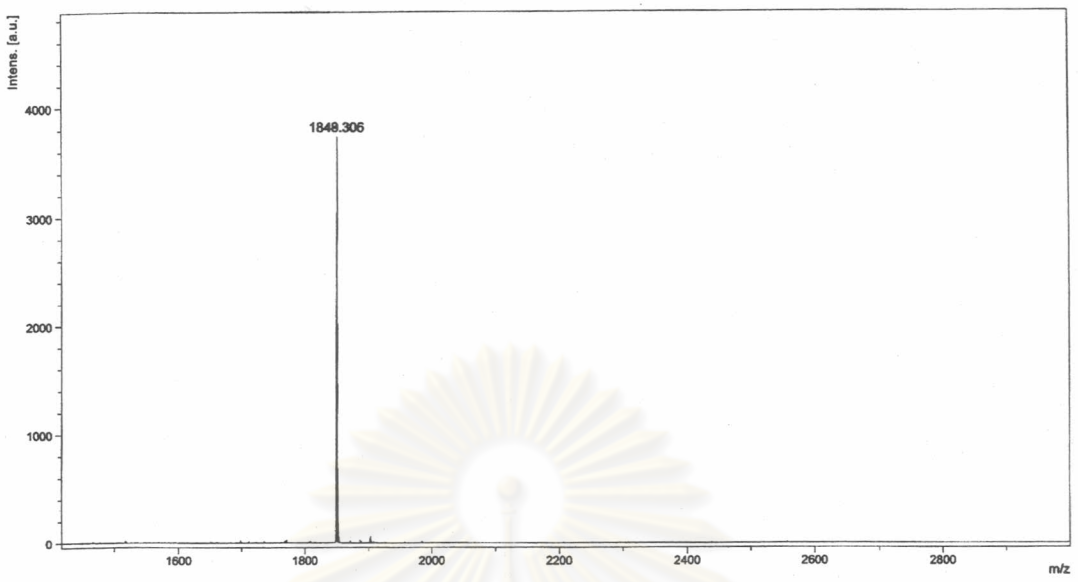

Figure A.41: MALDI-TOF mass spectrum of Ac-T_5-LysNH_2 (**12c**)

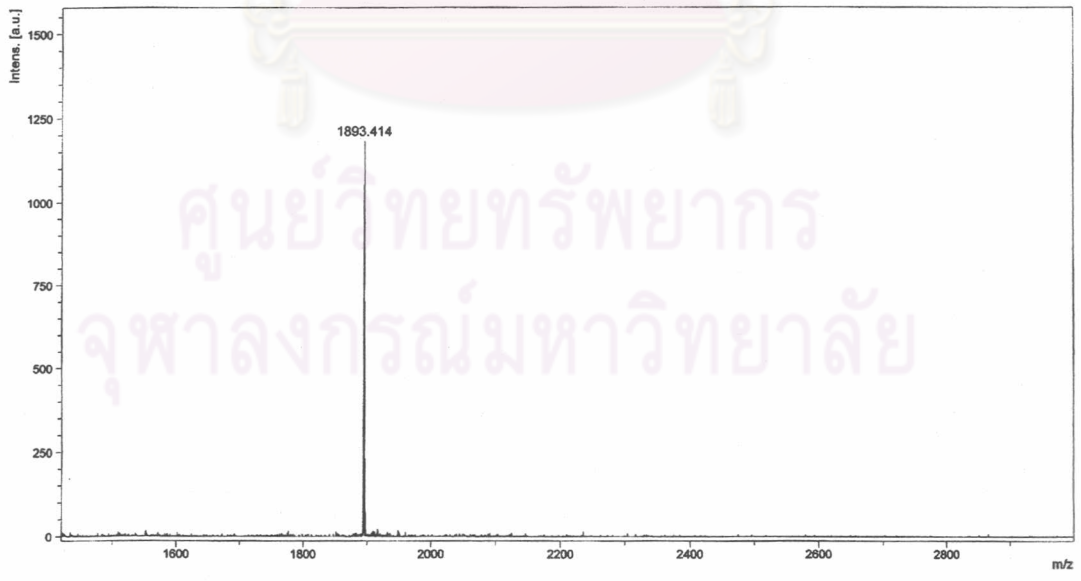

Figure A.42: MALDI-TOF mass spectrum of Ac-A_5-LysNH_2 (**12d**)

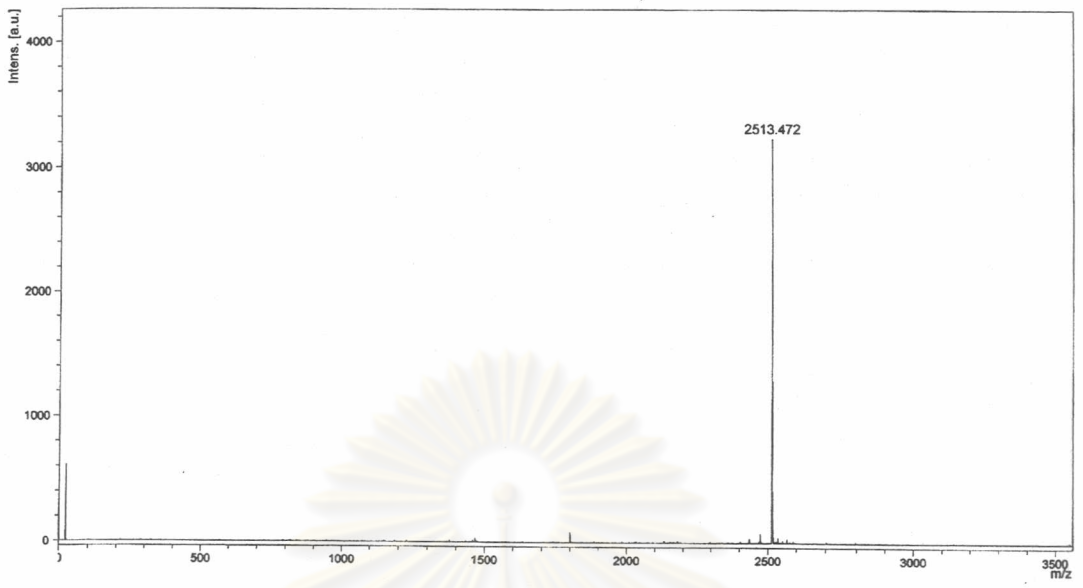

Figure A.43: MALDI-TOF mass spectrum of Ac-T_7-LysNH_2 (**12e**)

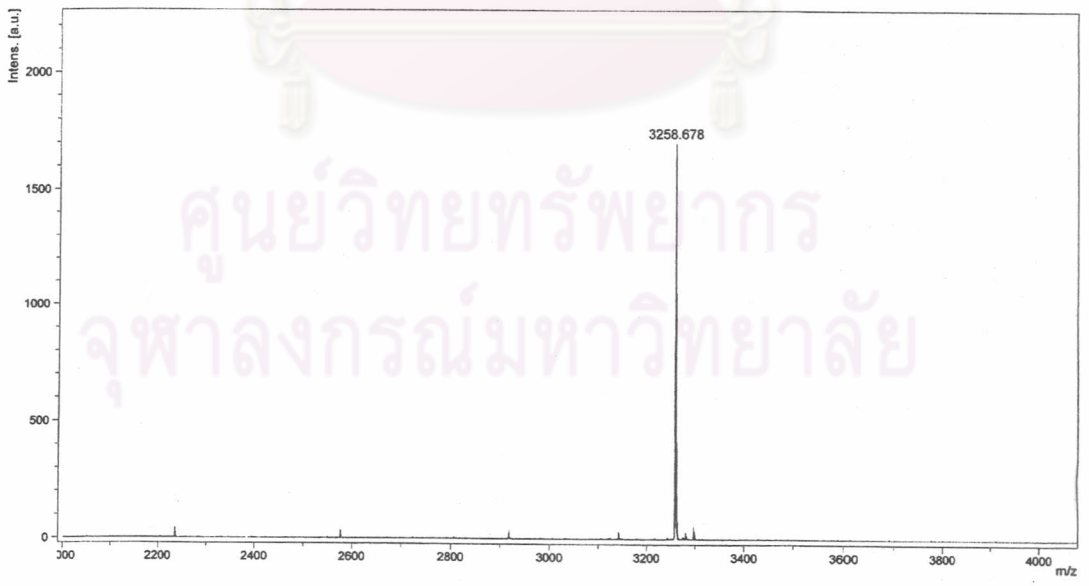

Figure A.44: MALDI-TOF mass spectrum of Ac-T_9-LysNH_2 (**12f**)

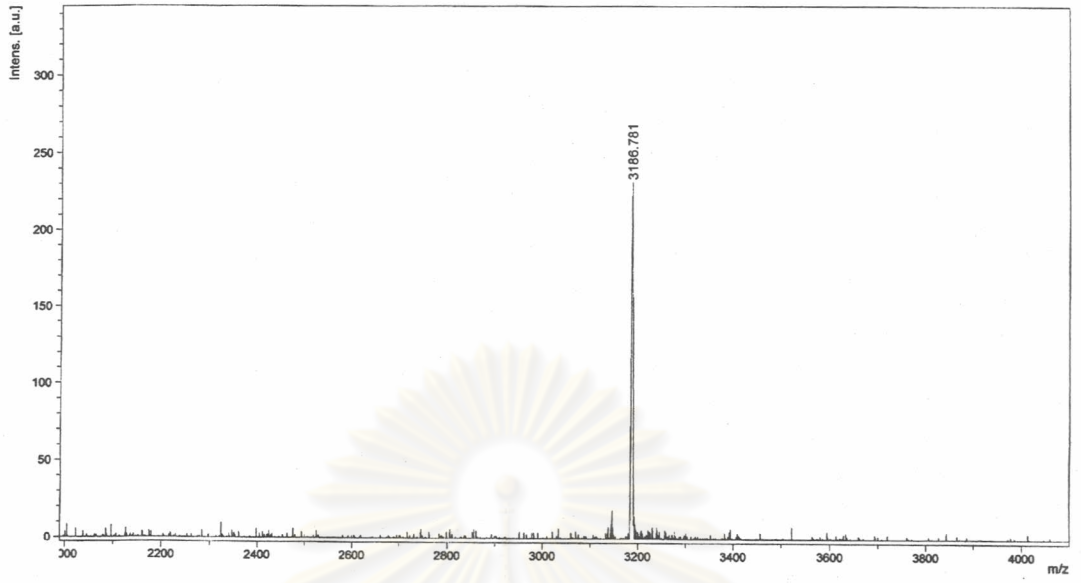

Figure A.45: MALDI-TOF mass spectrum of Ac-T_4AT_4-LysNH_2 (**12g**)

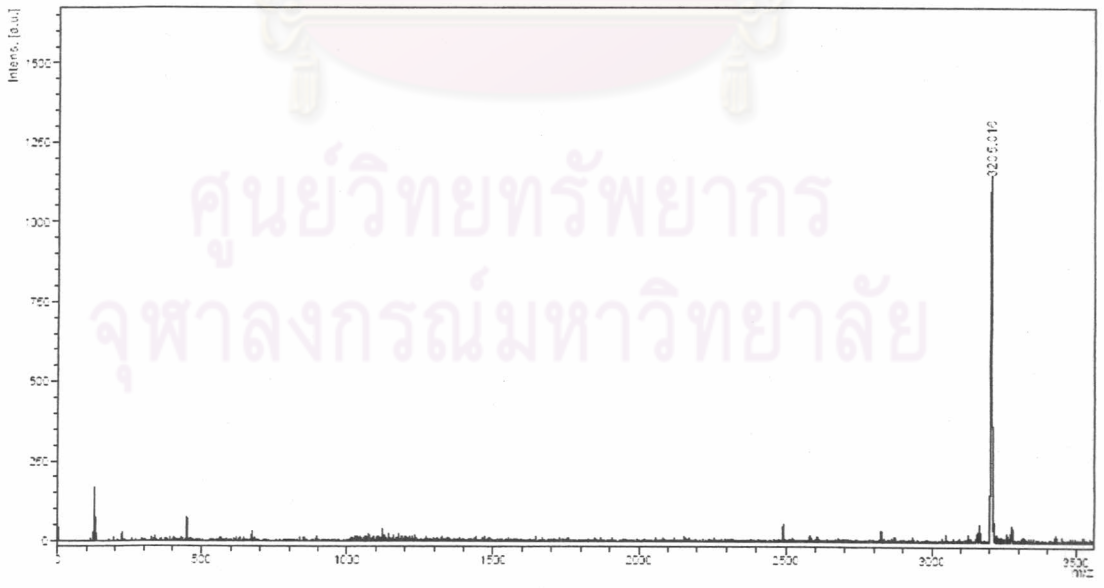

Figure A.46: MALDI-TOF mass spectrum of Ac-T_4GT_4-LysNH_2 (**12h**)

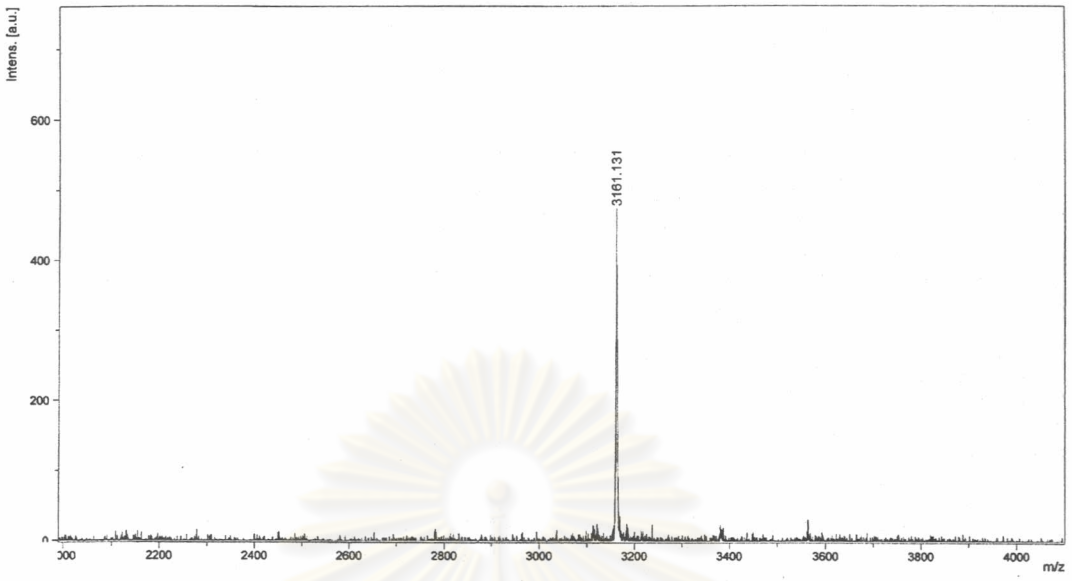

Figure A.47: MALDI-TOF mass spectrum of Ac-T_4CT_4-LysNH_2 (**12i**)

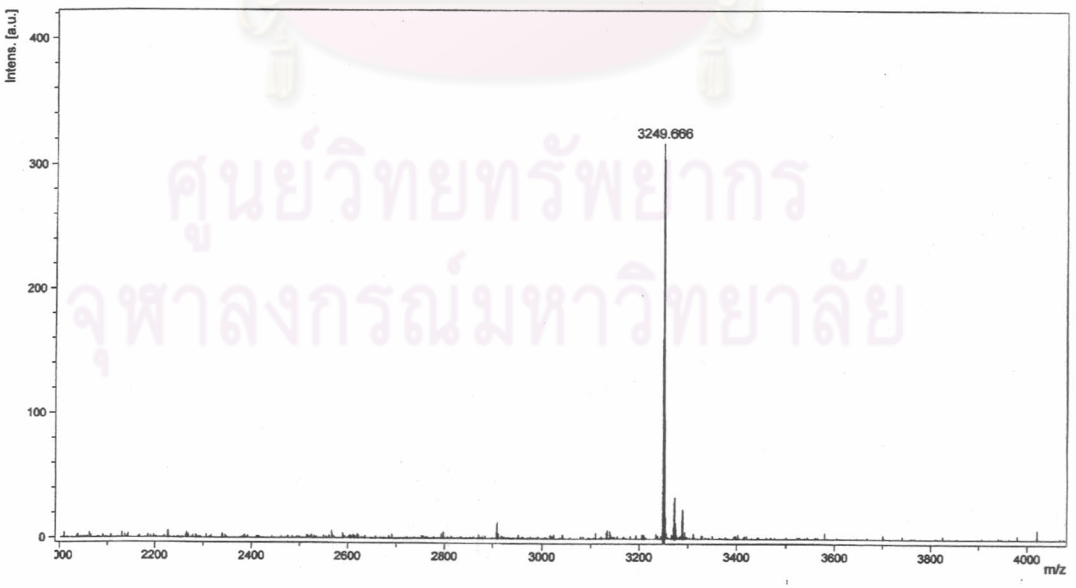

Figure A.48: MALDI-TOF mass spectrum of Ac-A_4TA_4-LysNH_2 (**12j**)

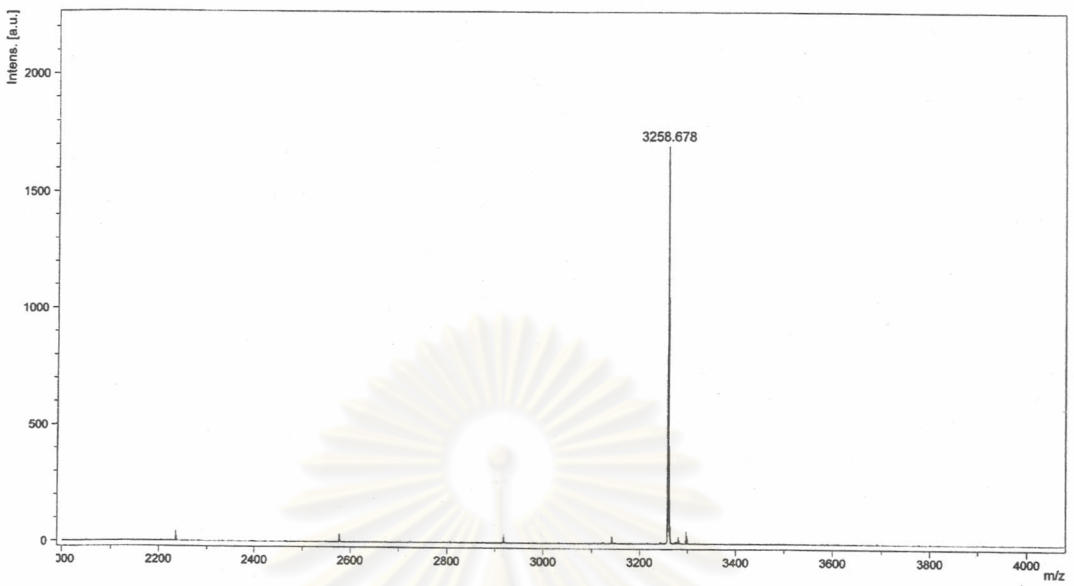

Figure A.49: MALDI-TOF mass spectrum of Ac-A_9-LysNH_2 (**12k**)

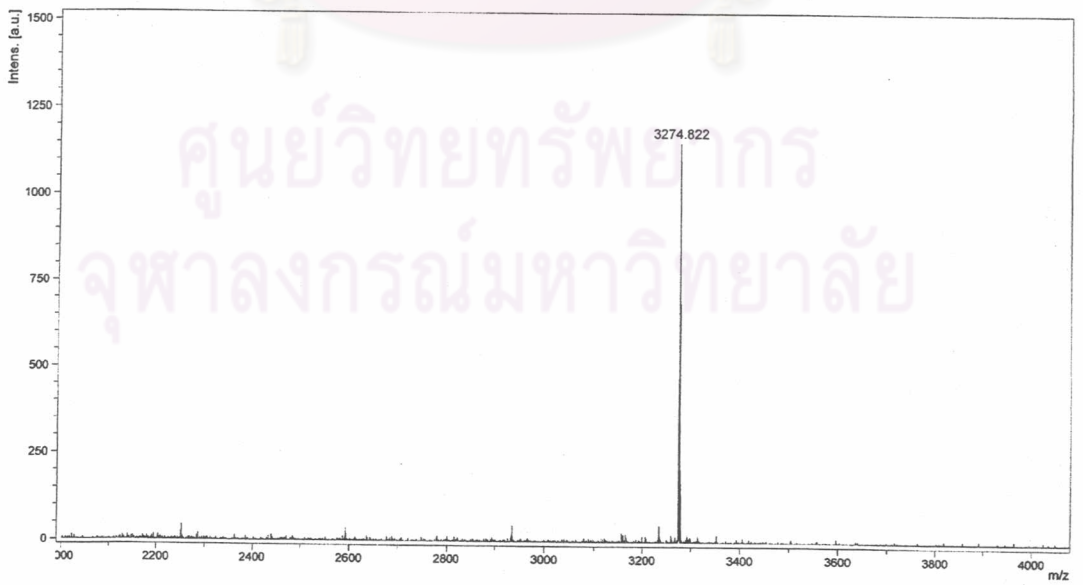

Figure A.50: MALDI-TOF mass spectrum of Ac-A_4GA_4-LysNH_2 (**12l**)

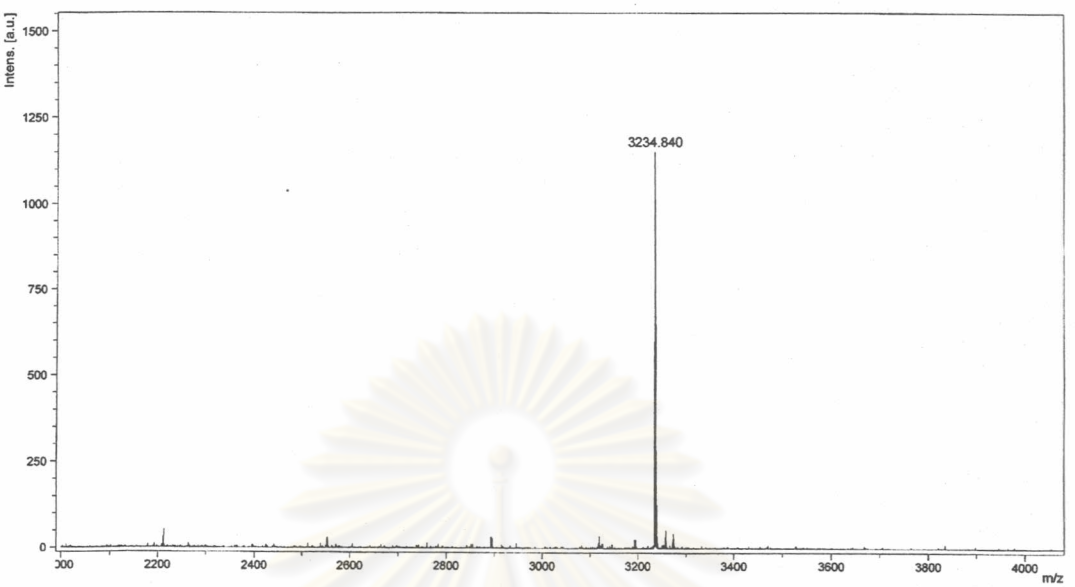

Figure A.51: MALDI-TOF mass spectrum of Ac-A_4CA_4-LysNH_2 (**12m**)

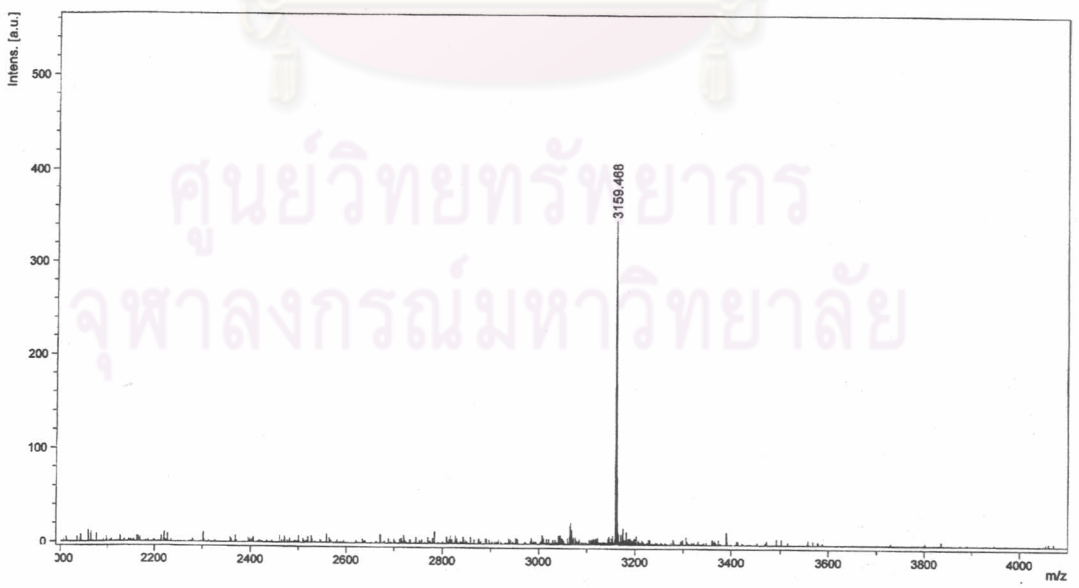

Figure A.52: MALDI-TOF mass spectrum of Ac-TCACTACTA-LysNH_2 (**12n**)

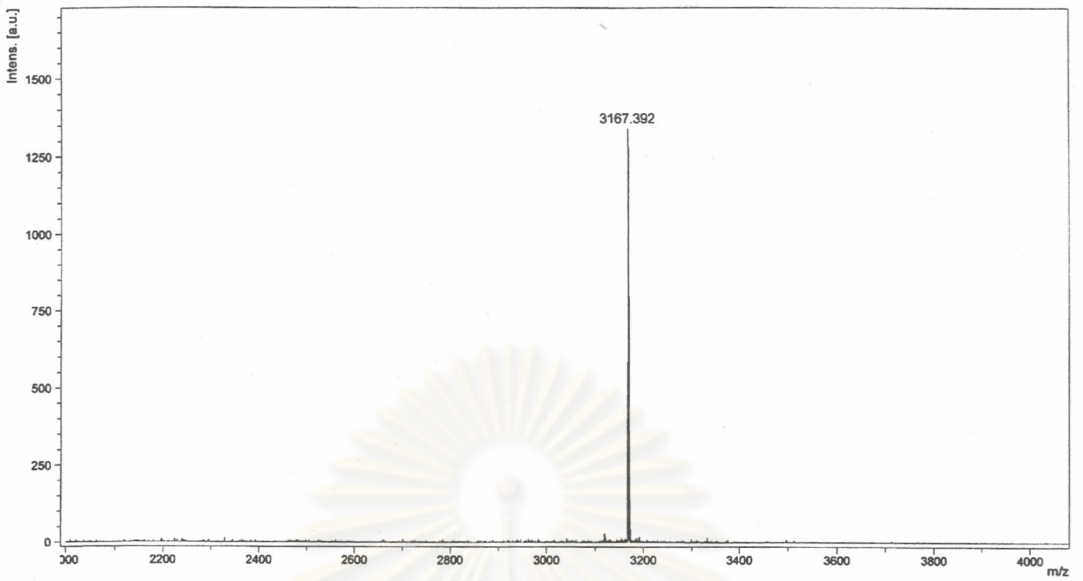

Figure A.53: MALDI-TOF mass spectrum of Ac-TCACAACTA-LysNH_2 (**12o**)

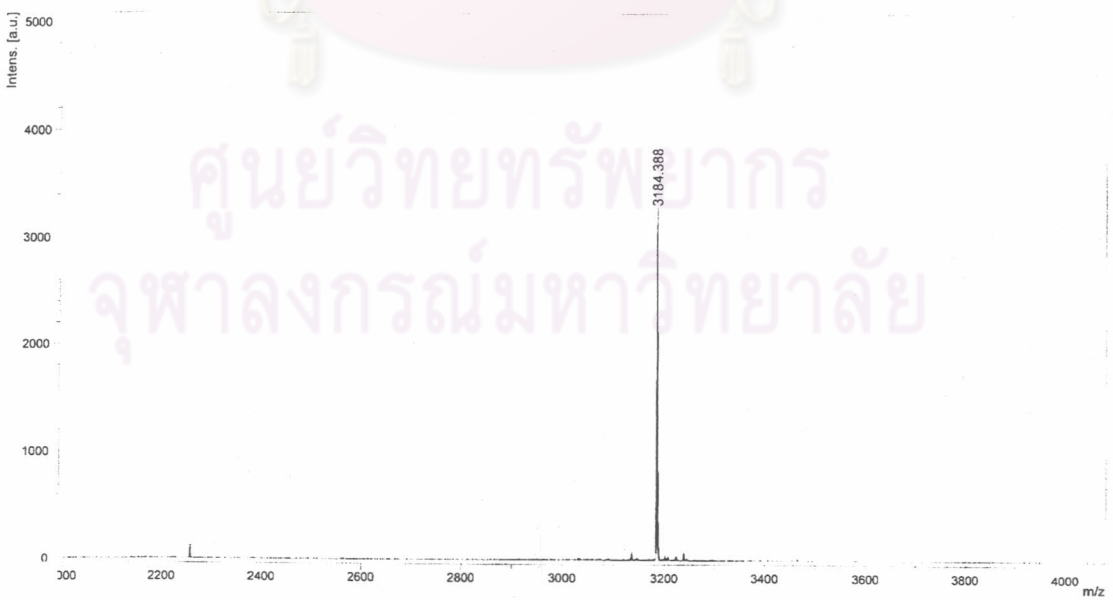

Figure A.54: MALDI-TOF mass spectrum of Ac-TCACGACTA-LysNH_2 (**12p**)

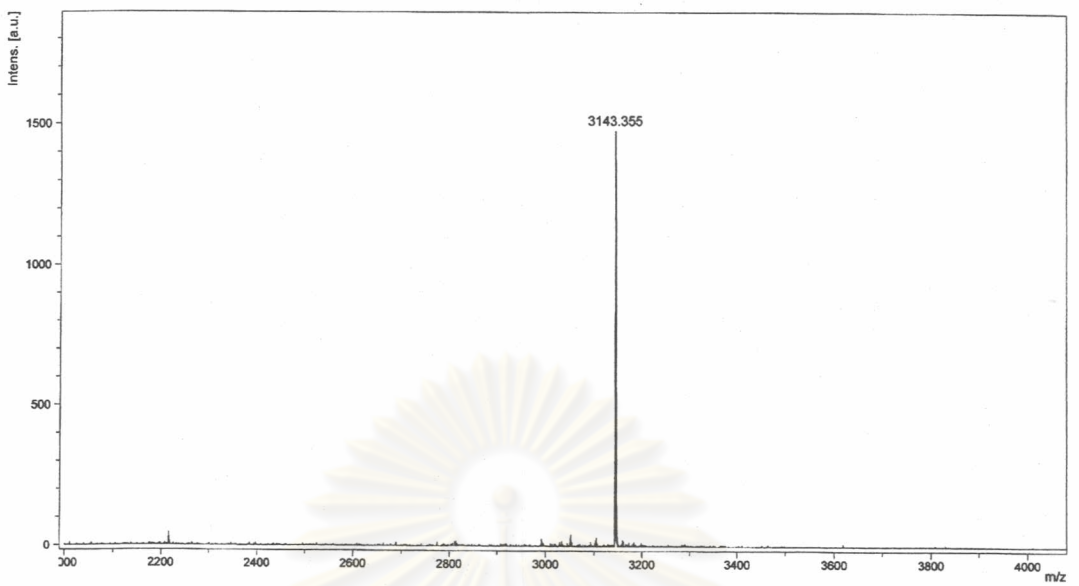

Figure A.55: MALDI-TOF mass spectrum of Ac-TCACTCCTA-LysNH_2 (**12q**)

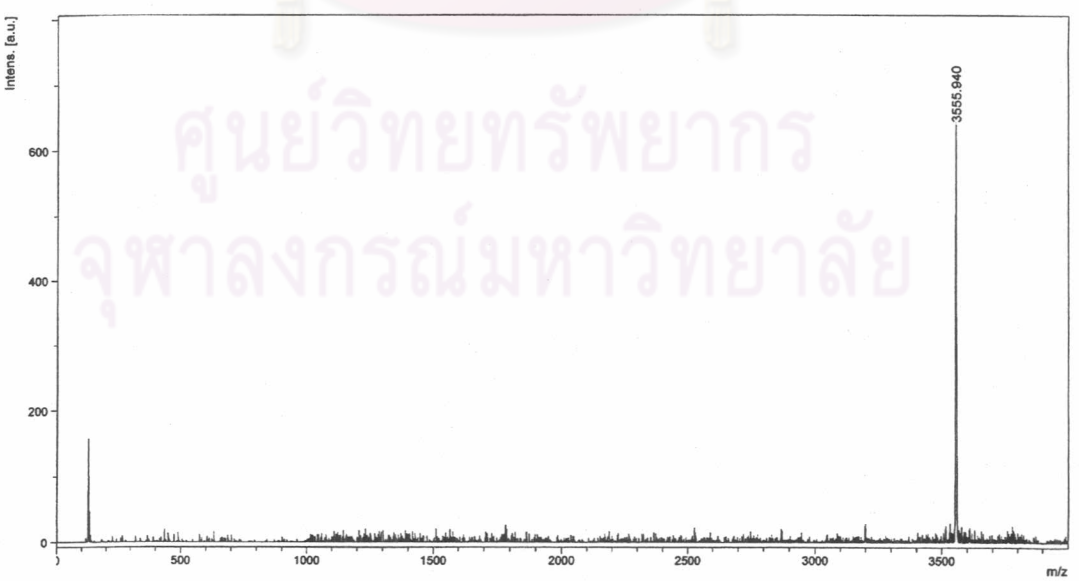

Figure A.56: MALDI-TOF mass spectrum of Ac-GTAGATCACT-LysNH_2 (**12r**)

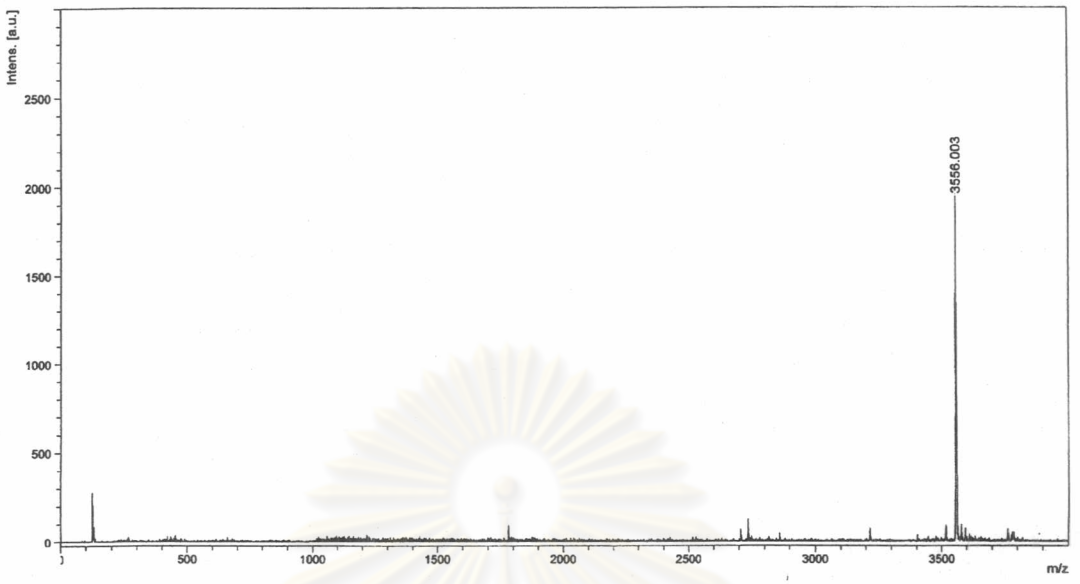

Figure A.57: MALDI-TOF mass spectrum of Ac-AGTGATCTAC-LysNH$_2$ (**12s**)

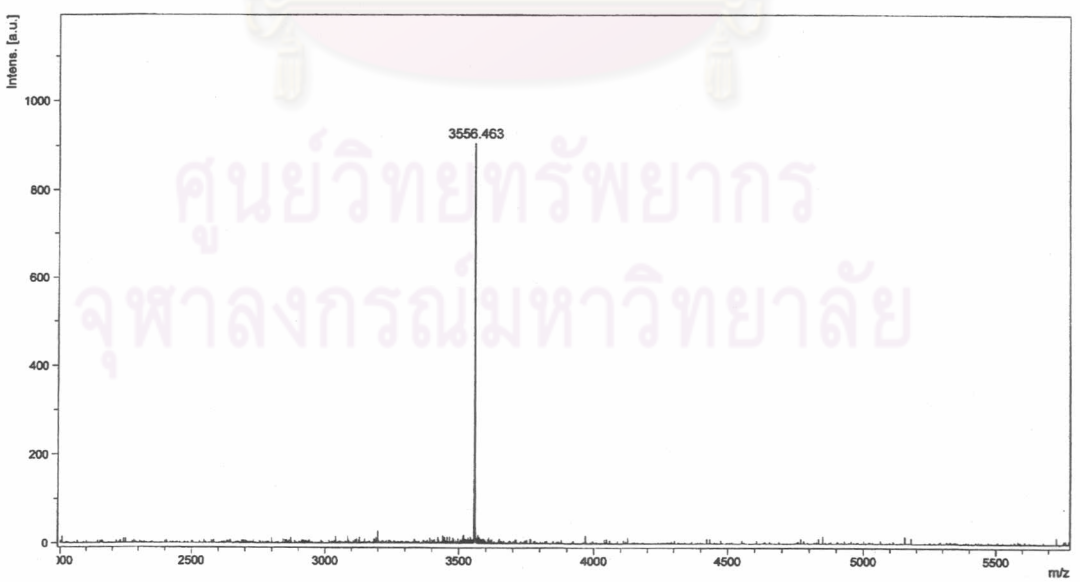

Figure A.58: MALDI-TOF mass spectrum of Ac-CATCTAGTGA-LysNH$_2$ (**12t**)

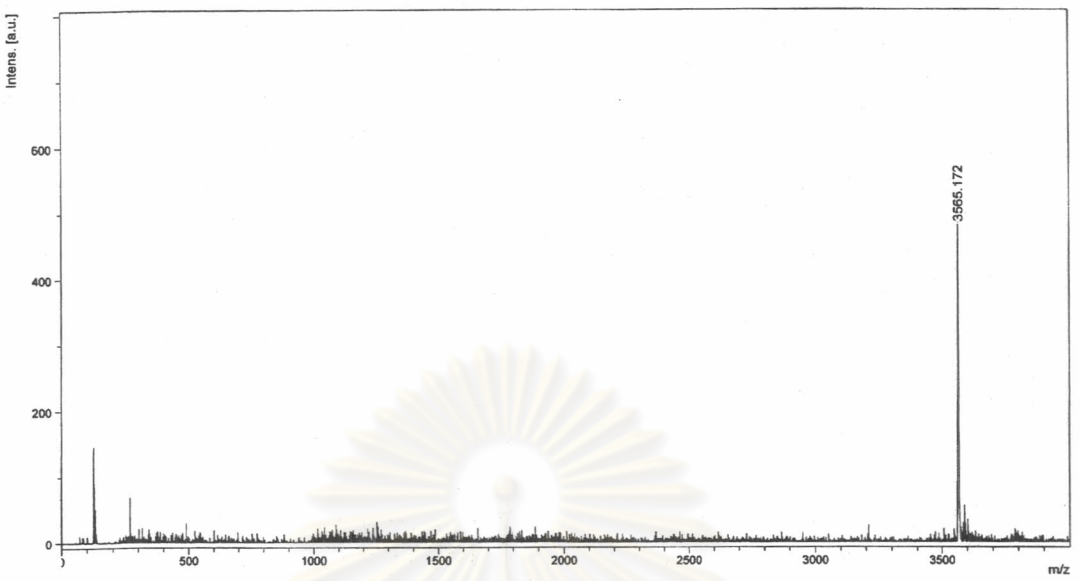

Figure A.59: MALDI-TOF mass spectrum of Ac-GACATCACAT-LysNH$_2$ (**12u**)

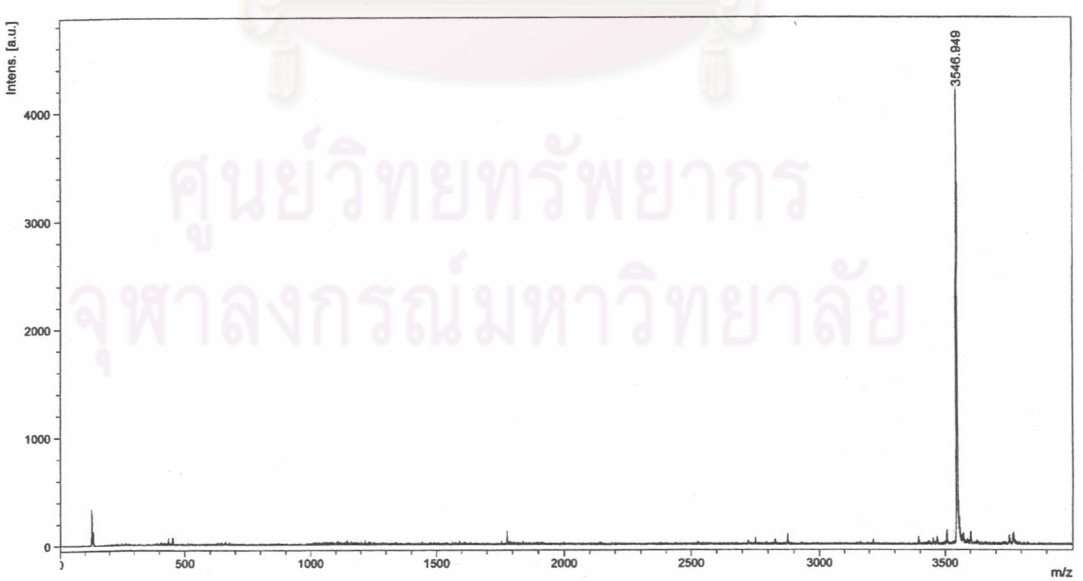

Figure A.60: MALDI-TOF mass spectrum of Ac-TATGTACTAT-LysNH$_2$ (**12v**)

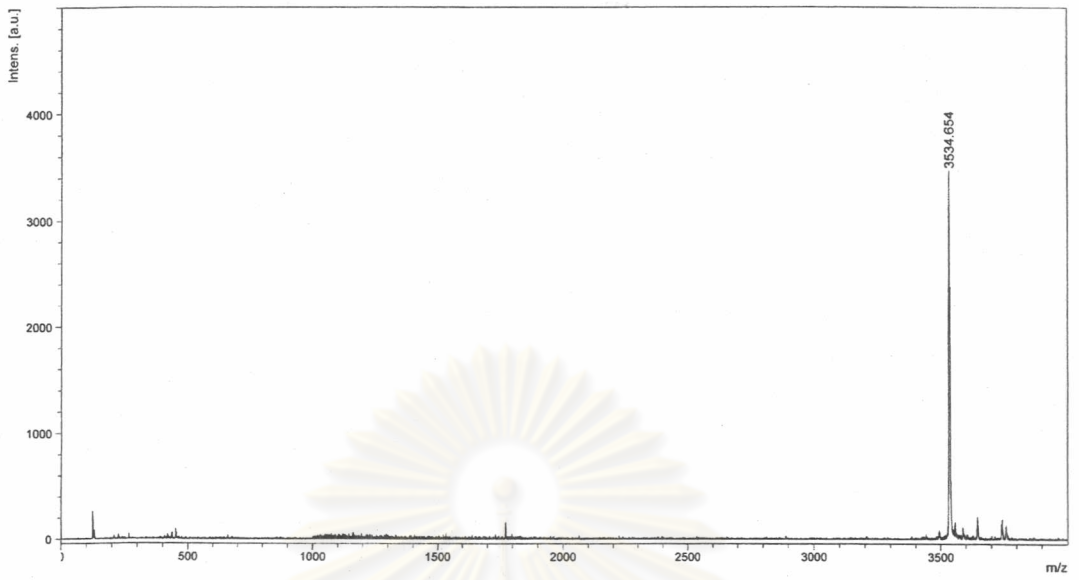

Figure A.61: MALDI-TOF mass spectrum of AcLys-GCTACGTCGC-NH_2 (**12w**)

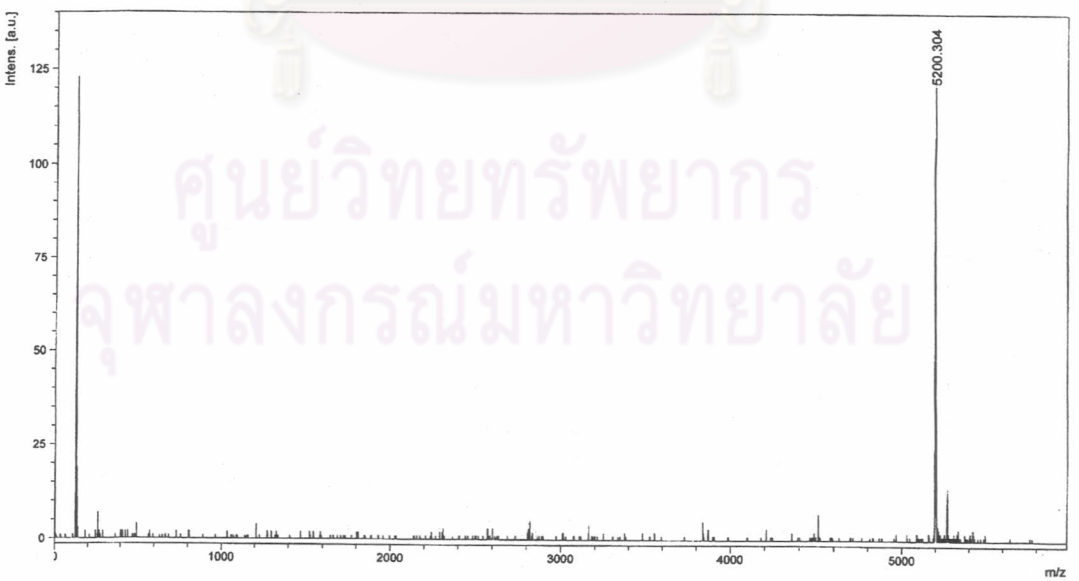

Figure A.62: MALDI-TOF mass spectrum of AcLys-TGTACGTCACAACTA-NH_2 (**12x**)

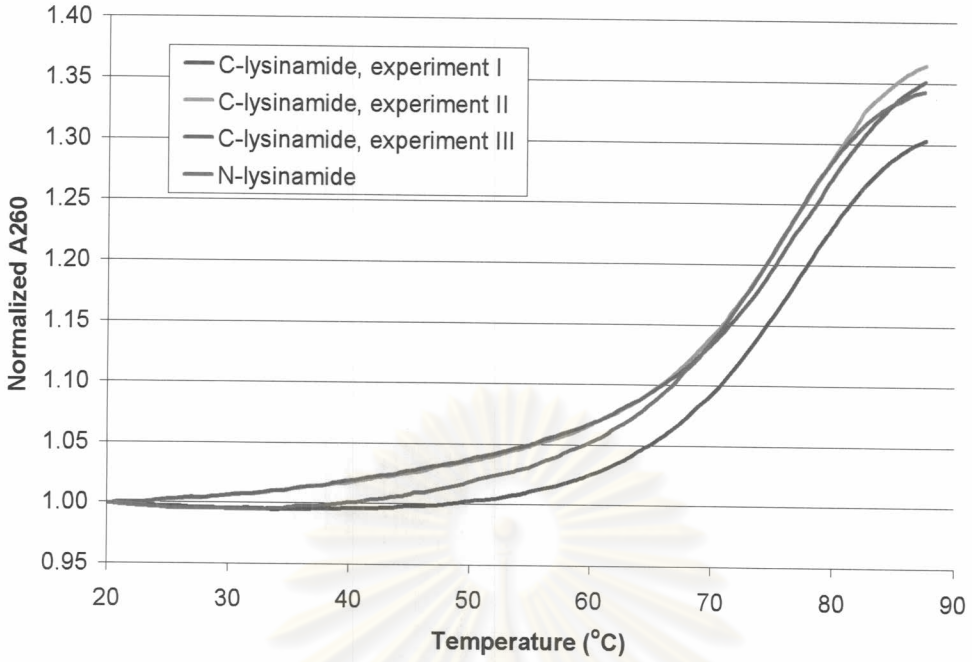

Figure A.63 The melting curves of C-lysinamide PNA T_9 with $d(A_9)$ in three experiments and N-lysinamide PNA T_9 with $d(A_9)$. The T_m were measured at a ratio of PNA:DNA = 1: 1, [PNA] = 1 μM, 10 mM sodium phosphate buffer, pH 7.0, heating rate 1.0 °C/min.

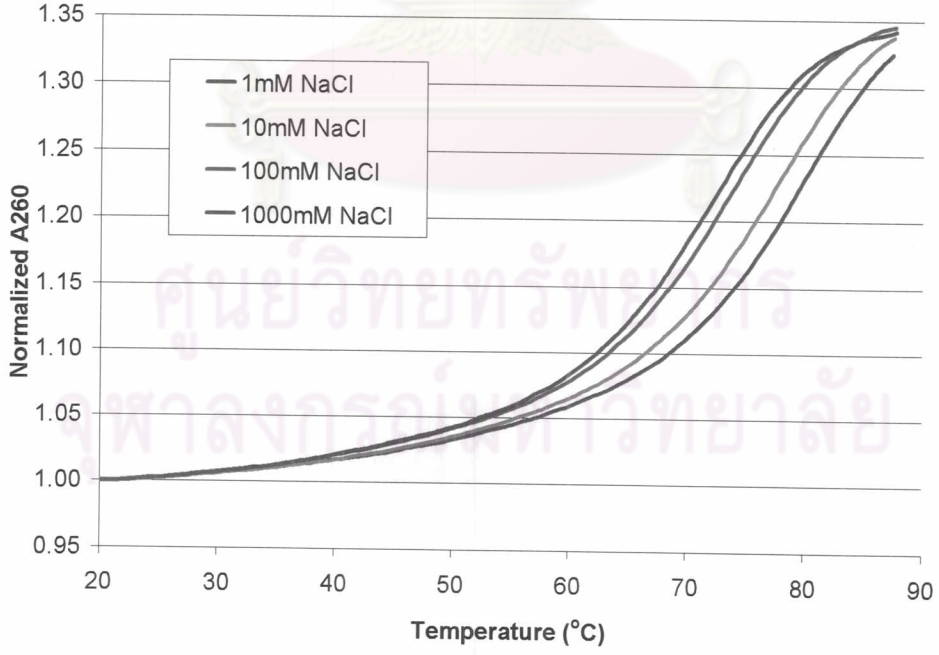

Figure A.64 The melting curves of T_9 **(12f)**·$d(A_9)$ hybrid at increasing concentration of NaCl. Condition: PNA:DNA 1:1, [PNA] = 1μM, 10 mM sodium phosphate buffer, pH 7.0, heating rate 1.0 °C/min.

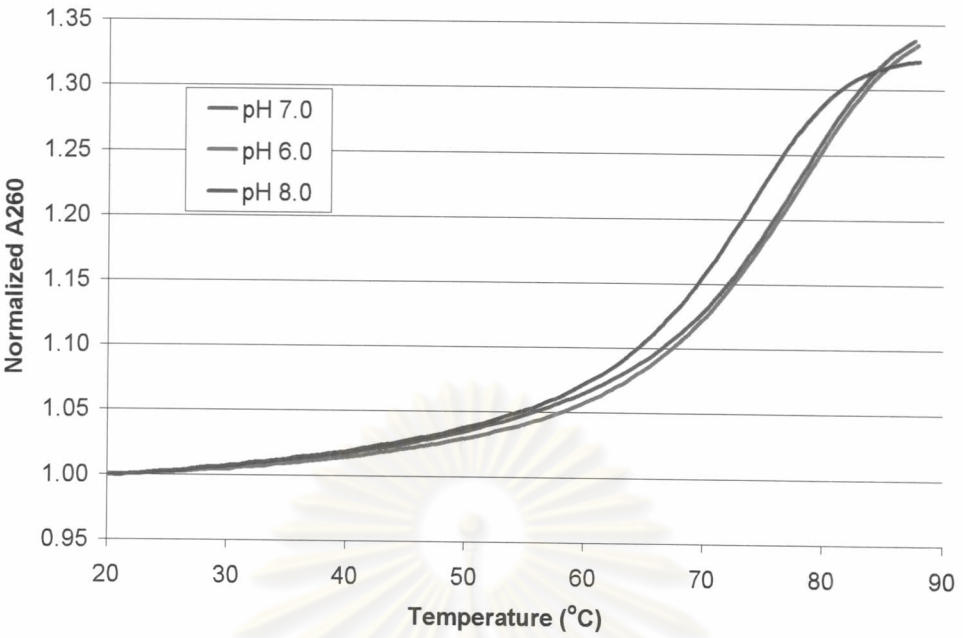

Figure A.65 The melting curves of T_9 (**12f**)·d(A_9) hybrid at vary pH (6.0, 7.0 and 8.0). Condition: PNA:DNA 1:1, [PNA] = 1μM, 10 mM sodium phosphate buffer, pH 7.0, heating rate 1.0 °C/min.

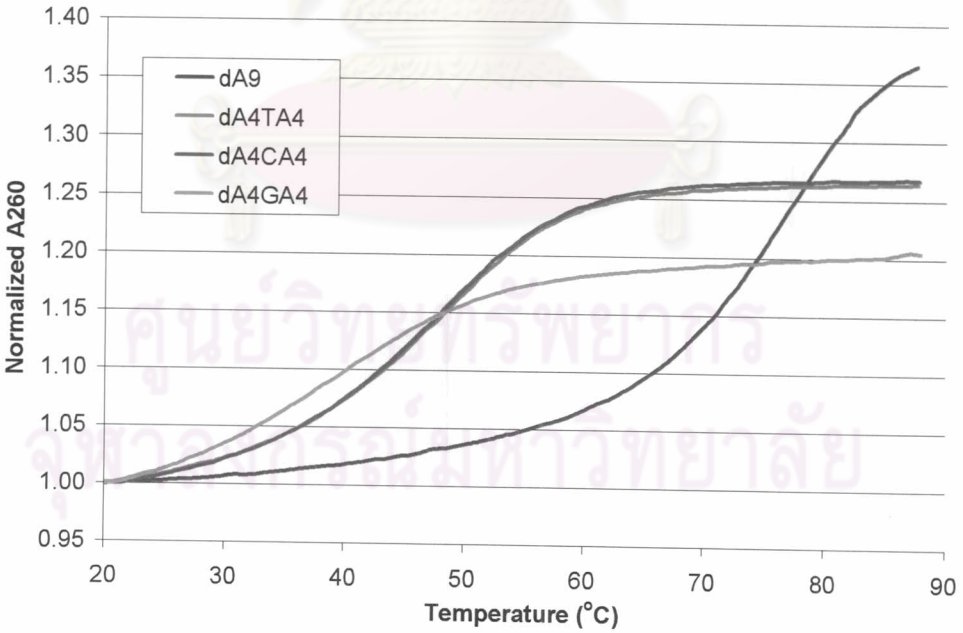

Figure A.66 The melting curves of hybrid between PNA T_9 (**12f**)·d(A_4YA_4), Y = A, T, C and G. Condition: PNA:DNA 1:1, [PNA] = 1μM, 10 mM sodium phosphate buffer, pH 7.0, heating rate 1.0 °C/min.

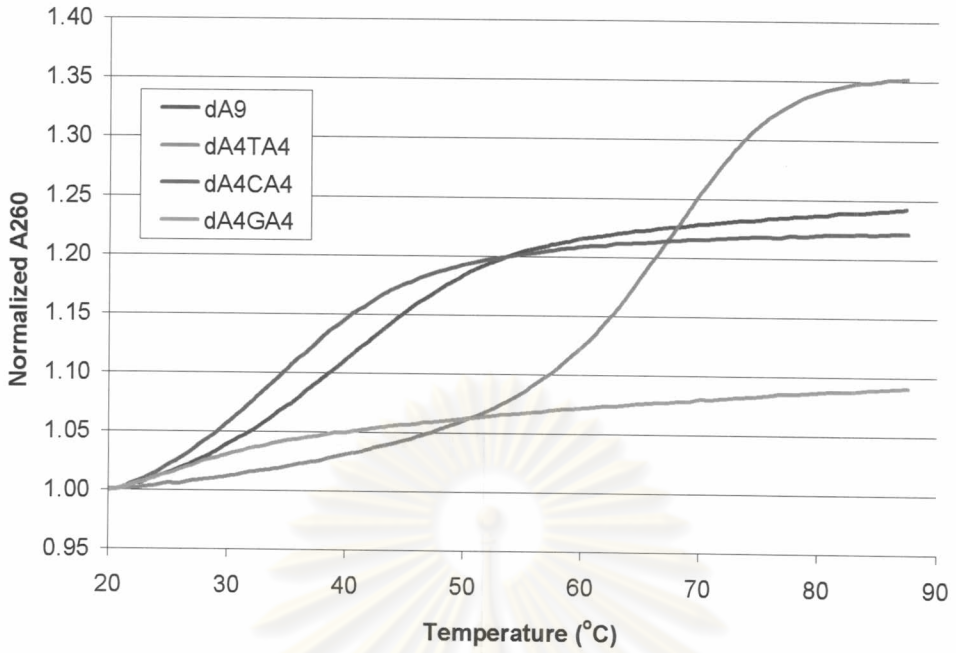

Figure A.67 The melting curves of hybrid between PNA T_4AT_4 (**12g**)·$d(A_4YA_4)$, Y = A, T, C and G. Condition: PNA:DNA 1:1, [PNA] = 1μM, 10 mM sodium phosphate buffer, pH 7.0, heating rate 1.0 °C/min.

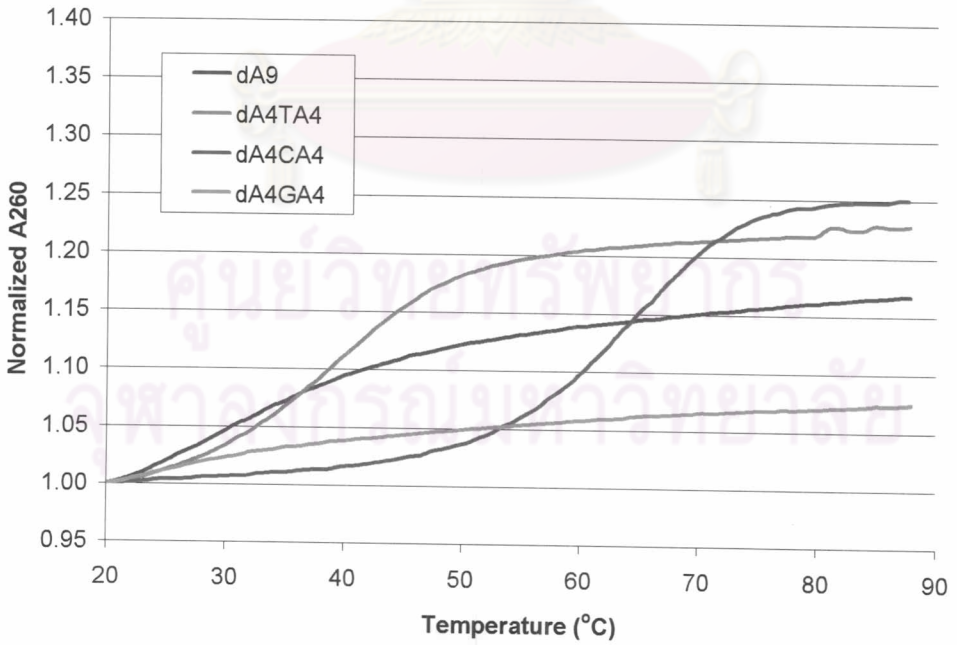

Figure A.68 The melting curves of hybrid between PNA T_4GT_4 (**12h**)·$d(A_4YA_4)$, Y = A, T, C and G. Condition: PNA:DNA 1:1, [PNA] = 1μM, 10 mM sodium phosphate buffer, pH 7.0, heating rate 1.0 °C/min.

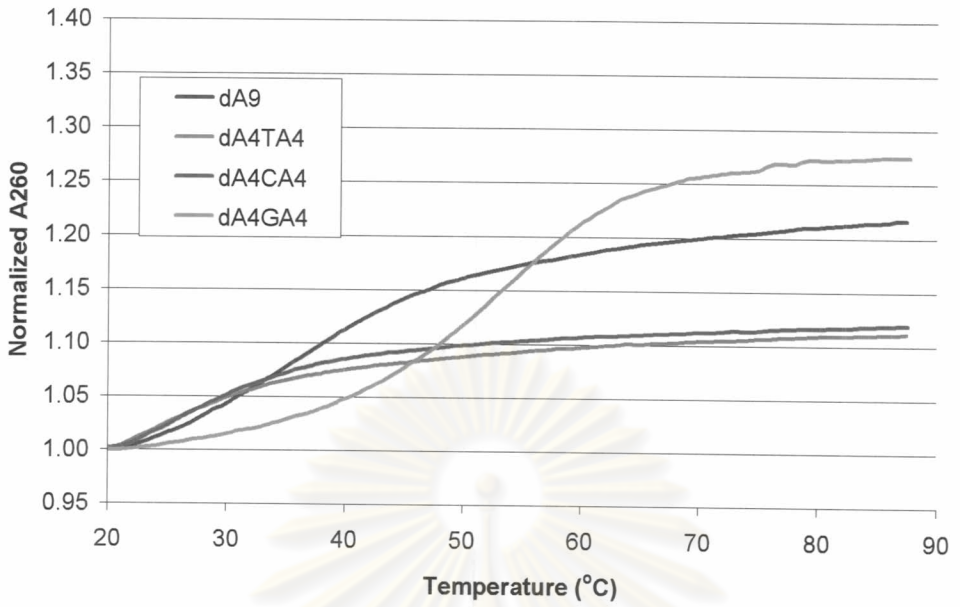

Figure A.69 The melting curves of hybrid between PNA T_4CT_4 (**12i**)·d(A_4YA_4), Y = A, T, C and G. Condition: PNA:DNA 1:1, [PNA] = 1μM, 10 mM sodium phosphate buffer, pH 7.0, heating rate 1.0 °C/min.

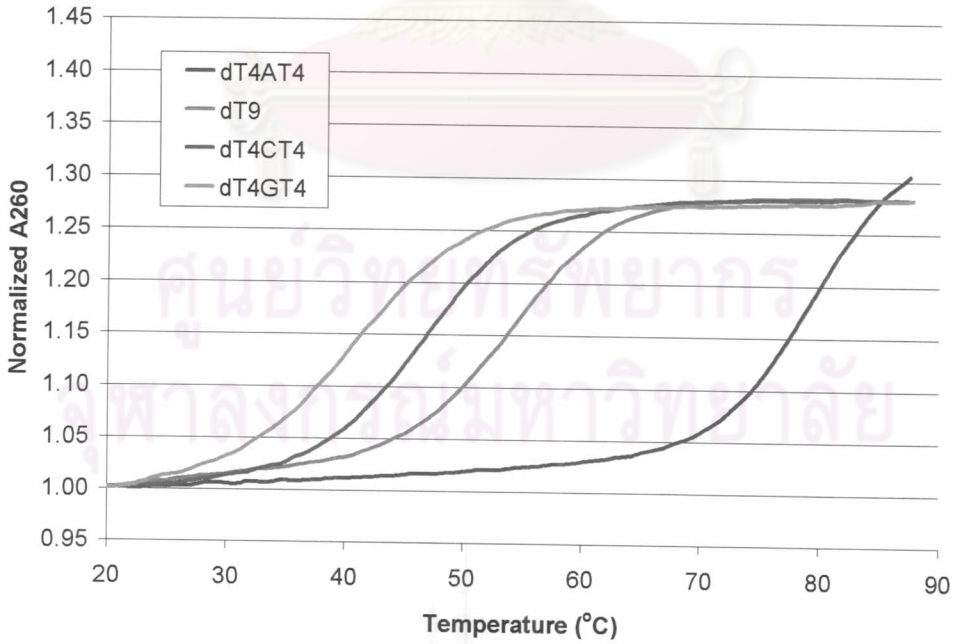

Figure A.70 The melting curves of hybrid between PNA A_4TA_4 (**12j**)·d(A_4YA_4), Y = A, T, C and G. Condition: PNA:DNA 1:1, [PNA] = 1μM, 10 mM sodium phosphate buffer, pH 7.0, heating rate 1.0 °C/min.

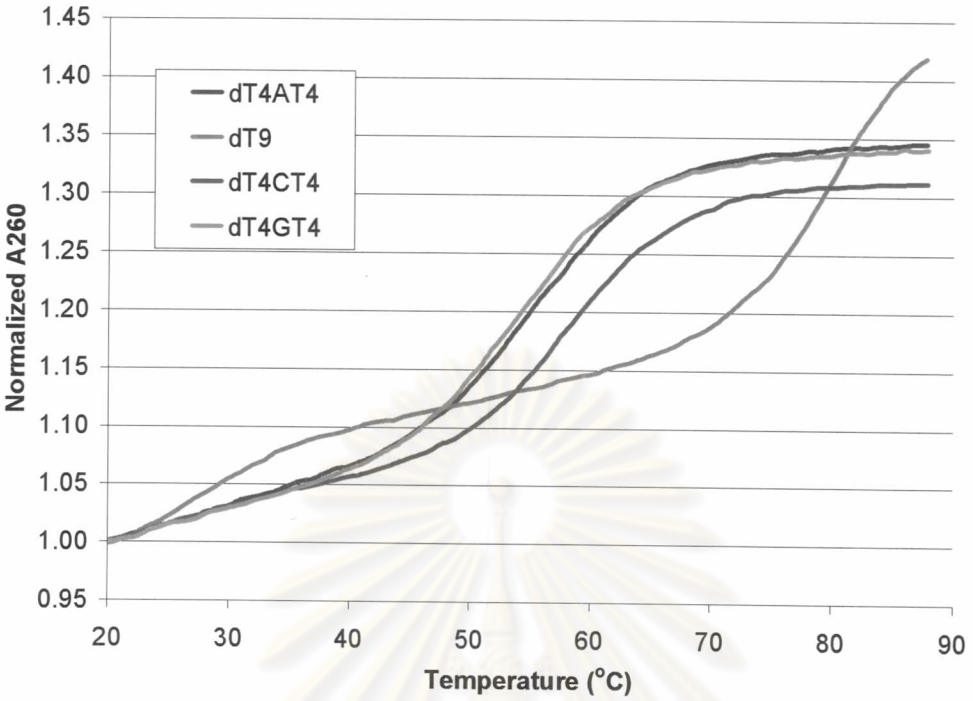

Figure A.71 The melting curves of hybrid between PNA A_9 (**12k**)·d(A_4YA_4), Y = A, T, C and G. Condition: PNA:DNA 1:1, [PNA] = 1μM, 10 mM sodium phosphate buffer, pH 7.0, heating rate 1.0 °C/min.

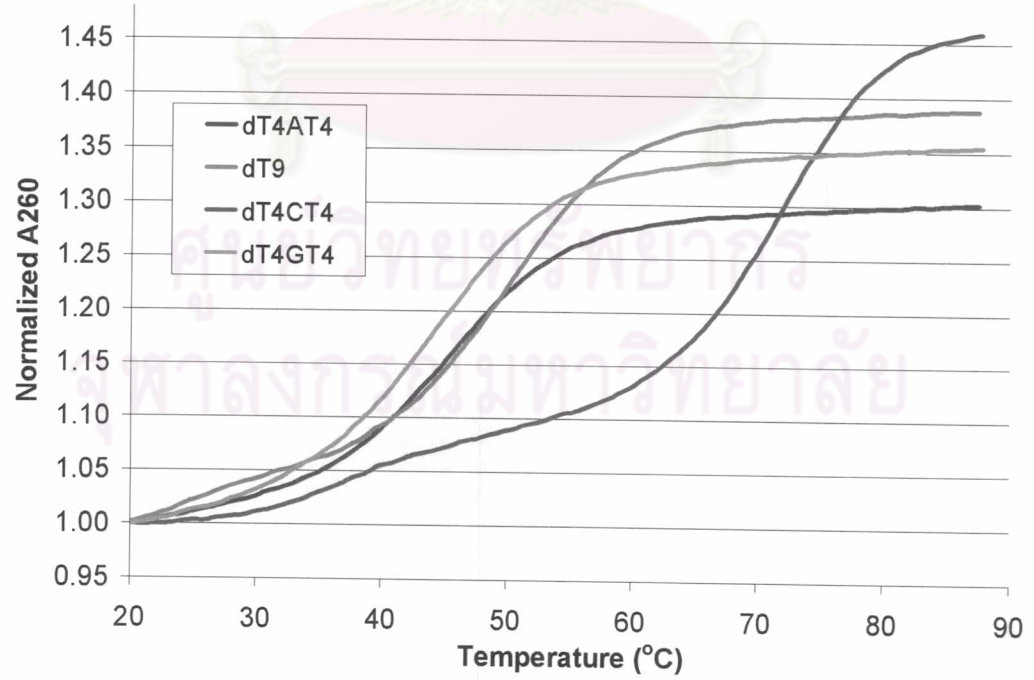

Figure A.72 The melting curves of hybrid between PNA A_4GA_4 (**12l**)·d(A_4YA_4), Y = A, T, C and G. Condition: PNA:DNA 1:1, [PNA] = 1μM, 10 mM sodium phosphate buffer, pH 7.0, heating rate 1.0 °C/min.

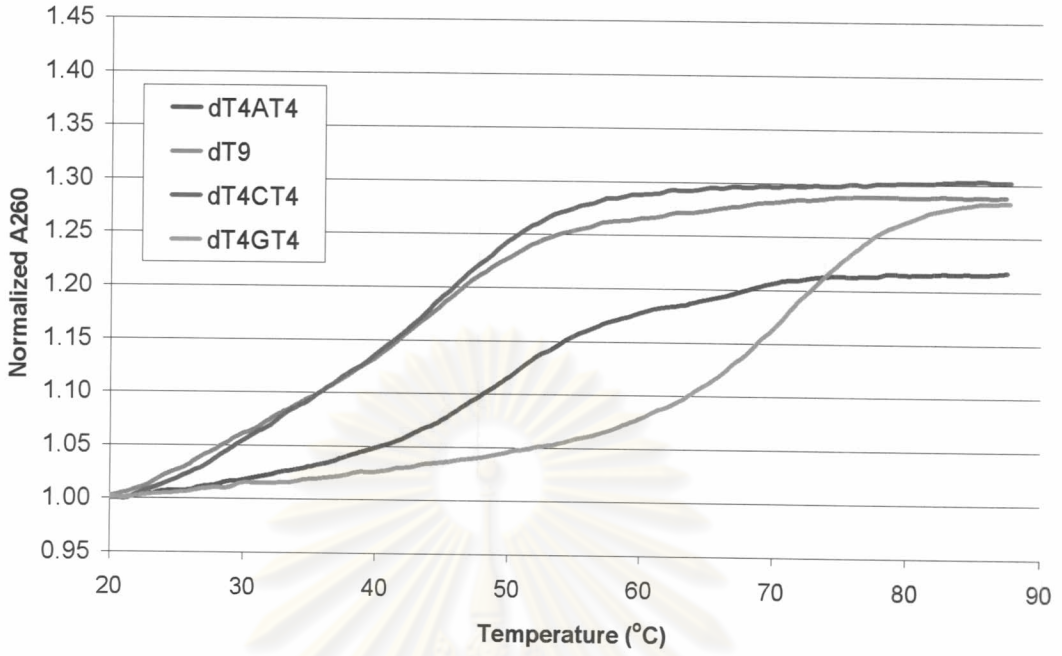

Figure A.73 The melting curves of hybrid between PNA A_4CA_4 (**12m**)·d(A_4YA_4), Y = A, T, C and G. Condition: PNA:DNA 1:1, [PNA] = 1μM, 10 mM sodium phosphate buffer, pH 7.0, heating rate 1.0 °C/min.

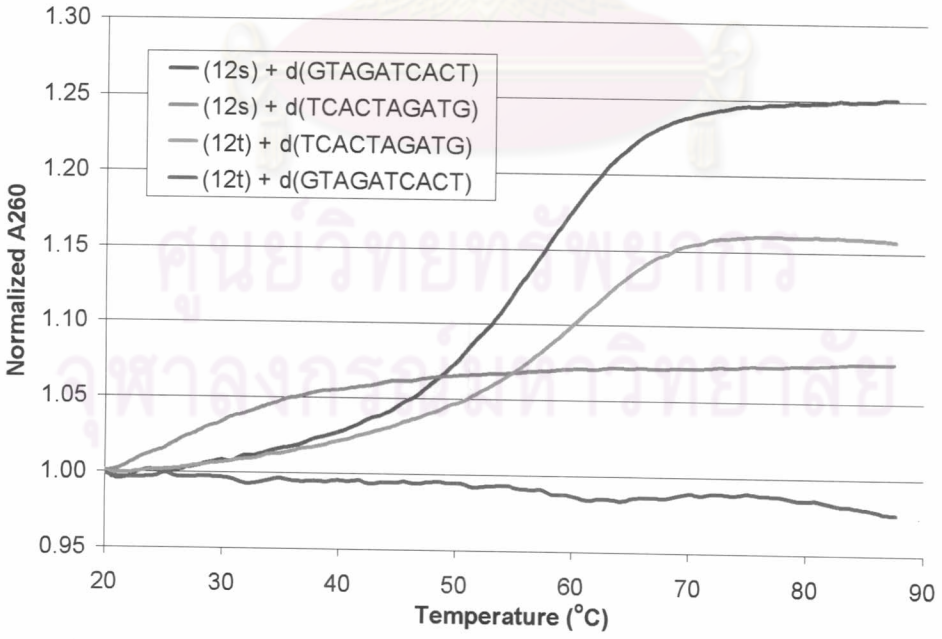

Figure A.74 The melting curves of PNA Ac-AGTGATCTAC-$LysNH_2$ (**12s**)·DNA hybrids (antiparallel and parallel) and PNA Ac-CATCTAGTGA-$LysNH_2$ (**12t**)·DNA hybrids (antiparallel and parallel). Condition: PNA:DNA 1:1, [PNA] = 1μM, 10 mM sodium phosphate buffer, pH 7.0, heating rate 1.0 °C/min.

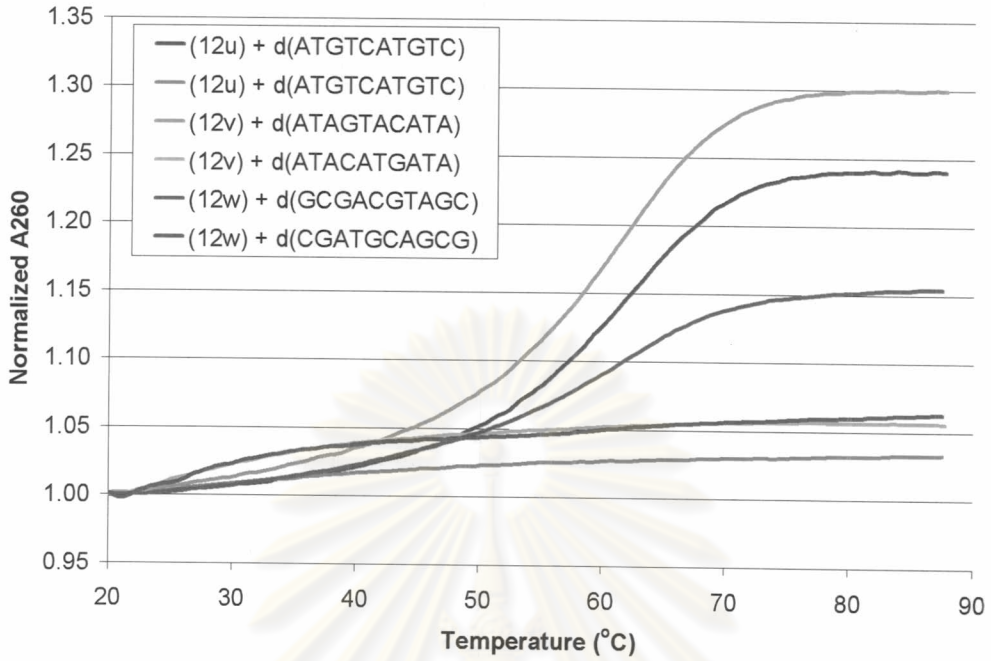

Figure A.75 The melting curves of antiparallel and parallel hybrid of PNA Ac-GACATGACAT-LysNH$_2$ (**12u**), Ac-TATGTACTAT-LysNH$_2$ (**12v**) and Ac-GCTACGTCGC-LysNH$_2$ (**12w**). Condition: PNA:DNA 1:1, [PNA] = 1μM, 10 mM sodium phosphate buffer, pH 7.0, heating rate 1.0 °C/min.

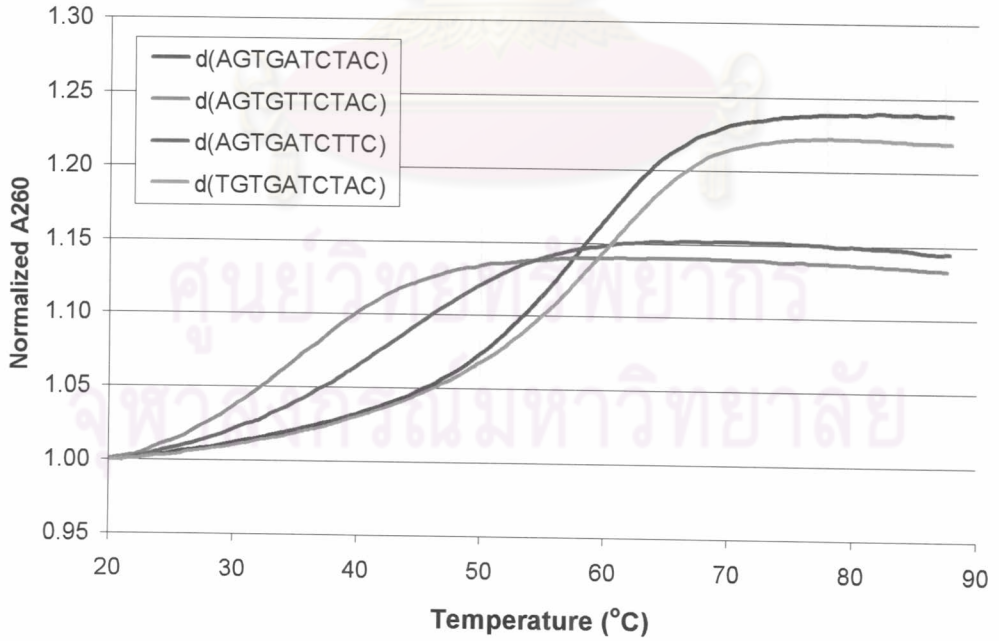

Figure A.76 The melting curves of PNA Ac-GTAGATCACT-LysNH$_2$ (**12r**) with perfect match and single mismatched position of DNA. Condition: PNA:DNA 1:1, [PNA] = 1μM, 10 mM sodium phosphate buffer, pH 7.0, heating rate 1.0 °C/min.

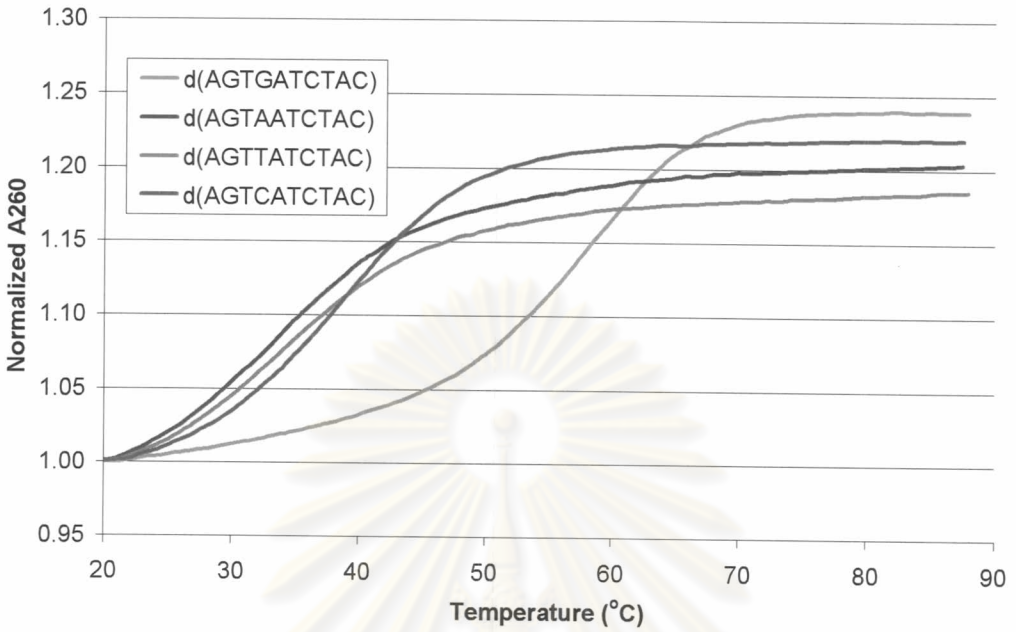

Figure A.77 The melting curves of hybrid between PNA Ac-GTAGATCACT-LysNH$_2$ (**12r**) ·d(AGTGAT**W**TAC), **W** = A, T, C and G. Condition: PNA:DNA 1:1, [PNA] = 1μM, 10 mM sodium phosphate buffer, pH 7.0, heating rate 1.0 °C/min.

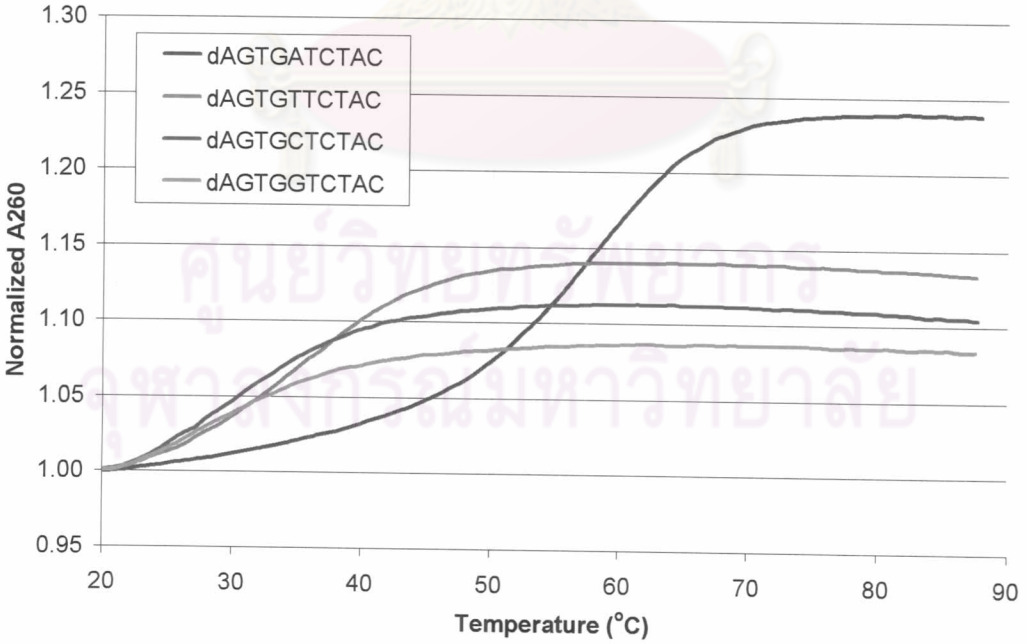

Figure A.78 The melting curves of hybrid between PNA Ac-GTAGATCACT-LysNH$_2$ (**12r**) ·d(AGTGA**X**CTAC), **X** = A, T, C and G. Condition: PNA:DNA 1:1, [PNA] = 1μM, 10 mM sodium phosphate buffer, pH 7.0, heating rate 1.0 °C/min.

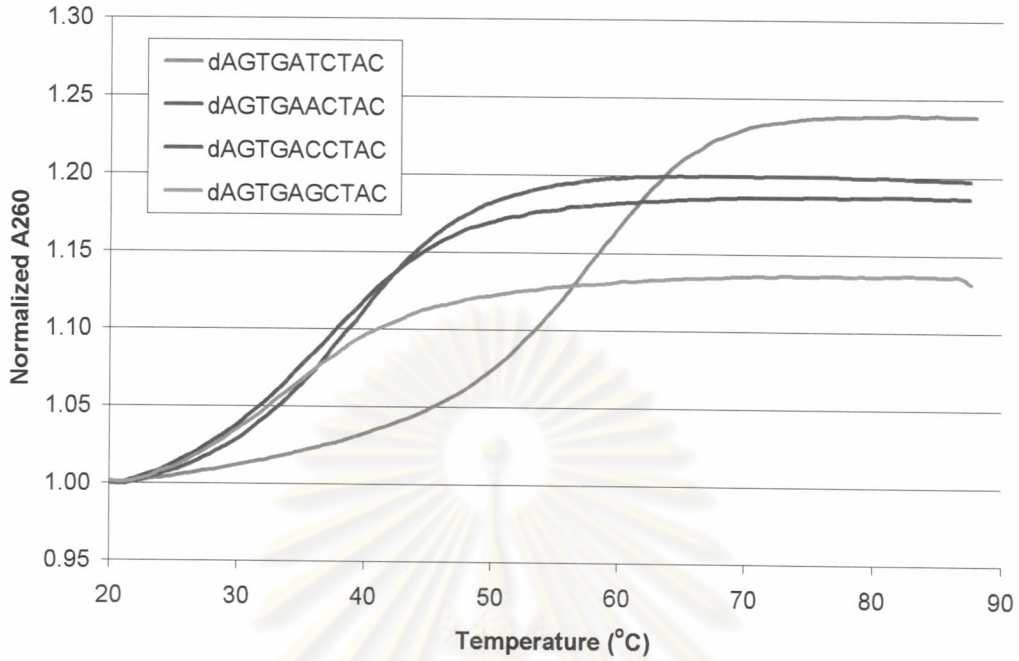

Figure A.79 The melting curves of hybrid between PNA Ac-GTAGATCACT-LysNH$_2$ (**12r**) ·d(AGTG**Y**TCTAC), **Y** = A, T, C and G. Condition: PNA:DNA 1:1, [PNA] = 1μM, 10 mM sodium phosphate buffer, pH 7.0, heating rate 1.0 °C/min.

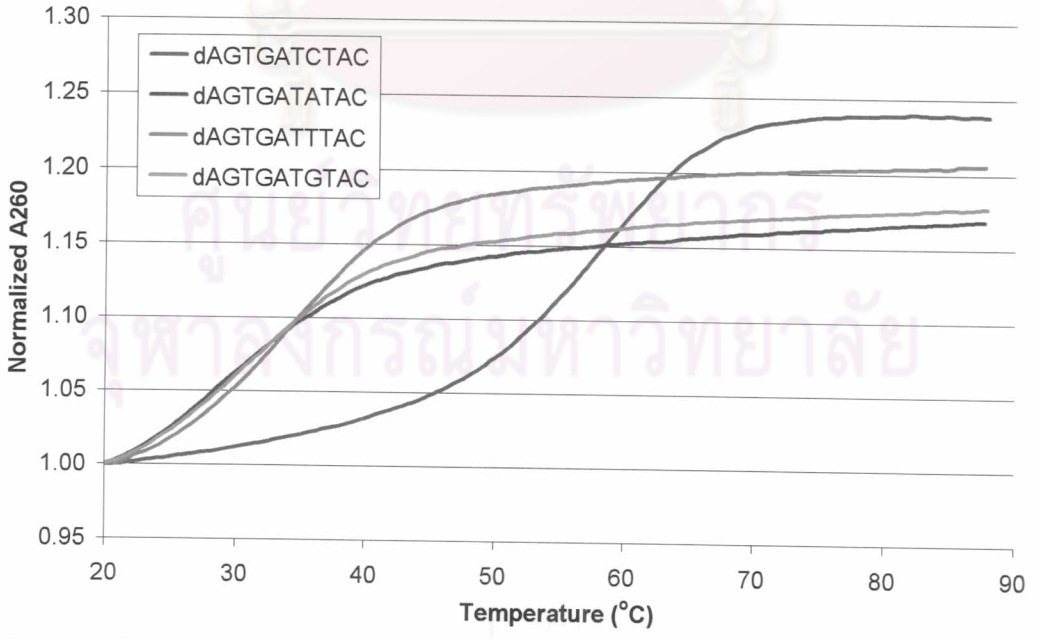

Figure A.80 The melting curves of hybrid between PNA Ac-GTAGATCACT-LysNH$_2$ (**12r**) ·d(AGT**Z**ATCTAC), **Z** = A, T, C and G. Condition: PNA:DNA 1:1, [PNA] = 1μM, 10 mM sodium phosphate buffer, pH 7.0, heating rate 1.0 °C/min.

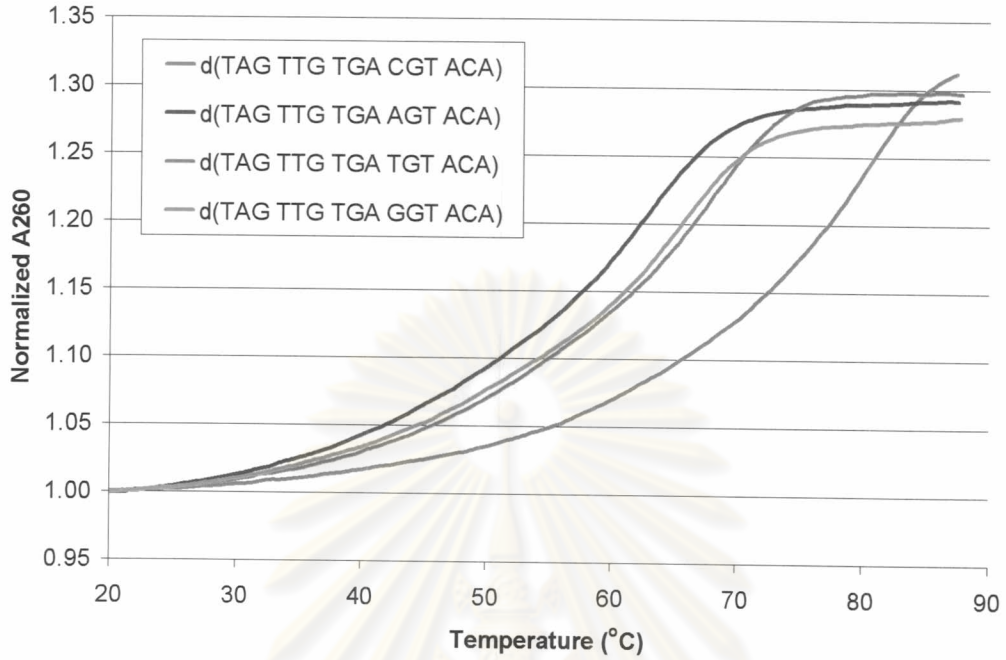

Figure A.81 The melting curves of hybrid between PNA AcLys-TGTACGTCACAACTA-NH_2 (**12x**) ·d(TAGTTGTGA**W**GTACA), **W** = A, T, C and G. Condition: PNA:DNA 1:1, [PNA] = 1μM, 10 mM sodium phosphate buffer, pH 7.0, heating rate 1.0 °C/min.

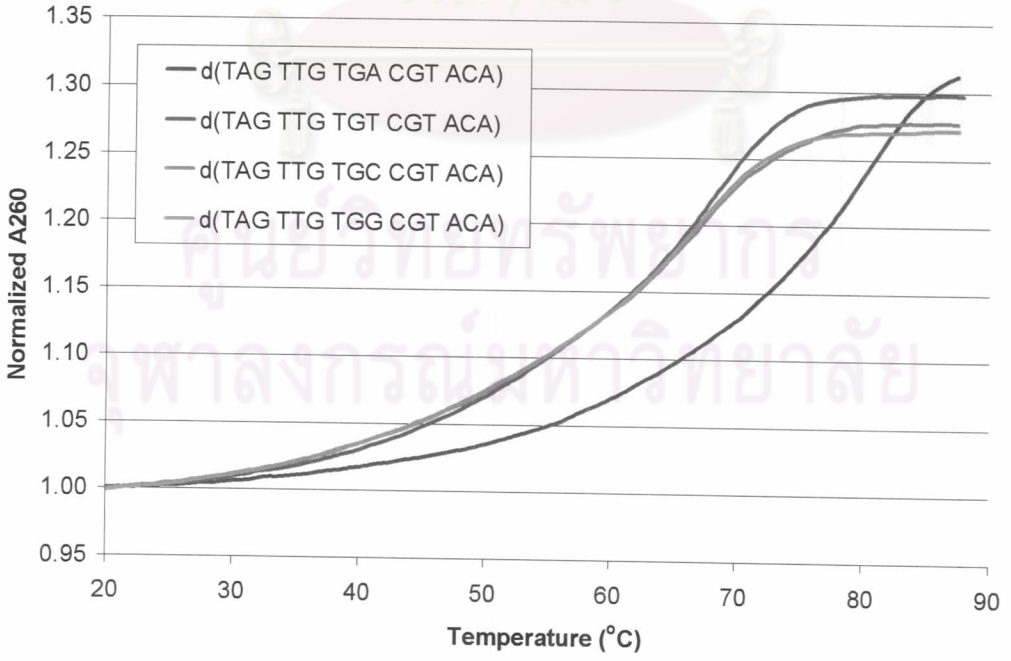

Figure A.82 The melting curves of hybrid between PNA AcLys-TGTACGTCACAACTA-NH_2 (**12x**) ·d(TAGTTGTG**X**CGTACA), **X** = A, T, C and G. Condition: PNA:DNA 1:1, [PNA] = 1μM, 10 mM sodium phosphate buffer, pH 7.0, heating rate 1.0 °C/min.

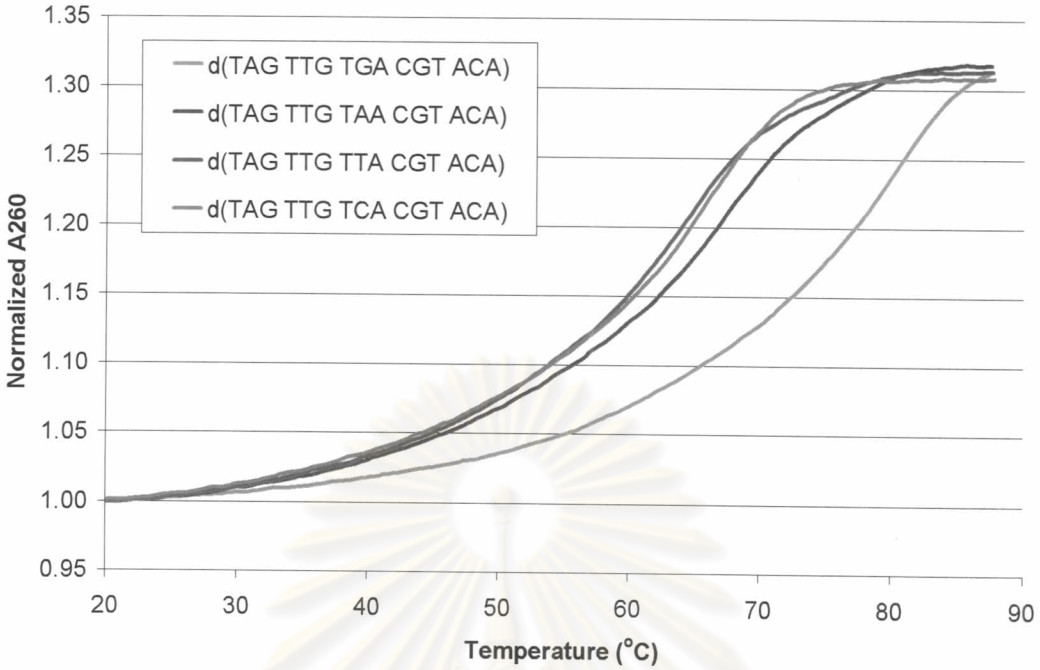

Figure A.83 The melting curves of hybrid between PNA AcLys-TGTACGTCACAACTA-NH_2 (**12x**) ·d(TAGTTGT**Y**ACGTACA), **Y** = A, T, C and G. Condition: PNA:DNA 1:1, [PNA] = 1μM, 10 mM sodium phosphate buffer, pH 7.0, heating rate 1.0 °C/min.

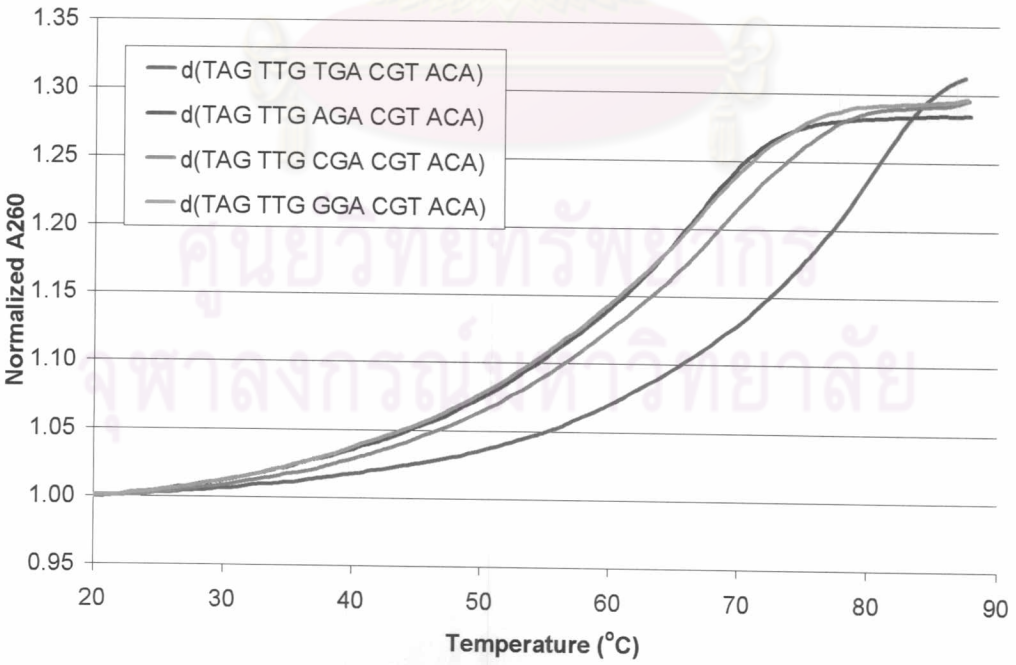

Figure A.84 The melting curves of hybrid between PNA AcLys-TGTACGTCACAACTA-NH_2 (**12x**) ·d(TAGTTG**Z**GACGTACA), **Z** = A, T, C and G. Condition: PNA:DNA 1:1, [PNA] = 1μM, 10 mM sodium phosphate buffer, pH 7.0, heating rate 1.0 °C/min.

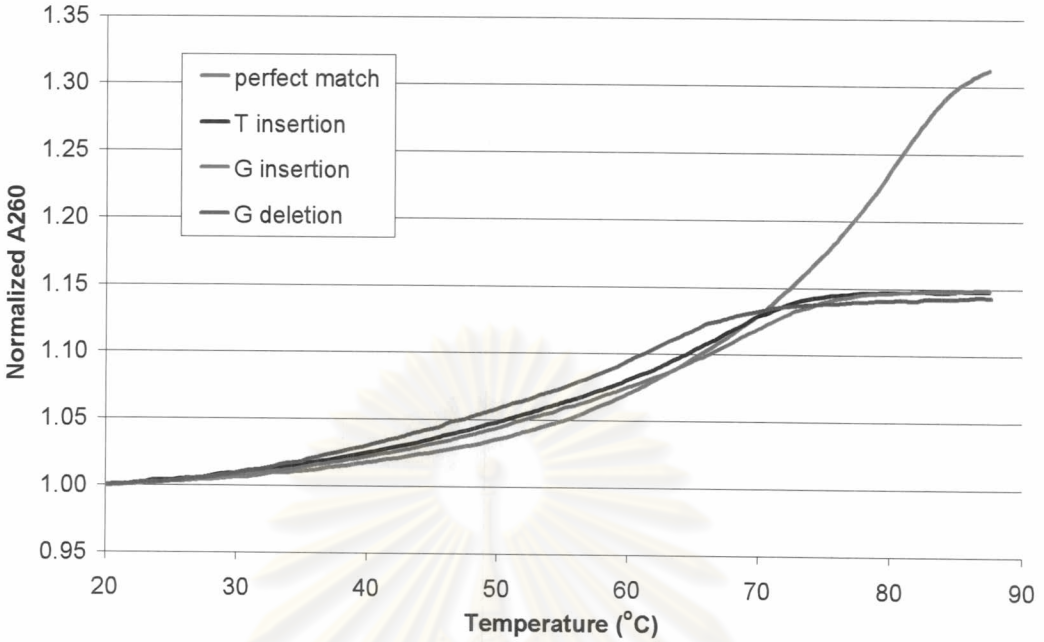

Figure A.85 The melting curves of PNA AcLys- TGTACGTCACAACTA-NH_2 (**12x**) with d(TAGTTGTG**T**ACGTACA) (T insertion), d(TAGTTGTG**G**ACGTACA) (G insertion) and d(TAGTTG**TA**CGTACA) (G deletion). Condition: PNA:DNA 1:1, [PNA] = 1μM, 10 mM sodium phosphate buffer, pH 7.0, heating rate 1.0 °C/min insertion and deletion

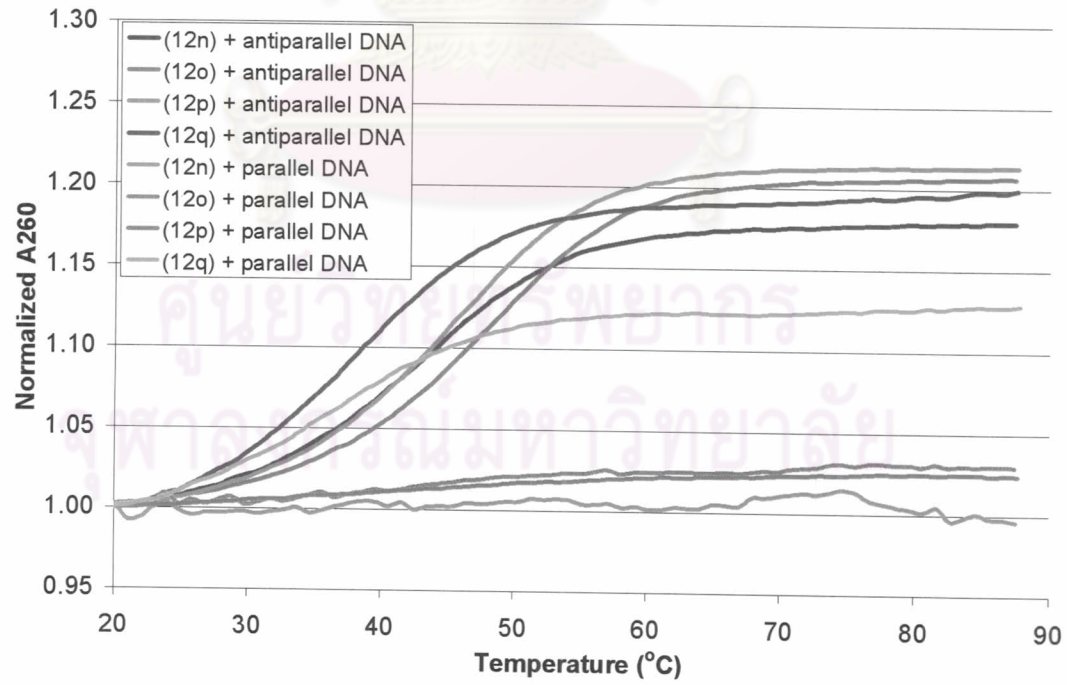

Figure A.86 The melting curves of antiparallel and parallel hybrids of PNA Ac-TCAC**X**ACTA-LysNH_2, **X** = T, A, G and C (**12n-12q**) with complementary DNA. Condition: PNA:DNA 1:1, [PNA] = 1μM, 10 mM sodium phosphate buffer, pH 7.0, heating rate 1.0 °C/min

VITA

Choladda (Choksomboonkul) Srisuwannaket was born on March 25, 1972 in Bangkok, Thailand. She received Bachelor Degree of Science in Chemistry from Chulalongkorn University in 1993 and graduated with the Master Degree of Science in 1996. Since 2001 she has become a student in Doctor of Philosophy of Chulalongkorn University studying in Department of Chemistry.