Supporting Information

Substrate stiffness and sequence of bioactive peptide hydrogels influence the chondrogenic differentiation of human mesenchymal stem sells

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Supporting Information

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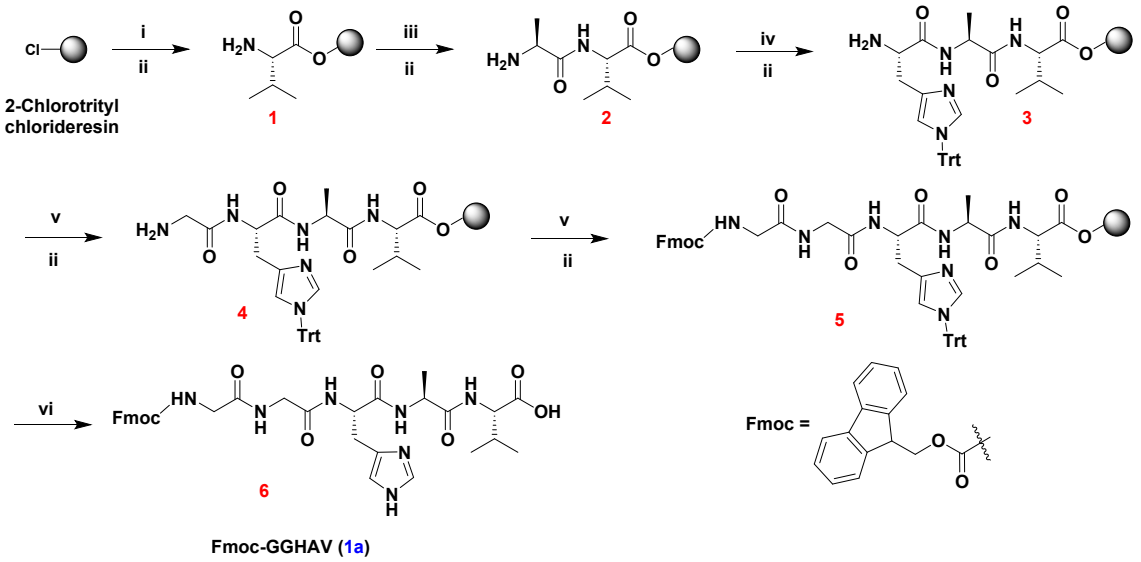
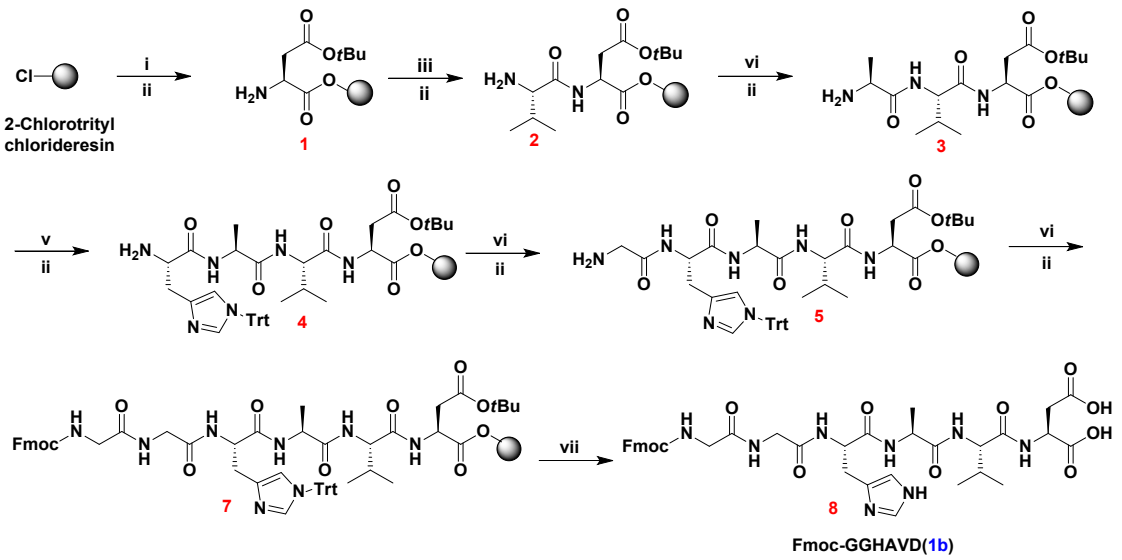
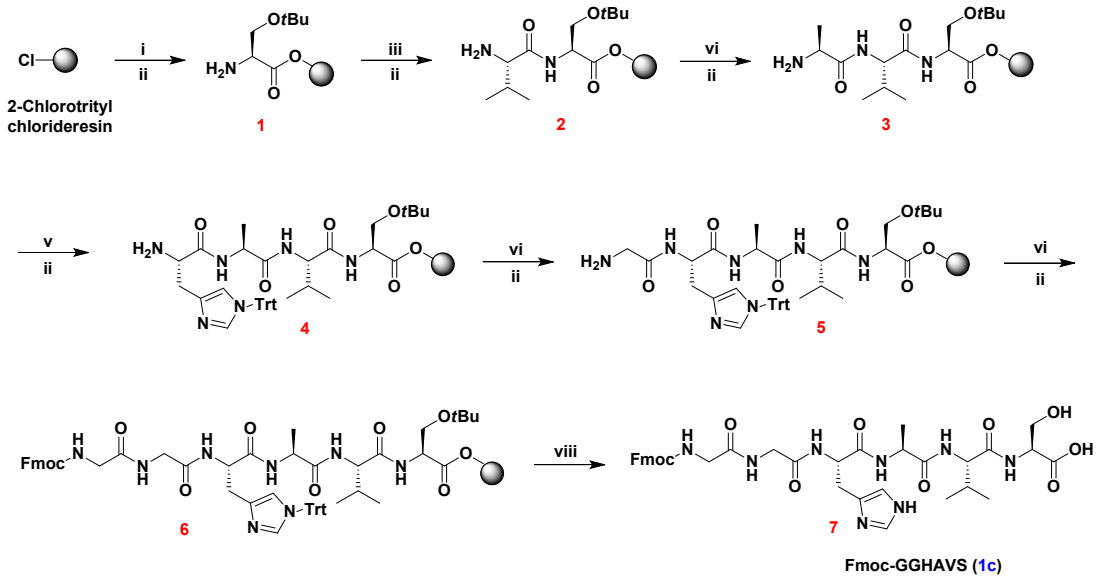
Experimental Section:



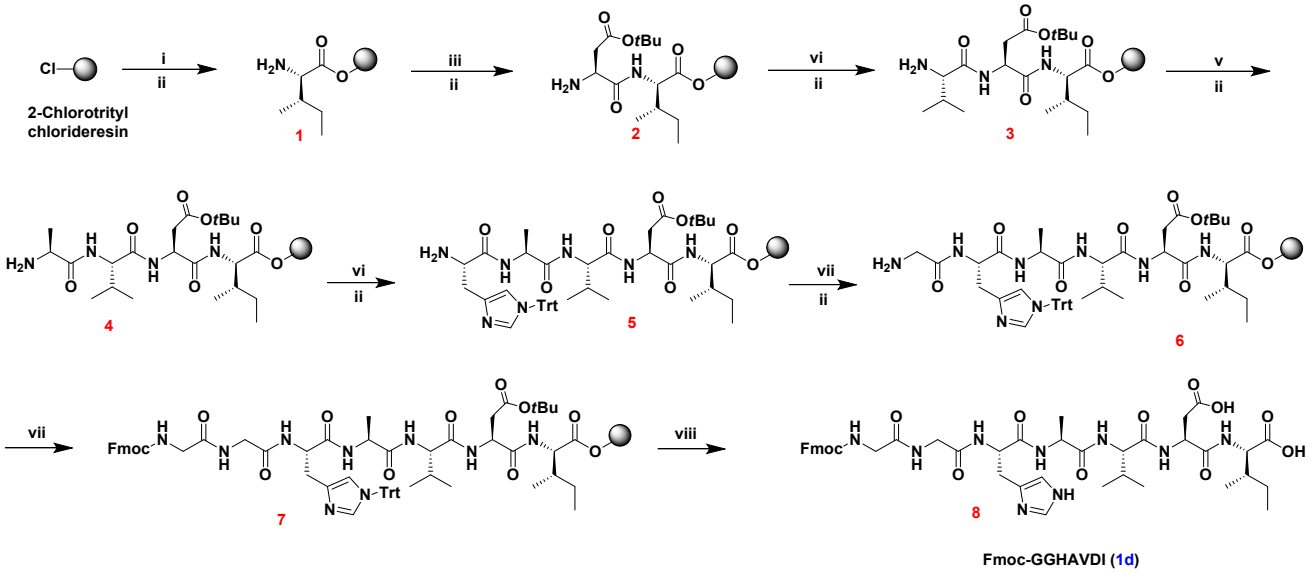
Scheme S1. Synthetic scheme for Fmoc-GGHAV: (i) Fmoc-Val-OH, DIEA; (ii) 20% Piperidine; (iii) Fmoc-Ala-OH, HBTU, DIEA; (iv) Fmoc-His(Trt)-OH, HBTU, DIEA; (v) Fmoc-Gly-OH, HBTU, DIEA; (vi) TFA: TIPS: water = 95:2.5:2.5 v/v%



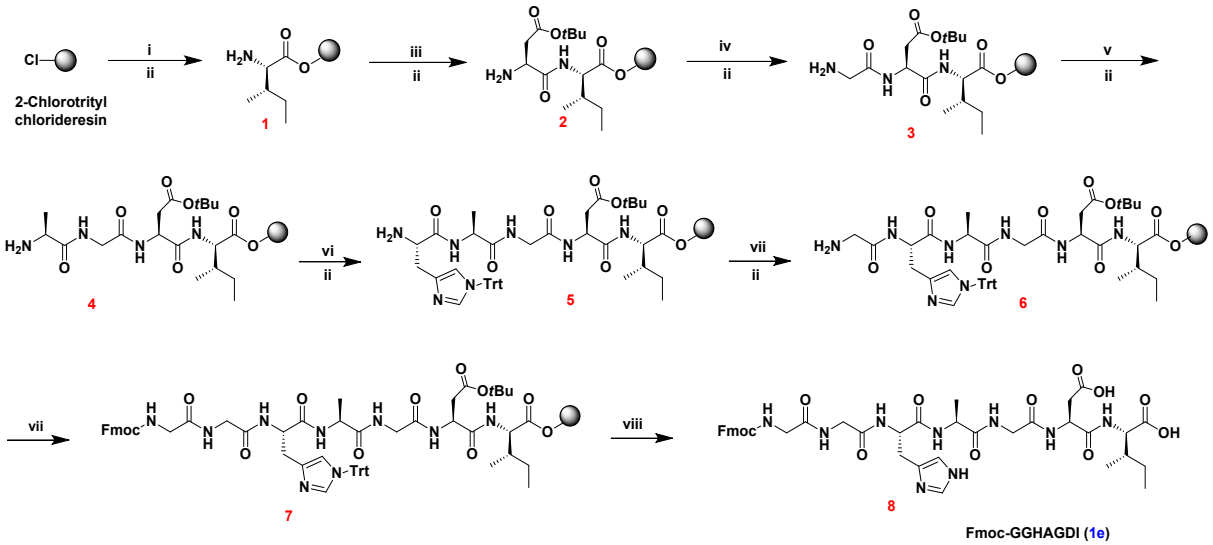
Scheme S2. Synthetic scheme for Fmoc-GGHAVD: (i) Fmoc-Asp(O*t*Bu)-OH, DIEA; (ii) 20% Piperidine; (iii) Fmoc-Val-OH, HBTU, DIEA (iv) Fmoc-Ala-OH, HBTU, DIEA; (v) Fmoc-His (Trt)-OH, HBTU, DIEA; (vi) Fmoc-Gly-OH, HBTU, DIEA; (vii) TFA:TIPS:water = 95:2.5:2.5 v/v%



Scheme S3. Synthetic scheme for Fmoc-GGHAVS: Fmoc-Ser(O*t*Bu)-OH, DIEA; (ii) 20% Piperidine; (iii) Fmoc-Val-OH, HBTU, DIEA (iv) Fmoc-Ala-OH, HBTU, DIEA; (v) Fmoc-His(Trt)-OH, HBTU, DIEA; (vi) Fmoc-Gly-OH, HBTU, DIEA; (vii) TFA:TIPS:water = 95:2.5:2.5 v/v% .

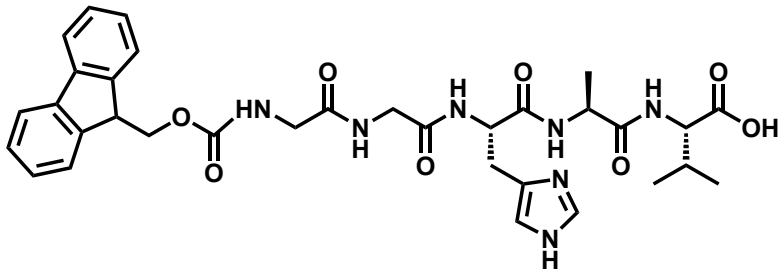


Scheme S4. Synthetic scheme for Fmoc-GGHAVDI: Fmoc-Ile-OH, DIEA; (ii) 20% Piperidine; (iii) Fmoc-Asp(O*t*Bu)-OH, HBTU, DIEA (iv) Fmoc-Val-OH, HBTU, DIEA (v) Fmoc-Ala-OH, HBTU, DIEA; (vi) Fmoc-His(Trt)-OH, HBTU, DIEA; (vii) Fmoc-Gly-OH, HBTU, DIEA; (viii) TFA: TIPS: water = 95:2.5:2.5 v/v%



Scheme S5. Synthetic scheme for Fmoc-GGHAGDI: Fmoc-Ile-OH, DIEA; (ii) 20% Piperidine; (iii) Fmoc-Asp(O*t*Bu)-OH, HBTU, DIEA (iv) Fmoc-Gly-OH, HBTU, DIEA (v) Fmoc-Ala-OH, HBTU, DIEA; (vi) Fmoc-His(Trt)-OH, HBTU, DIEA; (vii) Fmoc-Gly-OH, HBTU, DIEA; (viii) TFA: TIPS: water = 95:2.5:2.5 v/v%.

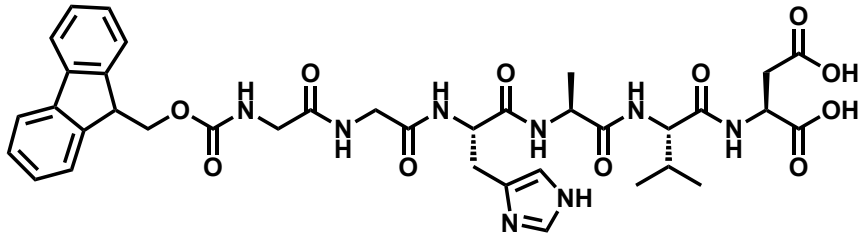
Synthesis of Fmoc-GGHAV (1a):



The peptide derivatives were synthesized by a solid-phase peptide synthesis using 2-chlorotrityl chloride resin as the solid phase substrate. Briefly, the resin (1.2 g, 2.0 mmol) was suspended in anhydrous dichloromethane and allowed to swell for 30 minutes with continuous stirring. The first amino acid Fmoc-Val-OH (2.0 mmol) and *N,N*-diisopropylethylamine DIEA (5.0 mmol) were dissolved in an appropriate amount of anhydrous dimethylformamide (DMF) and then added to the resin. The reaction was carried out for 1 hr to allow the amino acid to be attached to the resin. The Fmoc protecting group was then removed by reacting with 20% piperidine in DMF for 30 minutes, and the washing was repeated twice. Then, second amino acid Fmoc-Ala-OH (2.0 mmol) was coupled to amine using coupling agent *O*-(Benzotriazol-1-yl)-*N,N,N',N'*-tetramethyluronium hexafluorophosphate, HBTU (2.0 mmol) and DIEA (5.0 mmol) was dissolved in anhydrous DMF, and the solution was added to the resin to react for 60 minutes. After 1 hr reaction the Fmoc group was deprotected by reacting with 20% piperidine in DMF for an additional 30 minutes, and washing was repeated twice. The third amino acid Fmoc-His(Trt)-OH (2.0 mmol) was coupled to amine using coupling agent HBTU (2.0 mmol) and DIEA (5.0 mmol) was dissolved in anhydrous DMF, and the solution was added to the resin to react for 1 hr. The Fmoc group was then deprotected by reacting with 20% piperidine in DMF for 30 minutes, and washing was repeated twice. The fourth amino acid Fmoc-Gly-OH (2.0 mmol) was coupled to amine using coupling agent HBTU (2.0 mmol) and DIEA (5.0 mmol) was dissolved in anhydrous DMF, and the resulting solution was added to the resin to react for 1 hr. The Fmoc group was deprotected by reacting 20% piperidine DMF for 30 minutes,

and washing was repeated twice. The fifth amino acid Fmoc-Gly-OH (2.0 mmol) was coupled to amine using coupling agent HBTU (2.0 mmol) and DIEA (5.0 mmol) was dissolved in anhydrous DMF, and the resulting solution was added to the resin to react for 1 hr. Finally, the solvent was removed, and the resin was cleaved by adding trifluoroacetic acid (TFA) 95% with deionized water and Triisopropylsilane (TIPS) 2.5% each for 3 hrs. The resulting solution was air-dried, and then diethyl ether was added to precipitate the target product. The solid was dried under vacuum to remove residual solvents. ^{1}H NMR (300 MHz, DMSO-d_6): δ =0.91 (d, *J* = 6.6 Hz, 6H; $2CH_3$), 1.28 (d, *J* = 6.9 Hz, 3H; CH_3), 2.20-2.09 (m, 1H, CH), 3.20-2.95 (m, 2H; CH_2), 3.77-3.68 (m, 4H; $2CH_2$), 4.43-4.23 (m, 5H; 3CH, CH_2), 4.68-4.66 (m, 1H; CH), 7.47-7.22 (m, 5H; 4ArH; Imidazole H), 7.66-7.64 (m, 1H; NH), 7.74 (d, *J* = 7.2 Hz, 2H; 2ArH), 7.92 (d, *J* = 7.5 Hz, 2H; 2ArH), 8.25-8.16 (m, 4H; 4NH), 9.00 (s, 1H; Imidazole CH), ppm ; ^{13}C NMR (75 MHz, DMSO-d_6): δ =18.8, 20.0, 28.1, 30.9, 43.0, 44.5, 47.6, 49.2, 52.1, 58.1, 66.7, 118.1, 121.0, 126.2, 127.6, 128.0, 128.5, 128.6, 128.7, 129.9, 134.7, 141.7, 144.8, 148.7, 157.5, 169.7, 170.3, 170.5, 173.8, ppm;, HRMS (ESI) *m/z* : [*M*-H]$^-$ calcd for $C_{33}H_{38}N_7O_8$: 660.2787, obsvd: 660.2791

Synthesis of Fmoc-GGHAVD (1b):

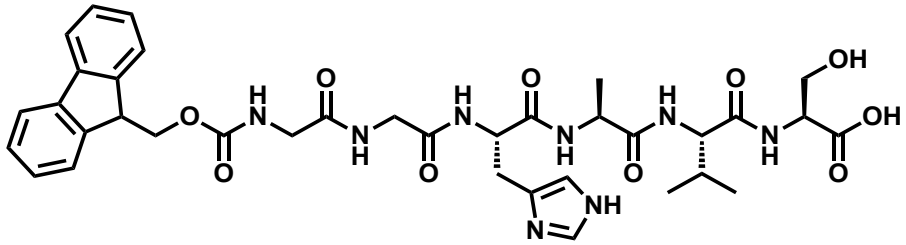


The peptide derivatives were synthesized by a solid-phase peptide synthesis using 2-chlorotrityl chloride resin as the solid phase substrate. Briefly, the resin (1.2 g, 2.0 mmol) was suspended in anhydrous dichloromethane and allowed to swell for 30 minutes with continuous stirring. The Fmoc-Asp(O*t*Bu)-OH (2.0 mmol) and DIEA (5.0 mmol) were dissolved in an appropriate amount of anhydrous DMF and then added to the resin. The reaction was carried out for 1 hr to allow the amino acid to be attached to the

resin. The Fmoc protecting group was then removed by reacting with 20% piperidine in DMF for 30 minutes, and the washing was repeated twice. The second amino acid Fmoc-Val-OH (2.0 mmol) was coupled to amine using coupling agent HBTU (2.0 mmol) and DIEA (5.0 mmol) dissolved in an anhydrous DMF, and the solution was added to SPPS apparatus to react for 1 hr and the Fmoc group was deprotected with 20% piperidine in DMF for 30 minutes, and washing was repeated twice. Then, third amino acid Fmoc-Ala-OH (2.0 mmol) was coupled to amine using coupling agent HBTU (2.0 mmol) and DIEA (5.0 mmol) was dissolved in an anhydrous DMF, and the solution was added to the resin to react for 60 minutes. After 1 hr reaction the Fmoc group was deprotected by reacting with 20% piperidine in DMF for an additional 30 minutes, and washing was repeated twice. The fourth amino acid Fmoc-His(Trt)-OH (2.0 mmol) was coupled to amine using a coupling agent, HBTU (2.0 mmol) and DIEA (5.0 mmol) was dissolved anhydrous DMF, and the solution was added to the resin to react for 1 hr. The Fmoc group was then deprotected by reacting with 20% piperidine in DMF for 30 minutes, and washing was repeated twice. The fifth amino acid Fmoc-Gly-OH (2.0 mmol) was coupled to amine using coupling agent HBTU (2.0 mmol) and DIEA (5.0 mmol) was dissolved in anhydrous DMF, and the resulting solution was added to the resin to react for 1 hr. The Fmoc group was deprotected by reacting 20% piperidine in DMF for 30 minutes, and washing was repeated twice. The sixth amino acid Fmoc-Gly-OH (2.0 mmol) was coupled to amine using coupling agent HBTU (2.0 mmol) and DIEA (5.0 mmol) was dissolved in anhydrous DMF, and the resulting solution was added to the resin to react for 1 hr. Finally, the solvent was removed, and the resin was cleaved by adding. TFA 95% with deionized water and TIPS 2.5% each for 3 hrs. The resulting solution was air-dried, and then diethyl ether was added to precipitate the target product. The solid was dried under vacuum to remove residual solvents. ^{1}H NMR (300 MHz, DMSO-d_6): δ = 0.90-0.85 (m, 6H; 2CH_3), 1.29-1.26 (m, 3H; CH_3), 2.05-1.85 (m, 1H, CH), 2.73-2.65 (m, 2H; CH_2), 3.11-3.04 (m, 2H; CH_2), 3.77-3.68 (m, 4H; 2CH_2), 4.67-4.23 (m, 7H; 5CH, CH_2), 7.64-7.34 (m, 5H; 4ArH; Imidazole H), 7.75-7.66 (m, 3H; 2ArH, NH), 8.04- 7.92 (m, 3H; 2ArH, NH), 8.27- 8.18 (m, 4H; 4NH), 8.99 (s, 1H; Imidazole CH) ppm; ^{13}C NMR (75 MHz,

DMSO-d_6): δ =18.7, 20.0, 28.2, 31.8, 36.8, 43.0, 44.5, 47.6, 49.5, 52.1, 58.3, 66.7, 118.1, 121.1, 126.2, 128.0, 128.6, 130.0, 134.7, 141.7, 144.8, 157.5, 169.8, 170.4, 170.6, 171.5, 172.6, 173.2, 173.5 ppm; HRMS (ESI) *m/z* : [*M*-H]$^-$ calcd for $C_{37}H_{43}N_8O_{11}$: 775.3057, obsvd: 775.3070.

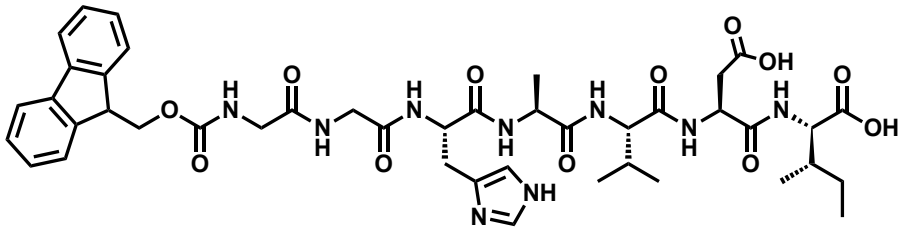
Synthesis of Fmoc-GGHAVS (1c):



The peptide derivatives were synthesized by a solid-phase peptide synthesis using 2-chlorotrityl chloride resin as the solid phase substrate. Briefly, the resin (1.2 g, 2.0 mmol) was suspended in anhydrous dichloromethane and allowed to swell for 30 minutes with continuous stirring. The first amino acid Fmoc-Ser(O*t*Bu)-OH (2.0 mmol) and DIEA (5.0 mmol) were dissolved in an appropriate amount of anhydrous DMF and then added to the resin. The reaction was carried out for 1 hr to allow the amino acid to be attached to the resin. The Fmoc protecting group was then removed by reacting with 20% piperidine in DMF for 30 minutes, and the washing was repeated twice Then, second amino acid Fmoc-Val-OH (2.0 mmol) was coupled to amine using coupling agent HBTU (2.0 mmol) and DIEA (5.0 mmol) was dissolved in an anhydrous DMF, and the solution was added to the resin to react for 1 hr. After that, the Fmoc group was deprotected by reacting with 20% piperidine in DMF for an additional 30 minutes, and washing was repeated twice. The third amino acid Fmoc-Ala-OH (2.0 mmol) was coupled to amine using HBTU (2.0 mmol) and DIEA (5.0 mmol) was dissolved anhydrous DMF, and the solution was added to the resin to react for 1 hr. The Fmoc group was then deprotected by reacting with 20% piperidine in DMF for 30 minutes, and washing was repeated twice. The fourth amino acid Fmoc-His(Trt)-OH (2.0 mmol) was coupled to amine using coupling agent HBTU (2.0 mmol) and DIEA (5.0 mmol) was dissolved in anhydrous

DMF, and the resulting solution was added to the resin to react for 1 hr. The Fmoc group was deprotected by reacting 20% piperidine in DMF for 30 minutes, and washing was repeated twice. The fifth amino acid Fmoc-Gly-OH (2.0 mmol) was coupled to amine using coupling agent HBTU (2.0 mmol) and DIEA (5.0 mmol) was dissolved in anhydrous DMF, and the resulting solution was added to the resin to react for 1 hr. The Fmoc group was deprotected by reacting 20% piperidine in DMF for 30 minutes, and washing was repeated twice. The sixth amino acid Fmoc-Gly-OH (2.0 mmol) was coupled to amine using coupling agent HBTU (2.0 mmol) and DIEA (5.0 mmol) was dissolved in anhydrous DMF, and the resulting solution was added to the resin to react for 1 hr. Finally, the solvent was removed, and the resin was cleaved by adding TFA 95% with deionized water and TIPS 2.5% each for 3 hrs. The resulting solution was air-dried, and then diethyl ether was added to precipitate the target product. The solid was dried under vacuum to remove residual solvents. ^{1}H NMR (300 MHz, DMSO-d_6): δ = 0.87-0.82 (m, 6H; 2CH_3), 1.22 (d, *J* = 7.0 Hz, 3H; CH_3), 2.02-1.98 (m, 1H, CH), 2.95-2.82 (m, 2H; CH_2), 3.05-3.03 (m, 2H; CH_2), 3.72-3.61 (m, 4H; 2CH_2), 4.34-4.21 (m, 6H; 4CH, CH_2), 4.58-4.57 (m, 1H; 1CH), 7.23 (s, 1H; Imidazole H), 7.34-7.31 (m, 2H; 2ArH), 7.43-7.40 (m, 2H; 2ArH), 7.59-7.56 (m, 1H; 1NH), 7.70 (d, *J* = 7.5 Hz, 2H; 2ArH), 7.89 (d, *J* = 7.5 Hz, 2H; 2ArH), 7.94-7.93 (m, 1H; 1NH), 8.05-8.03 (m, 1H; 1NH), 8.12-8.09 (m, 2H; 2NH), 8.18-8.17 (m, 1H; 1NH), 8.64 (s, 1H; Imidazole CH) ppm; ^{13}C NMR (125 MHz, DMSO-d_6): δ =17.9, 19.2, 27.7, 30.9, 42.1, 43.6, 46.7, 48.7, 51.6, 54.8, 57.4, 61.3, 65.9, 117.2, 120.2, 125.3, 127.1, 127.7, 129.9, 133.9, 140.8, 143.9, 156.7, 168.9, 169.8, 170.9, 171.8, 172.5, ppm; HRMS (ESI) m/z : $[M-H]^-$ calcd for $C_{36}H_{43}N_8O_{10}$: 747.3108, obsvd: 747.3117.

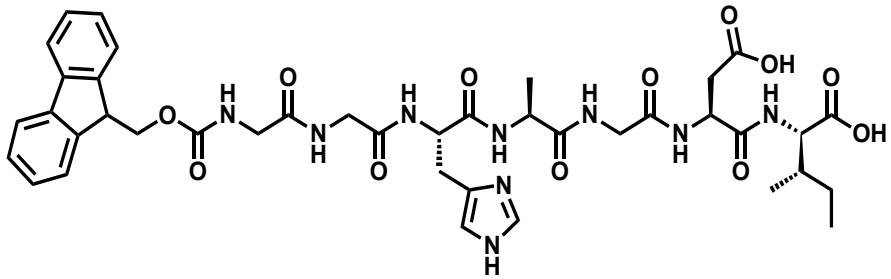
Synthesis of Fmoc-GGHAVDI (1d):



The peptide derivatives were synthesized by a solid-phase peptide synthesis using 2-chlorotrityl chloride resin as the solid phase substrate. Briefly, the resin (1.2 g, 2.0 mmol) was suspended in anhydrous dichloromethane and allowed to swell for 30 minutes with continuous stirring. The Fmoc-Ile (2.0 mmol) and DIEA (5.0 mmol) were dissolved in an appropriate amount of anhydrous DMF and then added to the resin. The reaction was carried out for 1 hr to allow the amino acid to be attached to the resin. The Fmoc protecting group was then removed by reacting with 20% piperidine in DMF for 30 minutes, and the washing was repeated twice. The second amino acid Fmoc-Asp(O*t*Bu)-OH (2.0 mmol) was coupled to amine using coupling agent HBTU (2.0 mmol) and DIEA (5.0 mmol) dissolved in an anhydrous DMF, and the solution was added to SPPS apparatus to react for 1 hr and the Fmoc group was deprotected with 20% piperidine in DMF for 30 minutes, and washing was repeated twice. The third amino acid Fmoc-Val-OH (2.0 mmol) was coupled to amine using coupling agent HBTU (2.0 mmol) and DIEA (5.0 mmol) dissolved in an anhydrous DMF, and the solution was added to SPPS apparatus to react for 1 hr and the Fmoc group was deprotected with 20% piperidine in DMF for 30 minutes, and washing was repeated twice. Then, the fourth amino acid Fmoc-Ala-OH (2.0 mmol) was coupled to amine using coupling agent HBTU (2.0 mmol) and DIEA (5.0 mmol) was dissolved in an anhydrous DMF, and the solution was added to the resin to react for 1 hr. After that, reaction the Fmoc group was deprotected by reacting with 20% piperidine in DMF for an additional 30 minutes, and washing was repeated twice. The fifth amino acid Fmoc-His(Trt)-OH (2.0 mmol) was coupled to amine using coupling agent HBTU (2.0 mmol) and DIEA (5.0 mmol) was dissolved anhydrous DMF, and the solution was added to the resin to react for 1 hr. The Fmoc group was then deprotected by reacting with 20% piperidine in DMF for 30 minutes, and washing was repeated twice. The sixth amino acid Fmoc-Gly-OH (2.0 mmol) was coupled to amine using a coupling agent, HBTU (2.0 mmol), and DIEA (5.0 mmol) was dissolved in anhydrous DMF, and the resulting solution was added to the resin to react for 1 hr. The Fmoc group was deprotected by reacting 20% piperidine in DMF for 30 minutes, and washing was repeated twice. The seventh amino acid Fmoc-Gly-OH (2.0 mmol) was coupled

to amine using a coupling agent (2.0 mmol) and DIEA (5.0 mmol) was dissolved in anhydrous DMF, and the resulting solution was added to the resin to react for 1 hr. Finally, the solvent was removed, and the resin was cleaved by TFA 95% with deionized water and TIPS 2.5% each for 3 hrs. The resulting solution was air-dried, and then diethyl ether was added to precipitate the target product. The solid was dried under vacuum to remove residual solvents ^{1}H NMR (300 MHz, DMSO-d_6): δ = 0.89-0.84 (m, 12H; 4CH_3), 1.28-1.22 (m, 4H; CH, CH_3), 1.45-1.40 (m, 1H, CH), 2.10-1.75 (m, 2H; 2CH), 2.75-2.65 (m, 2H; CH_2), 3.15-2.95 (m, 2H; CH_2), 3.85- 3.65 (m, 4H; 2CH_2), 4.40-4.18 (m, 6H; 4CH, CH_2), 4.75-4.60 (m, 2H; 2CH), 7.49-7.34 (m, 5H; 4ArH; Immidazole H), 7.64 (bs, 1H; NH), 7.85-7.73 (m, 3H; 2ArH, NH), 8.07-7.92 (m, 3H; 2ArH, NH), 8.27-8.17 (m, 4H; 4NH), 8.99 (s, 1H; Immidazole H), ppm; ^{13}C NMR (75 MHz, DMSO-d_6): δ =12.2, 16.4, 18.7, 20.1, 25.5, 28.1, 31.8, 36.8, 37.4, 43.0, 44.5, 47.6, 49.5, 50.3, 52.1, 57.2, 58.4, 66.7, 118.1, 121.1, 126.2, 128.0, 128.6, 128.7, 130.0, 134.6, 141.7, 144.8, 157.5, 169.8, 170.4, 170.6, 171.3, 171.7, 172.5, 173.5, ppm; HRMS (ESI) *m/z* : [*M*-H]$^-$ calcd for $C_{43}H_{54}N_9O_{12}$: 888.3897, obsvd: 888.3928.

Synthesis of Fmoc-GGHAGDI (1e):



The peptide derivatives were synthesized by a solid-phase peptide synthesis using 2-chlorotrityl chloride resin as the solid phase substrate. Briefly, the resin (1.2 g, 2.0 mmol) was suspended in anhydrous dichloromethane and allowed to swell for 30 minutes with continuous stirring. The Fmoc-Ile-OH (2.0 mmol) and DIEA (5.0 mmol) were dissolved in an appropriate amount of anhydrous DMF and then added to the resin. The reaction was carried out for 1 hr to allow the amino acid to be attached to the resin. The Fmoc protecting group was then removed by reacting with 20% piperidine in DMF for 30 minutes, and the

washing was repeated twice. The second amino acid Fmoc-Asp(O*t*Bu)-OH (2.0 mmol) was coupled to amine using coupling agent HBTU (2.0 mmol) and DIEA (5.0 mmol) dissolved in an anhydrous DMF, and the solution was added to SPPS apparatus to react for 1 hr and the Fmoc group was deprotected with 20% piperidine in DMF for 30 minutes, and washing was repeated twice. The third amino acid Fmoc-Gly-OH (2.0 mmol) was coupled to amine using coupling agent HBTU (2.0 mmol) and DIEA (5.0 mmol) dissolved in an anhydrous DMF, and the solution was added to SPPS apparatus to react for 1 hr and the Fmoc group was deprotected with 20% piperidine in DMF for 30 minutes, and washing was repeated twice. Then, the fourth amino acid Fmoc-Ala-OH (2.0 mmol) was coupled to amine using coupling agent HBTU (2.0 mmol) and DIEA (5.0 mmol) was dissolved in an anhydrous DMF, and the solution was added to the resin to react for 1 hr. After that, reaction the Fmoc group was deprotected by reacting with 20% piperidine in DMF for an additional 30 minutes, and washing was repeated twice. The fifth amino acid Fmoc-His(Trt)-OH (2.0 mmol) was coupled to amine using coupling agent HBTU (2.0 mmol) and DIEA (5.0 mmol) was dissolved anhydrous DMF, and the solution was added to the resin to react for 1 hr. The Fmoc group was then deprotected by reacting with 20% piperidine in DMF for 30 minutes, and washing was repeated twice. The sixth amino acid Fmoc-Gly-OH (2.0 mmol) was coupled to amine using coupling agent HBTU (2.0 mmol) and DIEA (5.0 mmol) was dissolved in anhydrous DMF, and the resulting solution was added to the resin to react for 1 hr. The Fmoc group was deprotected by reacting 20% piperidine in DMF for 30 minutes, and washing was repeated twice. The seventh amino acid Fmoc-Gly-OH (2.0 mmol) was coupled to amine using coupling agent HBTU (2.0 mmol) and DIEA (5.0 mmol) was dissolved in anhydrous DMF, and the resulting solution was added to the resin to react for 1 hr. Finally, the solvent was removed, and the resin was cleaved by adding TFA 95% with deionized water and TIPS 2.5% each for 3 hrs. The resulting solution was air-dried, and then diethyl ether was added to precipitate the target product. The solid was dried under vacuum to remove residual solvents. ^{1}H NMR (300 MHz, DMSO-d_6): δ =0.84-0.80 (m, 6H; 2CH_3), 1.26-1.13 (m, 4H; CH, CH_3), 1.45-1.40 (m, 1H, CH), 1.85-1.74 (m, 1H, CH), 2.66-2.64 (m, 1H; CH_2), 3.15-2.93

(m, 3H; CH_2), 3.73- 3.64 (m, 6H; $3CH_2$), 4.40-4.12 (m, 5H; 3CH, CH_2), 4.67-4.59 (m, 2H; 2CH), 7.44-7.30 (m, 4ArH; Immidazole H), 7.60-7.58 (m, 1H; NH), 7.72-7.69 (m, 2H; 2ArH), 7.90-7.84 (m, 3H; NH, 2ArH), 8.21-8.09 (m, 4H; 4NH), 8.32 (bs, 1H; NH), 8.83 (s, 1H; Immidazole H), ppm; ^{13}C NMR (75 MHz, DMSO-d_6): δ = 12.3, 16.5, 18.8, 25.6, 28.0, 37.0, 37.3, 42.8, 43.1, 44.5, 47.6, 49.6, 50.2, 52.3, 57.4, 66.7, 118.0, 121.1, 126.2, 128.1, 128.6, 130.2, 134.7, 141.7, 144.8, 157.6, 169.6, 169.9, 170.6, 170.7, 171.6, 172.6, 173.7, ppm; HRMS (ESI) *m/z* : $[M\text{-H}]^-$ calcd for $C_{40}H_{48}N_9O_{12}$: 846.3428，obsvd: 846.3448.

Supplementary Figures and Tables

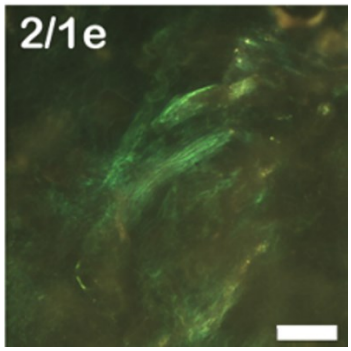


Figure. S1. The Congo red staining of **2/1e** co-gel at 2 wt% polarized optical microscopic image of **2/1e** stained with Congo red dye. (Scale bar = 100 µm).

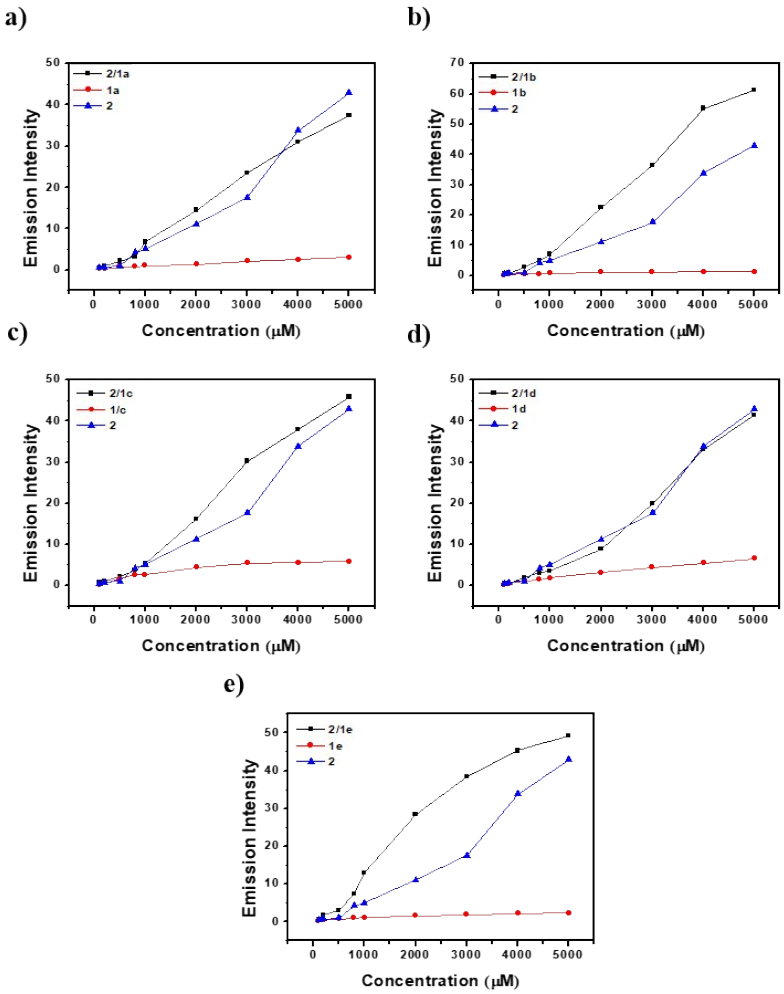


Figure. S2. The Th-T of 2 wt% co-gels : a) **2/1a**, b) **2/1b**; c) **2/1c**, d) **2/1d** and e) **2/1e**

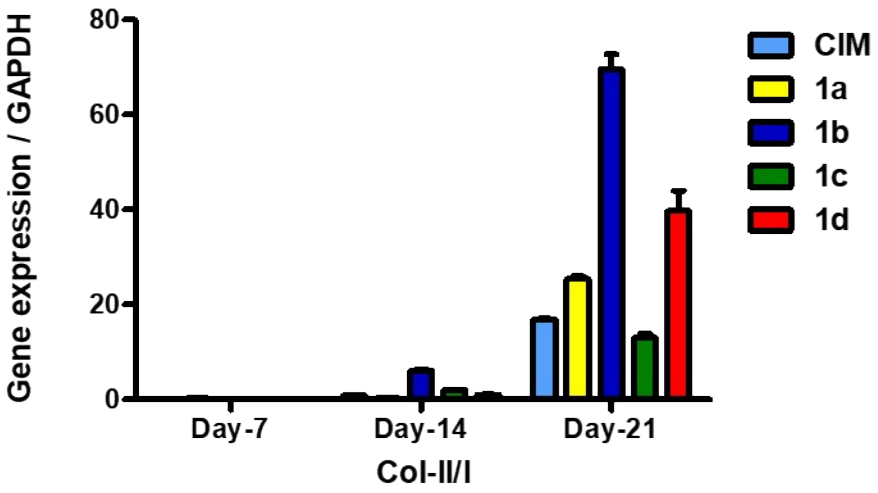


Figure. S3. Gene expression profiles of Col-II/I ratio of hMSCs exposed to peptide solutions of **1a, 1b, 1c, and 1d,** for the period of 21 days.

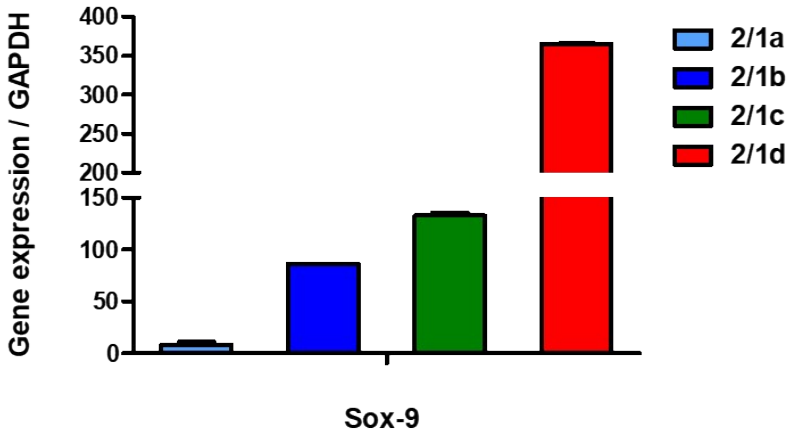


Figure. S4. Gene expression profile of chondrogenic marker Sox-9 of 3A6 cells cultured in a co-gels of **2/1a, 2/1b, 2/1c**, and **2/1d** for the period of 21 days culture. Gene expressions were normalized by GAPDH and CIM. The data are reported as the mean ± SD, n=3

Table.S1. Sequences of primers used for qPCR analysis

Gene	Forward primers (5´-3´)	Reverse primers (5´-3´)
COL-I	CCTGGAAAGAATGGAGATGATG	ATCCAAACCACTGAAACCTCTG
COL-II	GGTAAGTGGGGCAAGACTGTTA	TGTTGTTTCTGGGTTCAGGTTT
Sox-9	AGGAAGCTGGCAGACCAGTA	CGTTCTTCACCGACTTCCTC
Aggrecan	GTCAGATACCCCATCCACACTC	CATAAAAGACCTCACCCTCCAT
GAPDH	GAAGGTCGGAGTCAACGG	GGAAGATGGTGATGGGATT

^{1}H, ^{13}C NMR and HRMS spectra of all new compounds

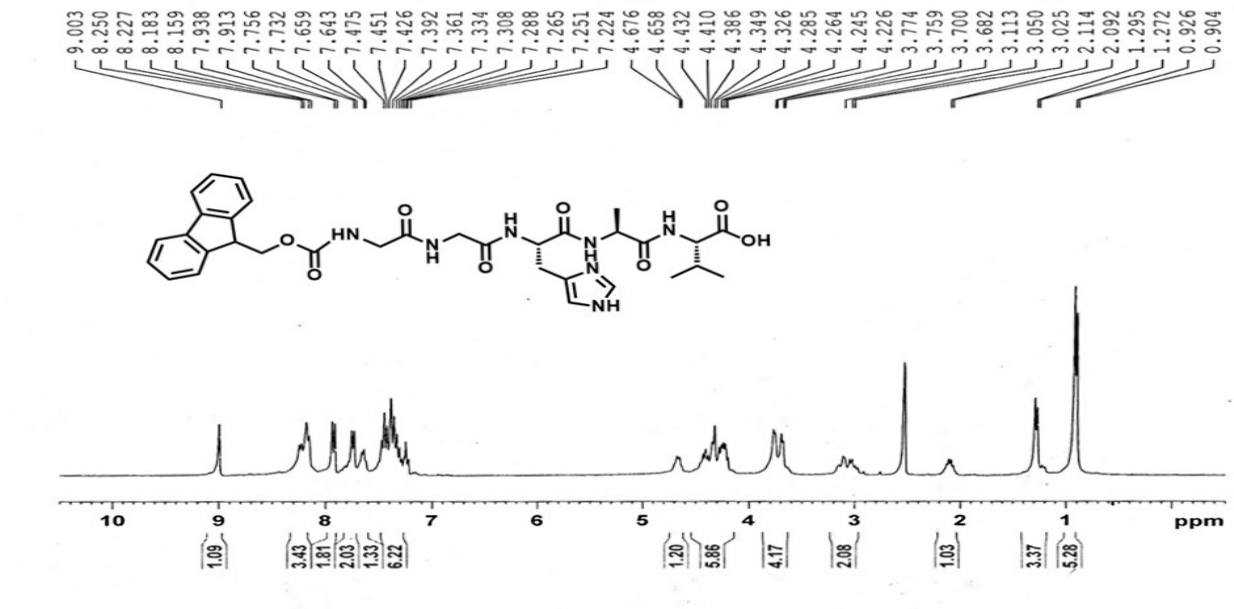


Figure. S5. ^{1}H NMR of Fmoc-GGHAV (**1a**) taken in DMSO-d_6

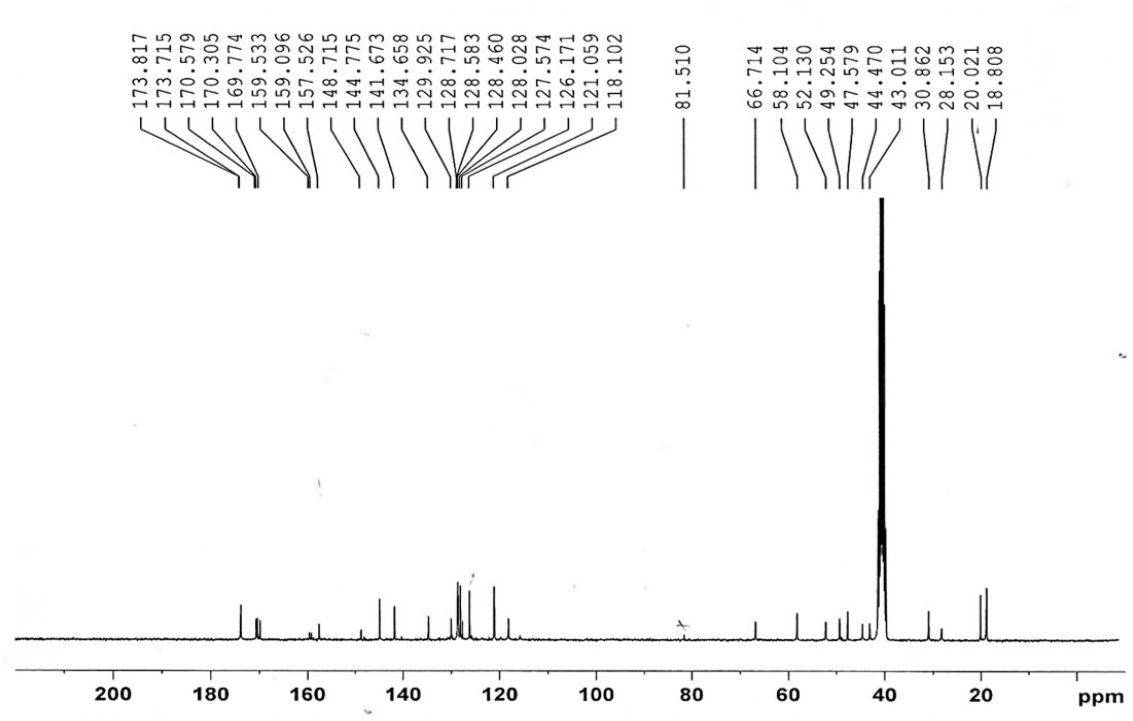


Figure. S6. ^{13}C NMR of Fmoc-GGHAV (**1a**) taken in DMSO-d_6

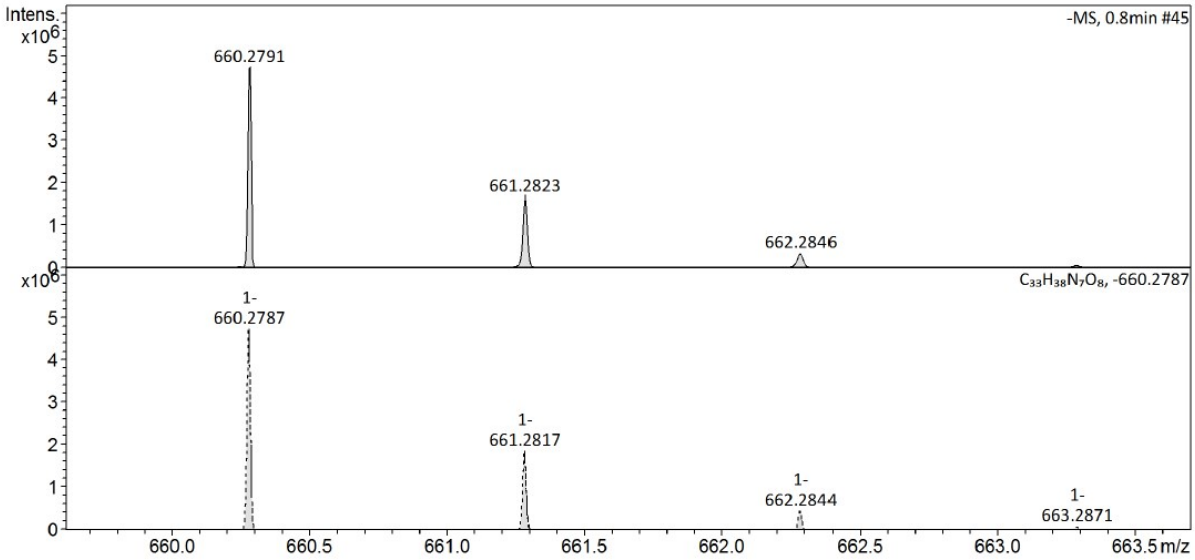


Figure. S7. High resolution mass spectrum of Fmoc-GGHAV (**1a**)

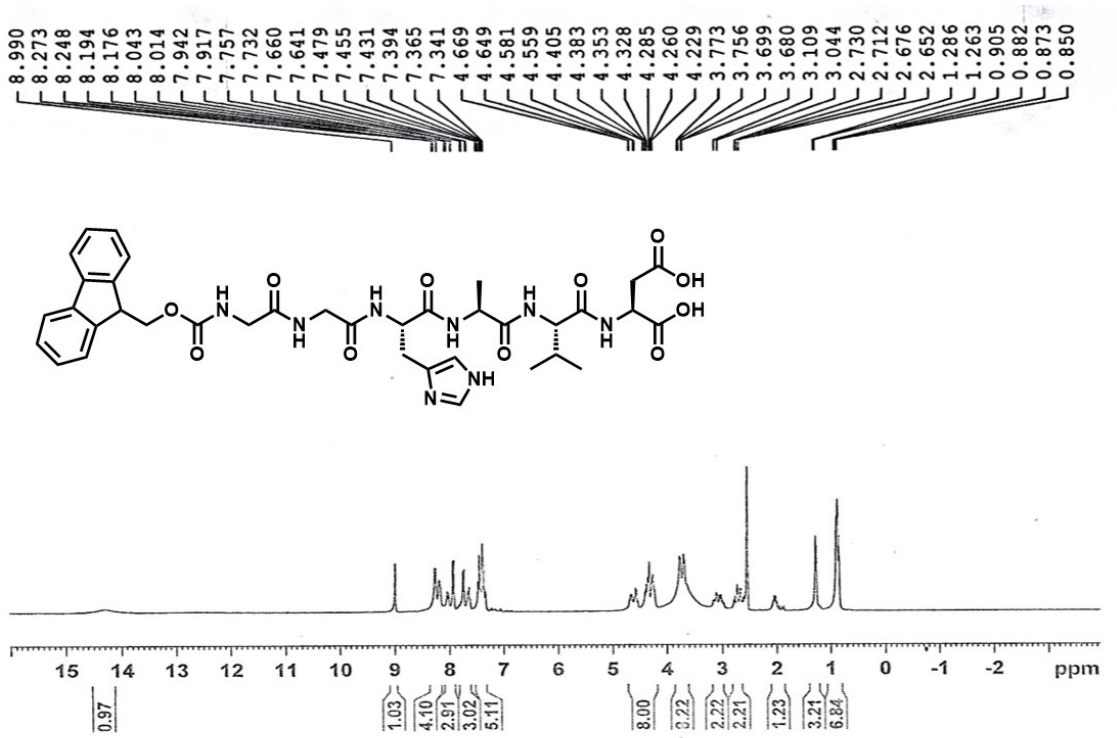


Figure. S8. ^{1}H NMR of Fmoc-GGHAVD (**1b**) taken in DMSO-d_6

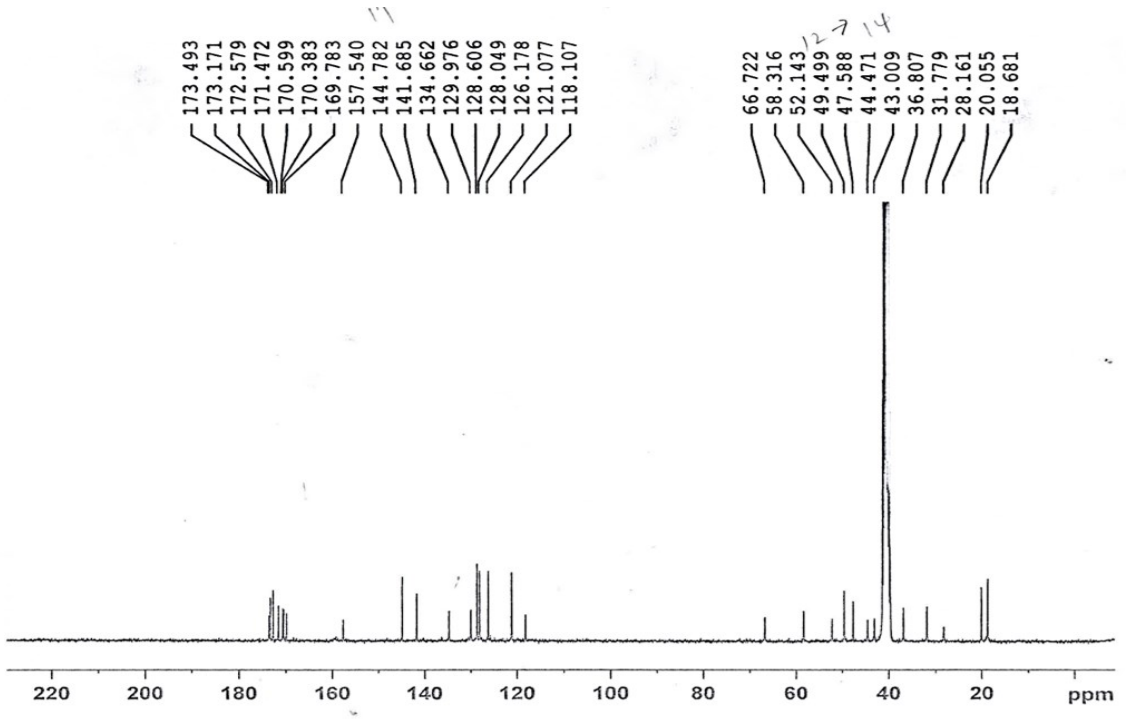


Figure. S9. ^{13}C NMR of Fmoc-GGHAVD (**1b**) taken in DMSO-d_6

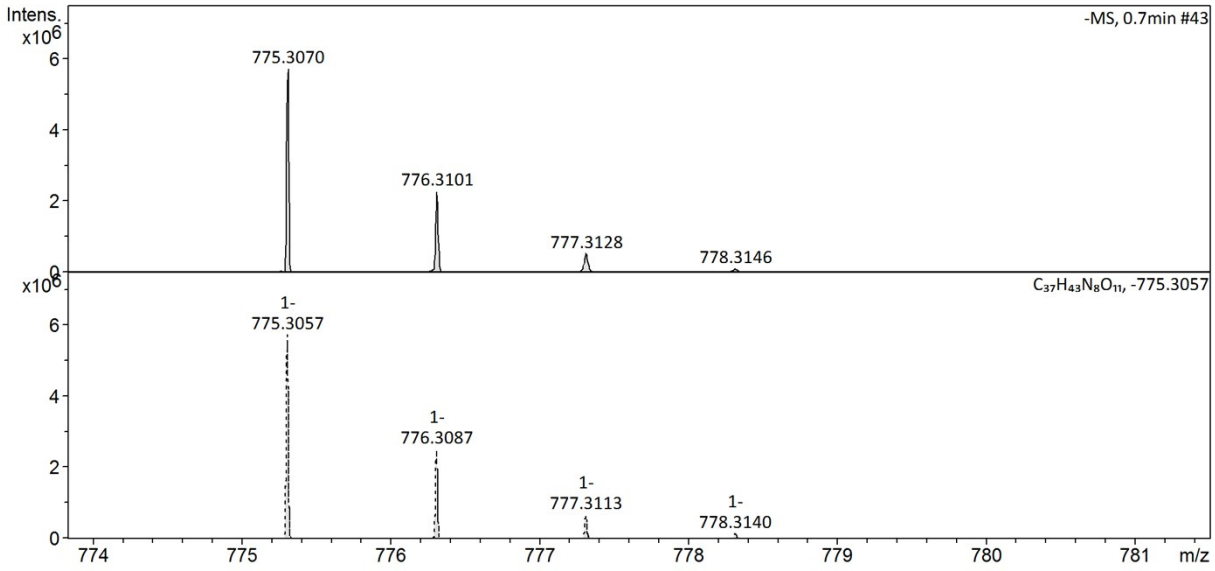


Figure. S10. High resolution mass spectrum of Fmoc-GGHAVD (**1b**)

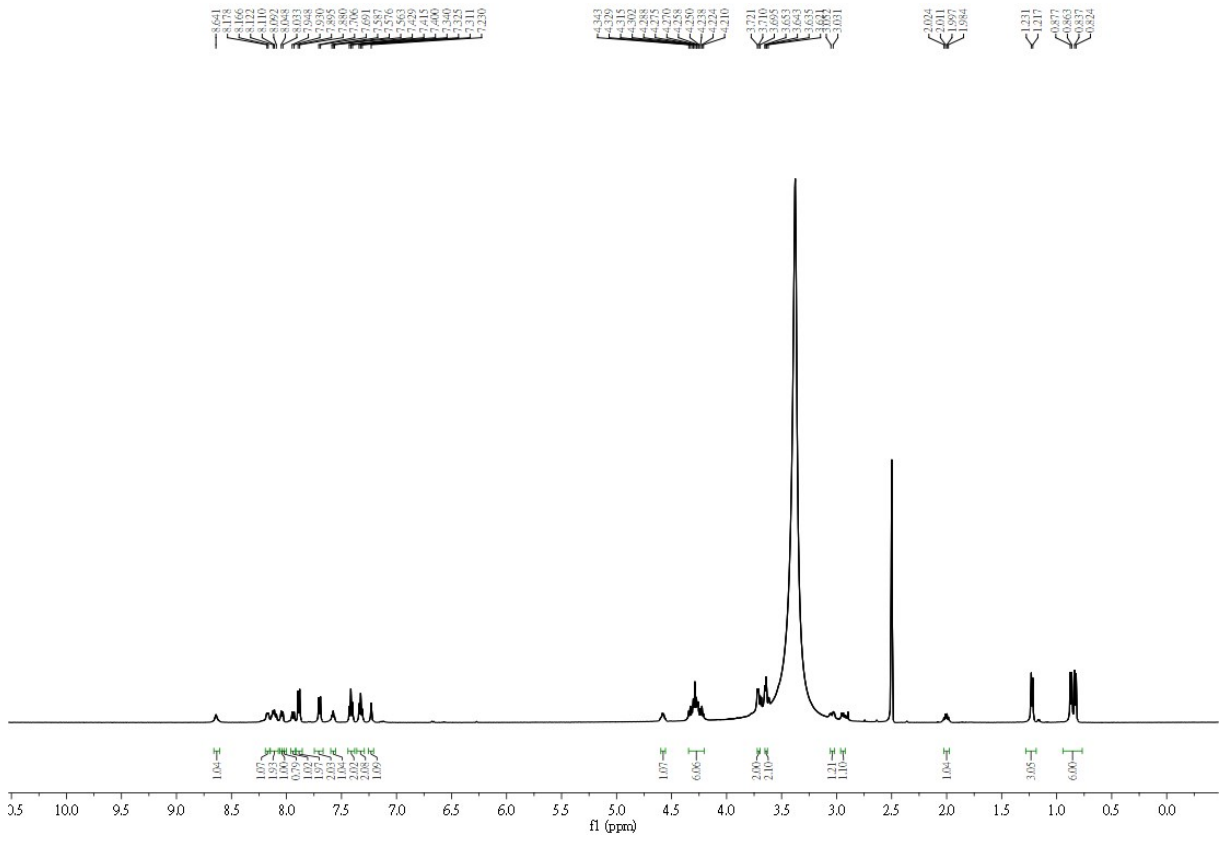


Figure S11. ^{1}H NMR of Fmoc-GGHAVS (**1c**) taken in DMSO-d_6

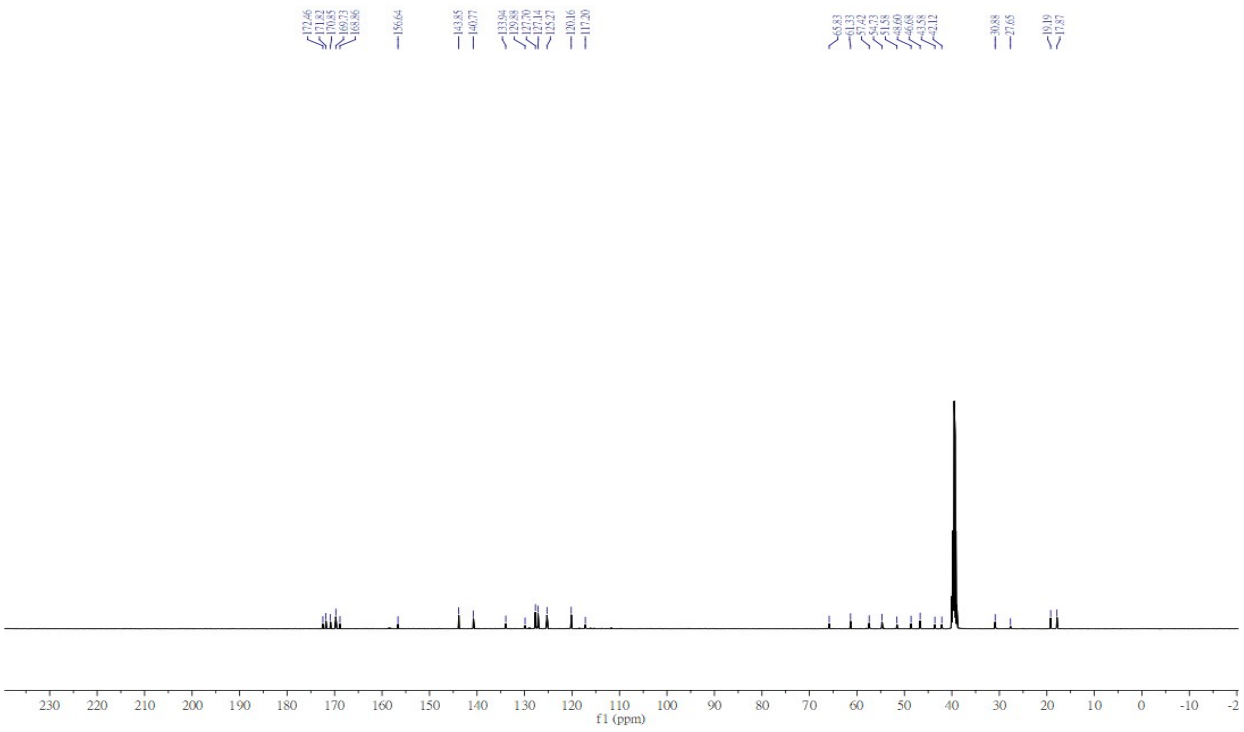


Figure. S12. ^{13}C NMR of Fmoc-GGHAVS (**1c**) taken in DMSO-d_6

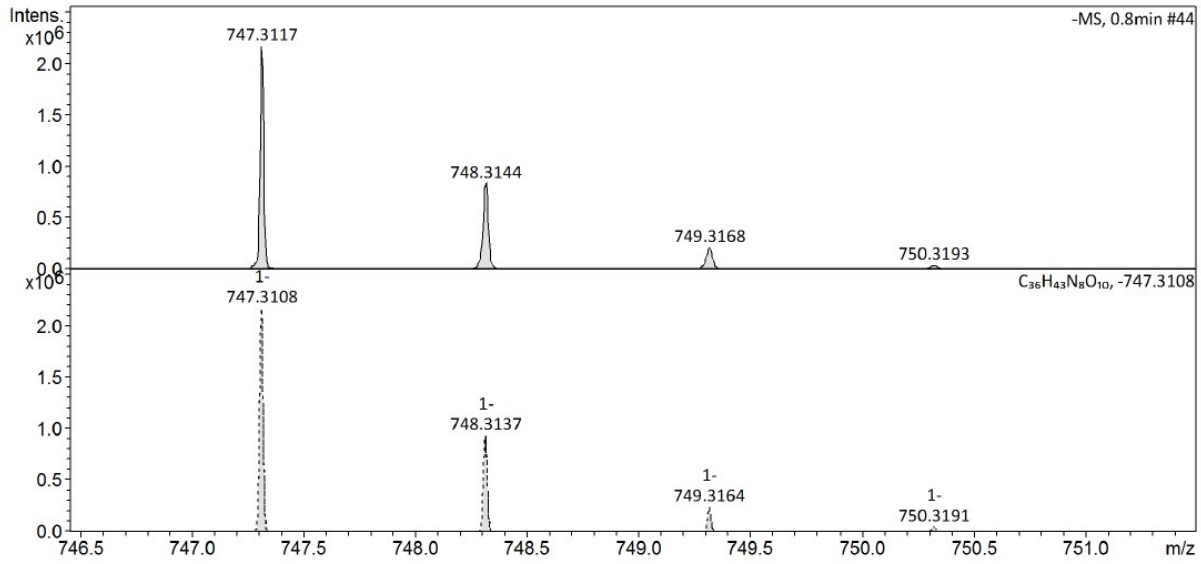


Figure. S13. High resolution mass spectrum of Fmoc-GGHAVS (**1c**)

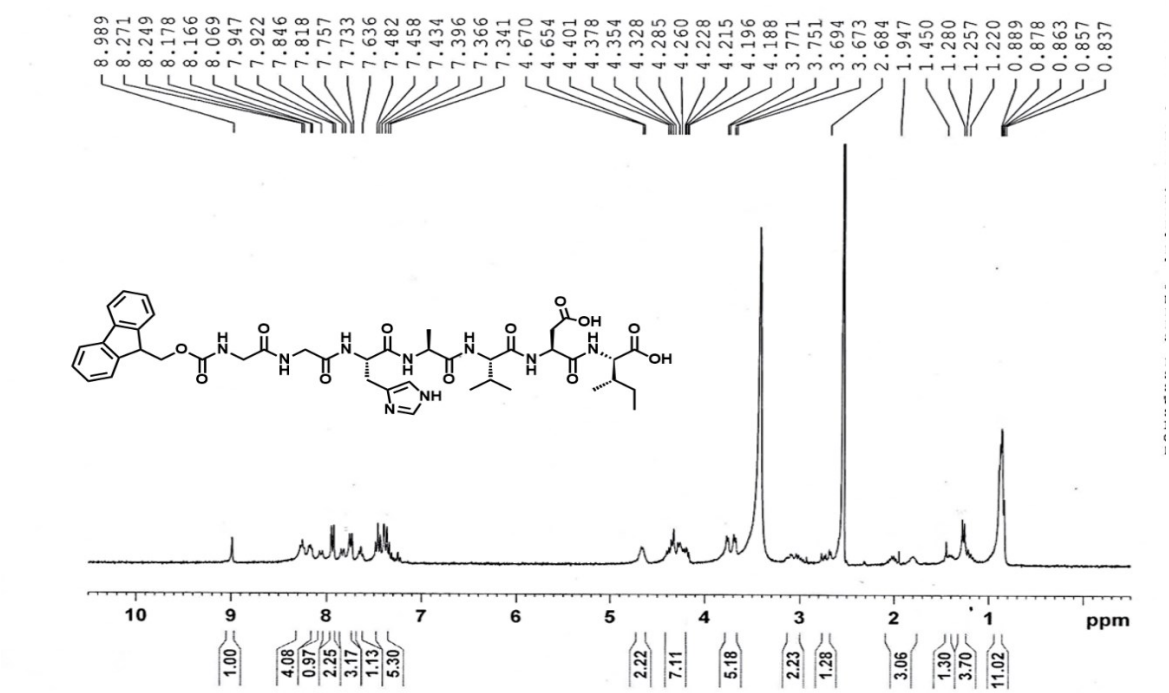


Figure. S14.[1]H NMR of Fmoc-GGHAVDI (**1d**) taken in DMSO-d_6

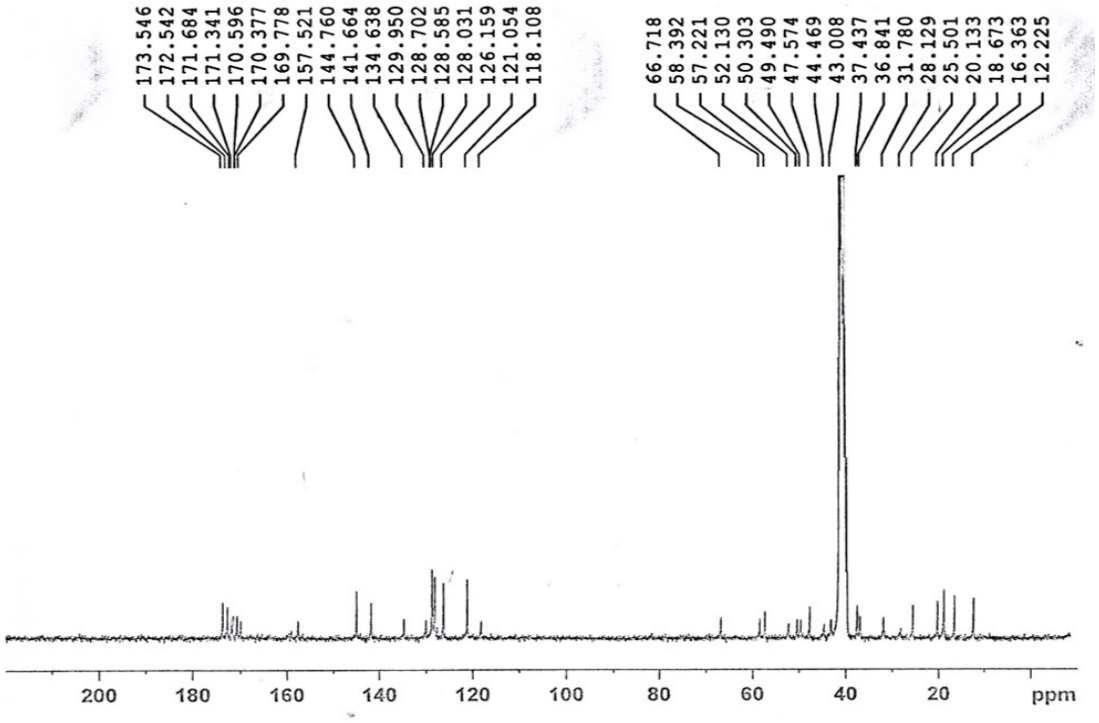


Figure. S15.[13]C NMR of Fmoc-GGHAVDI (**1d**) taken in DMSO-d_6

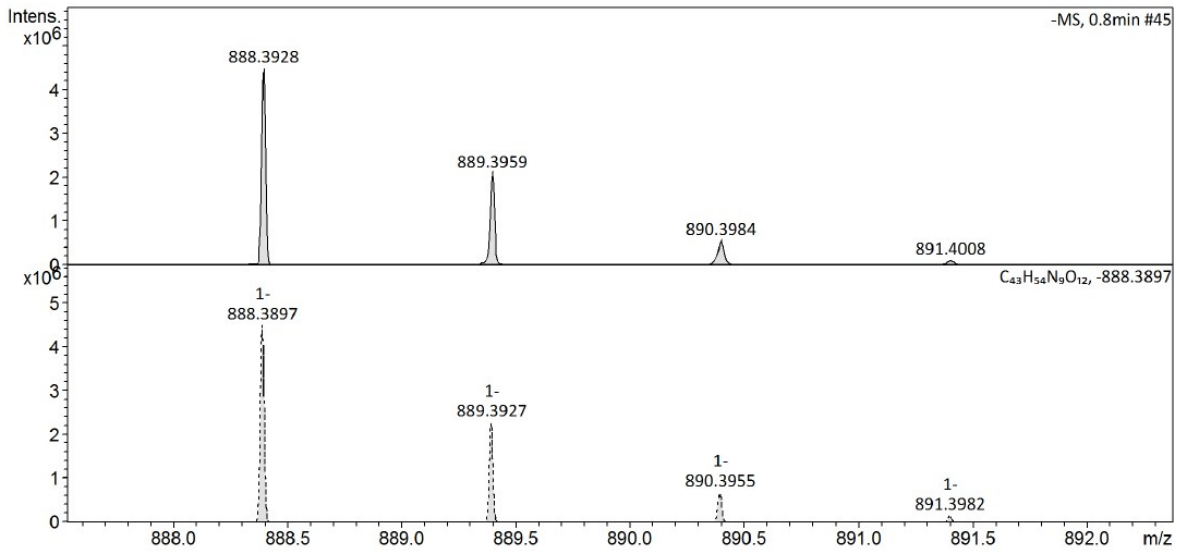


Figure. S16. High resolution mass spectrum of Fmoc-GGHAVDI (**1d**)

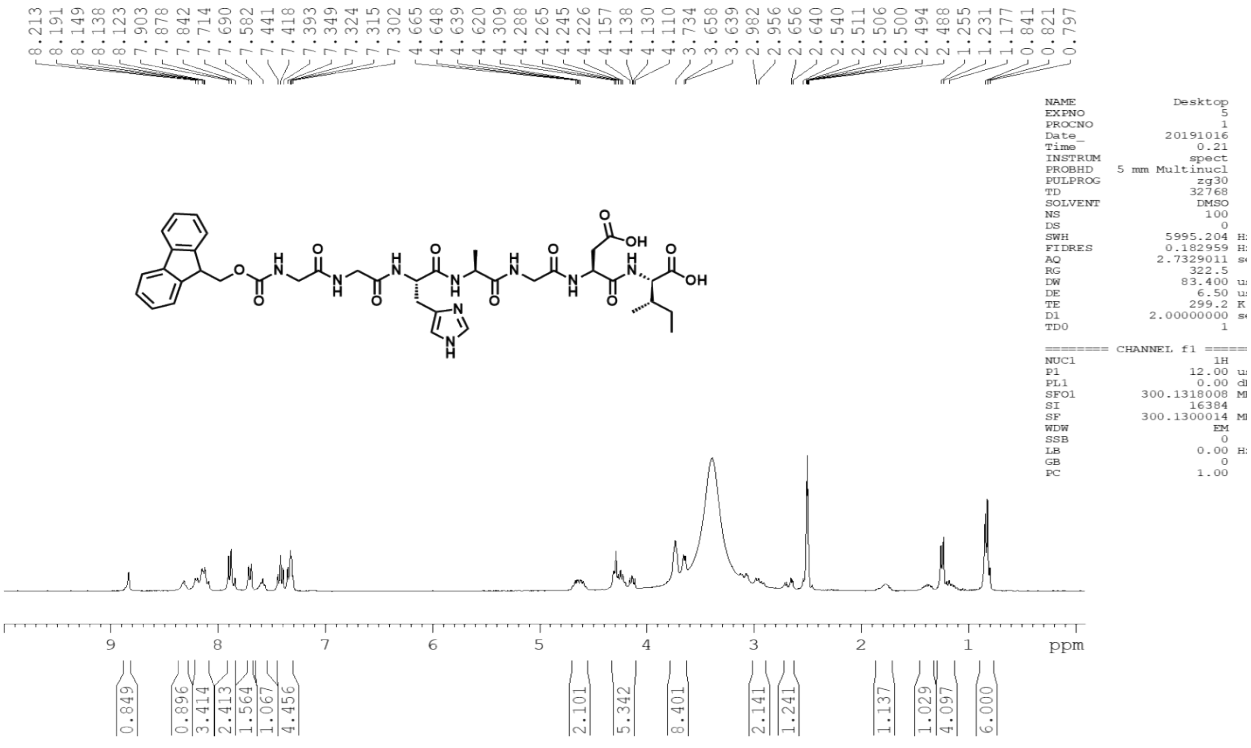


Figure. S17. ^{1}H NMR of Fmoc-GGHAGDI (**1e**) taken in DMSO-d_6

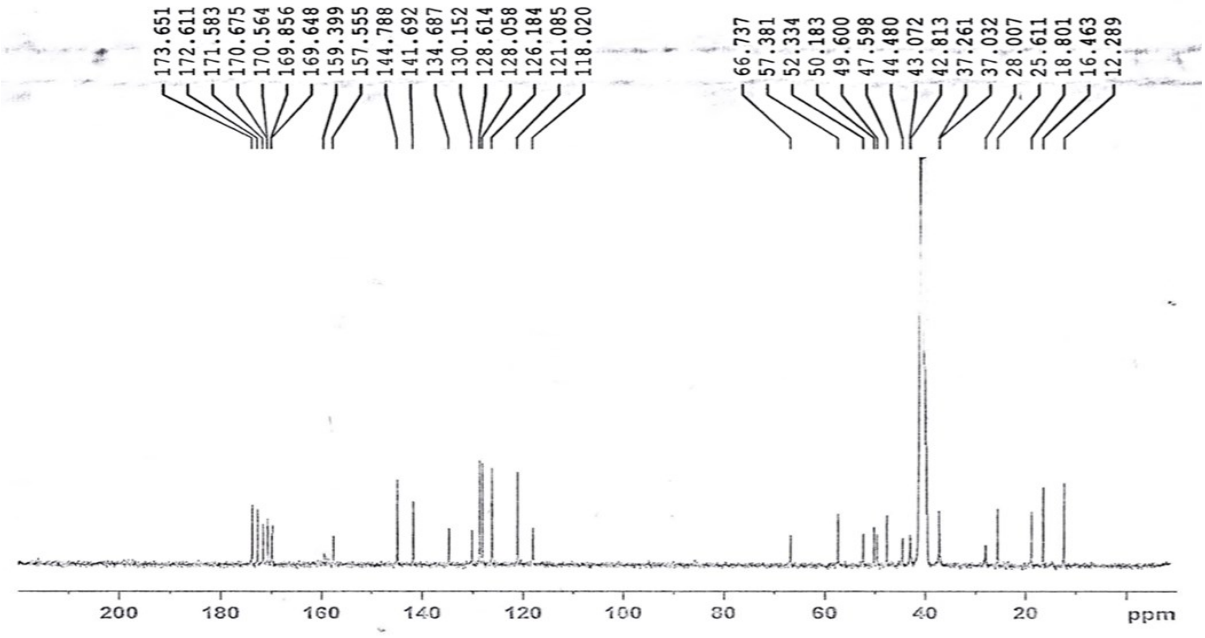


Figure. S18. ^{13}C NMR of Fmoc-GGHAGDI (**1e**) taken in DMSO-d_6

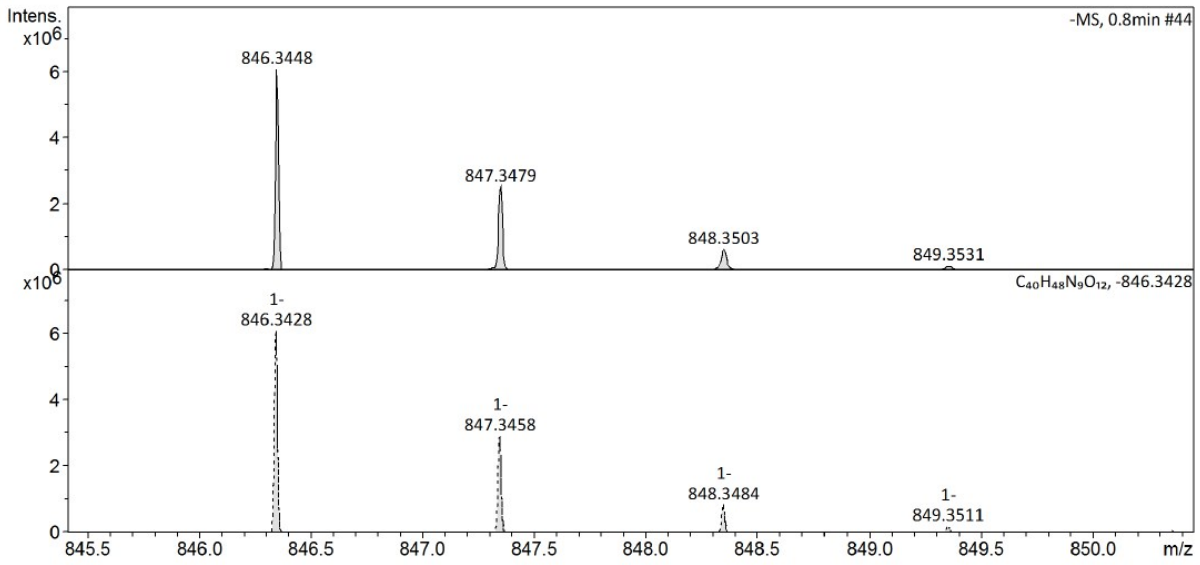


Figure. S19. High resolution mass spectrum of Fmoc-GGHAGDI (**1e**)