Electronic Supplementary Material (ESI) for New Journal of Chemistry.

Supporting Information

A peptidomimetic based thixotropic organogel showing syneresis-induced anti-adhesion for water and ice

Milan Gumtya,[a] Sahabaj Mondal,[a] Santosh Kumar,[a] Olamilekan Joseph Ibukun,[a] and Debasish Haldar*[a,b]

[a]Department of Chemical Sciences

Indian Institute of Science Education and Research Kolkata

Mohanpur 741246, West Bengal, India

[b]Centre for Advanced Functional Materials (CAFM),

Indian Institute of Science Education and Research, Kolkata,

Mohanpur-741246, West Bengal, India.

E-mail: deba_h76@iiserkol.ac.in, deba_h76@yahoo.com.

Table of contents

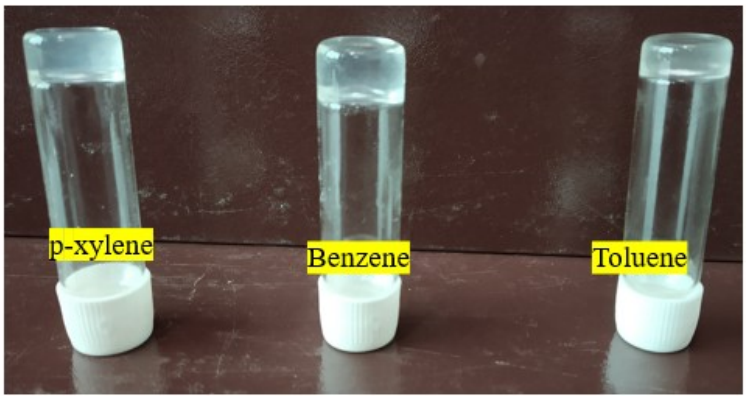


Fig. S1: The organogel formed by peptide mimetic compound **1**.

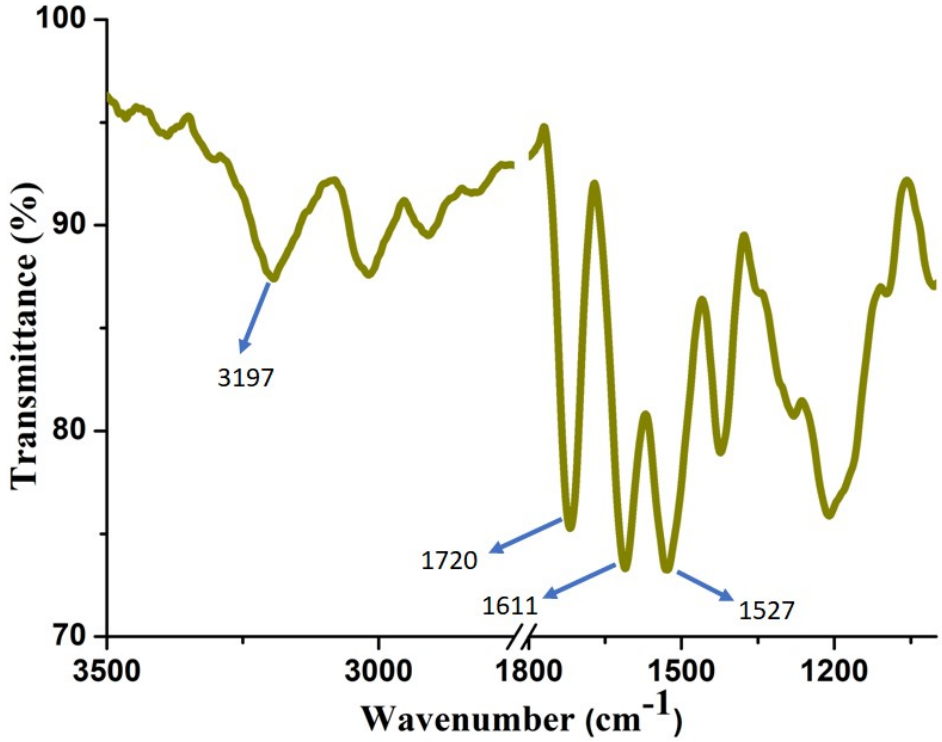


Fig. S2: ATR FT-IR spectra of peptide mimetic **1** in gel.

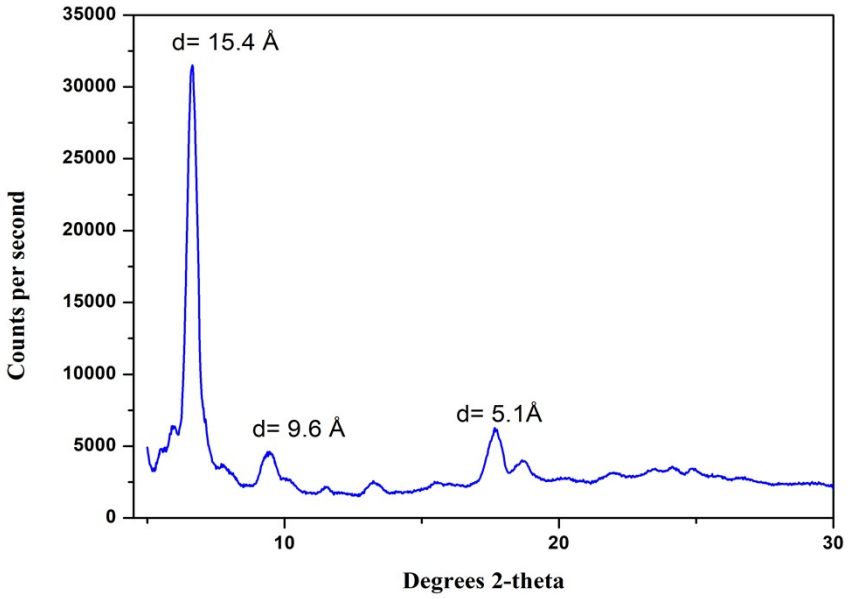


Fig. S3: PXRD pattern of peptide mimetic **1** in xerogel.

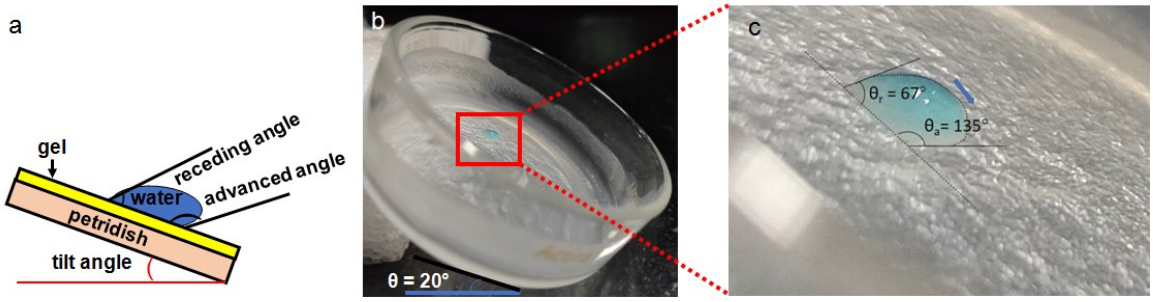
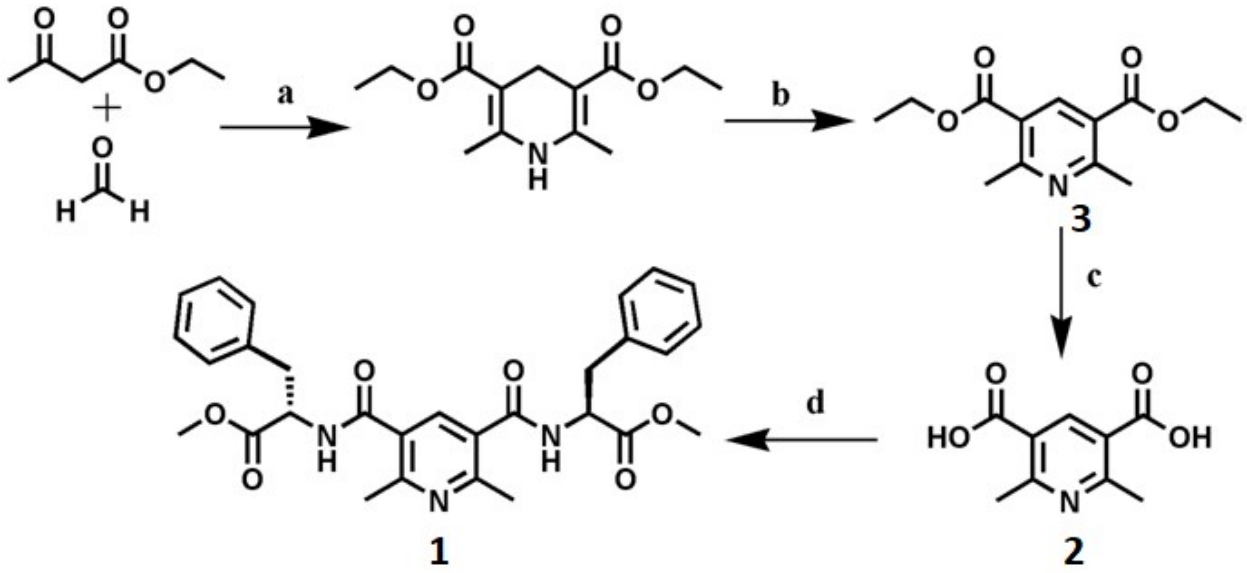


Fig. S4: (a) The schematic presentation of water sliding test showing different angles such as tilt angle, receding angle, advanced angle. (b) The photograph showing water drop on gel surface in a petridish tilted at 20°. (c) The receding angle and advanced angle of the water drop on gel surface.

Experimental

Peptide Synthesis: The reported peptide was synthesized by traditional solution-phase reaction using racemisation free fragment condensation strategy by N,N'-dicyclohexylcarbodiimide /1-hydroxybenzotriazole (DCC/ HOBt). The C-terminus was protected as a methyl ester and tertiary-butoxycarbonyl group was used for N-terminal protection. The products were purified by column chromatography using silica (100-200-mesh size) gel as stationary phase and n-hexane-ethylacetate 9:1 as eluent. The compounds were characterized by 400 MHz ^{1}H NMR spectroscopy, 100 MHz ^{13}C NMR spectroscopy, solid-state FT-IR Spectroscopy and mass spectrometry.



Synthetic scheme

Synthesis of 2,6-dimethylpyridine-3,5-dicarboxylate methylester (compound 3):

Formation of 1,4-Dihydropyridines and their Subsequent Aromatization in One Pot by Ferric Chloride General Procedure:

A mixture of formaldehyde (0.5 mmol), acetoacetate ester (150 mg, 1.5 mmol) and NH_4OAc (154.2 mg, 2 mmol) in H_2O (2 mL) was stirred vigorously at reflux temperature for one hour then $FeCl_3$ (270.3 mg, 1 mmol) was added to the mixture and the reflux was continued for four hours to obtain the pyridine products. After that, the mixture was cooled to the r.t. and neutralized with sat. aq Na_2CO_3. [While neutralizing, it is very important to maintain the pH of

the solution at 7, for the pyridine products readily form salts if the pH is under 7, otherwise Fe $(OH)_3$ will easily precipitate out and make the work-up troublesome]. Then the mixture was extracted with EtOAc (2 × 15 mL) and the combined organic extracts were dried in Na_2SO_4 and evaporated under vacuum to get crude product. The product was purified by column chromatography using silica (100-200 mesh) gel and ethyl acetate: hexane (1:24) as an eluent. Spectral data of compound 3 was given below.

^{1}H NMR (500 MHz, $CDCl_3$, δ ppm) of compound 3: 1.41 (t, 6H, ester), 2.83 (s, 6H, alpha to pyridine), 4.38 (q, 4H, ester), 8.66 (s, 1H, aromatic proton)

^{13}C NMR (125 MHz, $CDCl_3$, δ ppm) of compound 3: 9.56, 20.28,56.91, 118.55, 136.71, 157.56, 161.43)

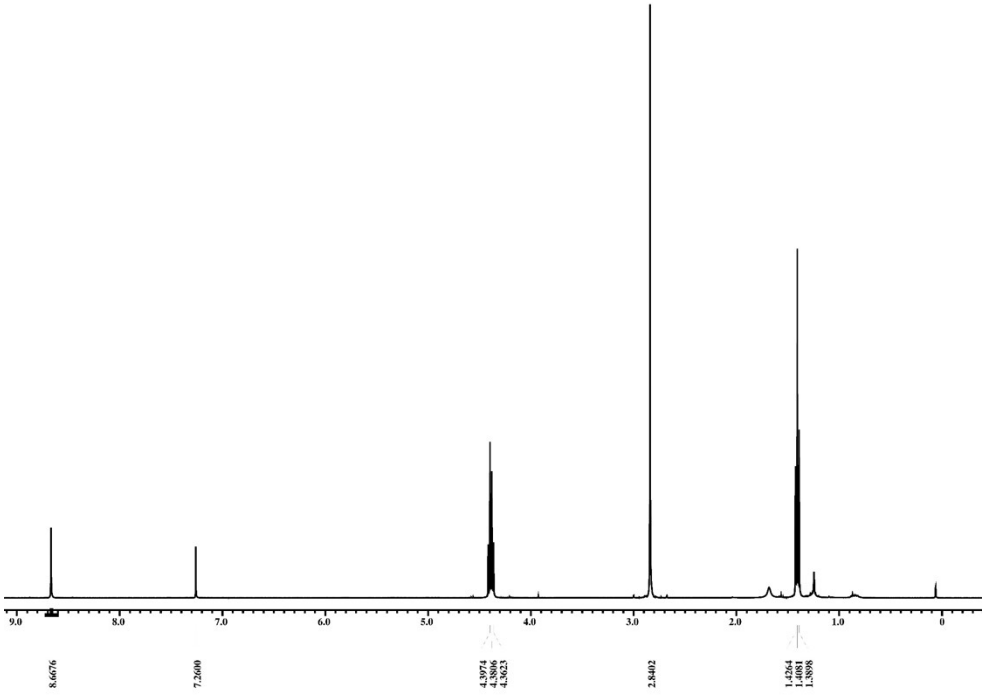


Fig. S5: ^{1}H NMR spectra of compound **3** in $CDCl_3$.

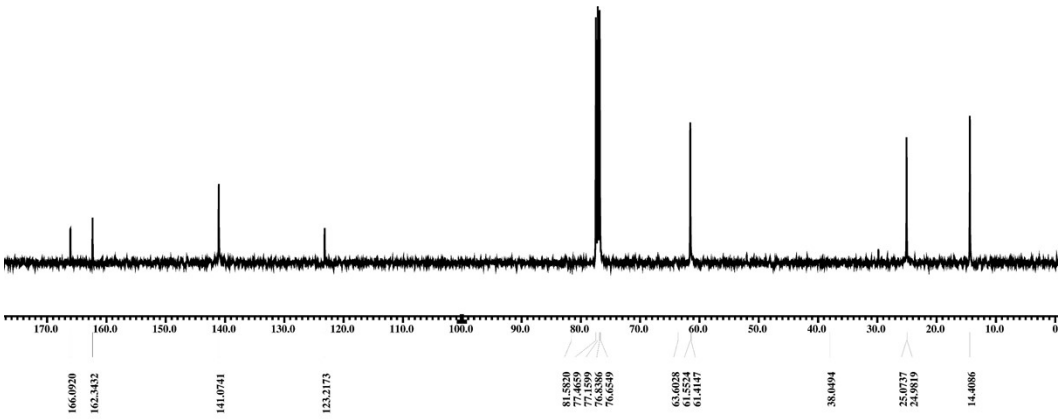


Fig. S6: ^{13}C NMR of compound **3** in $CDCl_3$.

Synthesis of 2,6-dimethylpyridine-3,5-dicarboxylic acid (2):

To 0.627 g (2.5mmol) of compound 3, 10 mL MeOH and 2M 4 mL NaOH solution were added and the progress of the reaction was monitored by thin layer chromatography (TLC). The reaction mixture was stirred. After 6h, methanol was removed under vacuum; the residue was dissolved in 20 mL of water and washed with diethyl ether (2 X 25mL). Then the pH of the aqueous layer was adjusted to 2 using 1M HCl and it was extracted with ethyl acetate (3 X 20 mL). The extracts were pooled, dried over anhydrous sodium sulfate, and evaporated under vacuum to obtained compound as a waxy solid. Yield: 0.577g (2.3 mmol, 92 %).

^{1}H NMR (400 MHz, DMSO-d_6 δ ppm) of compound 2: 2.7 (s, 6H, alpha proton with respect to pyridine ring), 8.53 (s, 1H, aromatic proton), 13.29 (s, 2H, acid proton).

^{13}C NMR (125 MHz, $CDCl_3$, δ ppm) of compound 2: 24.34, 123.23, 140.60, 161.19, 166.95.

ESI-MS of compound 2: m/z (Calc): $C_9H_9NO_4$ = 196.05; found: 196.32.

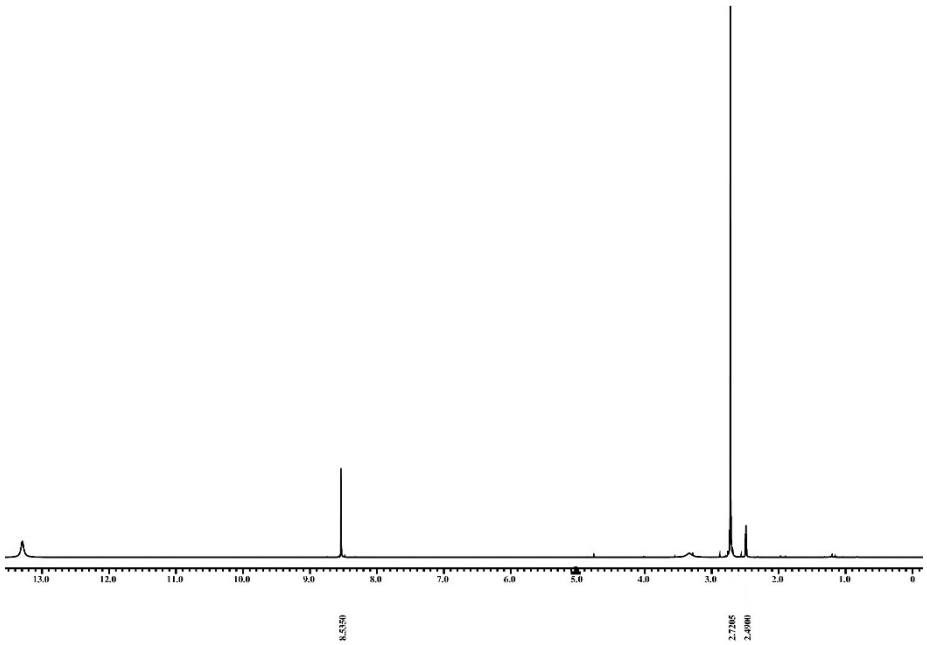


Fig. S7: ^{1}H NMR spectrum of compound **2**.

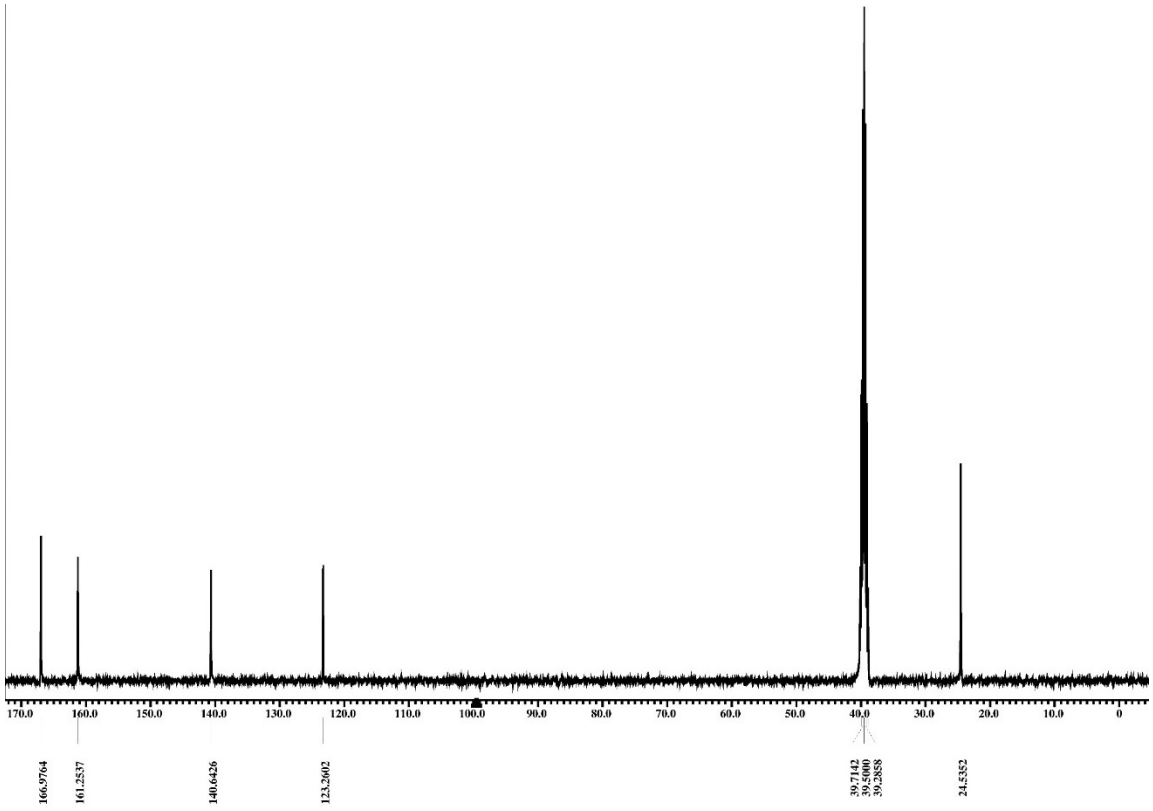


Fig. S8: ^{13}C NMR spectrum of compound **2**.

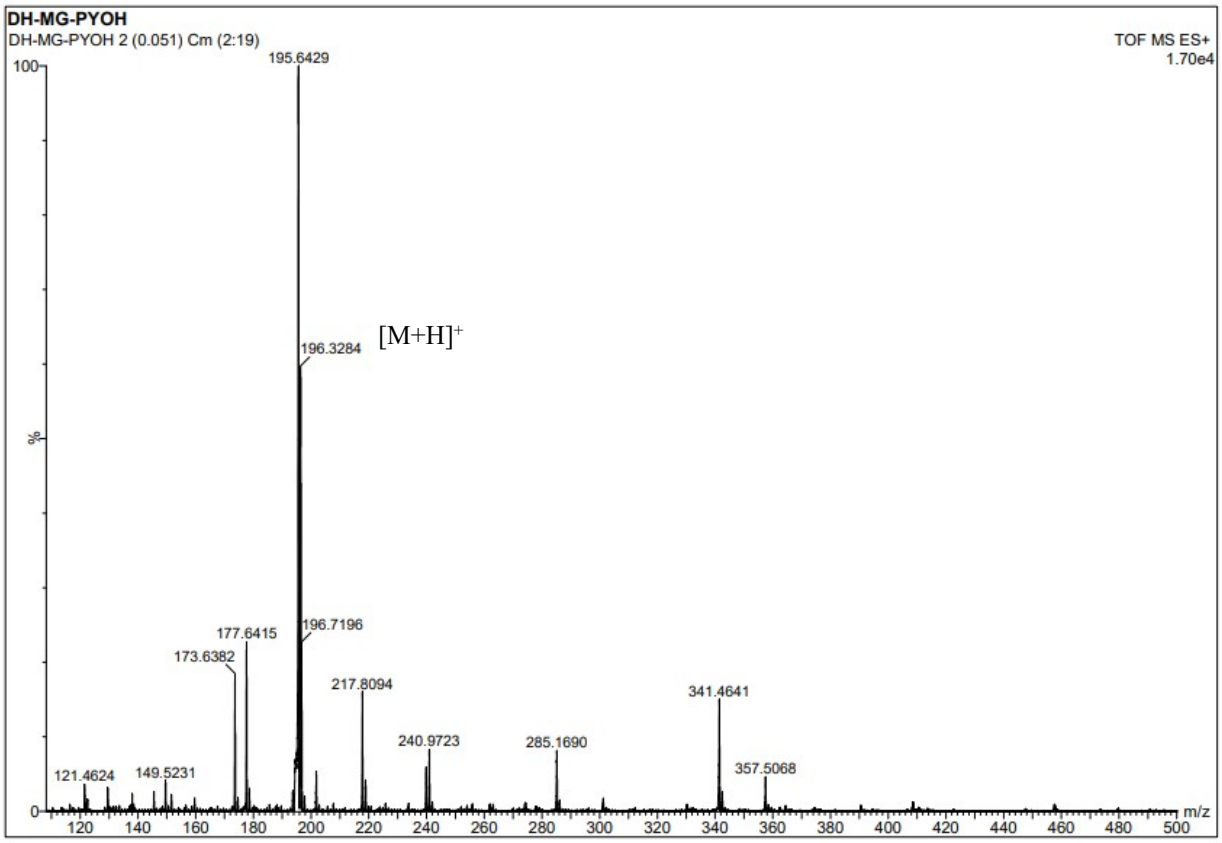


Fig. S9: Mass spectrum of compound **2**.

Synthesis of peptide (1): 0.487 g (2.5 mmol) of compound 2 was dissolved in 20 mL DCM in an ice-water bath. Phe-OMe was isolated from 1.07 g (6 mmol) of the corresponding methyl ester hydrochloride by neutralization and subsequent extraction with ethyl acetate and the ethyl acetate extract was concentrated to 7 mL. It was then added to the reaction mixture, followed immediately by 1.24 g (6 mmol) N, N'-dicyclohexylcarbodiimide (DCC) and 0.81 g (6 mmol) of HOBt. The reaction mixture was allowed to come to room temperature and stirred for 48 h. DCM was evaporated and the residue was dissolved in ethyl acetate (50 mL) and dicyclohexylurea (DCU) was filtered off. The organic layer was washed with 2M HCl (3 X 50 mL), brine (2x50 mL), 1M sodium carbonate (3 X 50 mL) and brine (2 X 50 mL) and dried over anhydrous sodium sulfate. It was evaporated in a vacuum to yield FPF as a white solid. The product was purified by column chromatography using silica (100–200 mesh) gel and ethyl acetate: hexane (3:2) as an eluent. Yield: 904 mg (1.75 mmol, 70%).

^{1}H-NMR (500 MHz, $CDCl_3$, δ ppm) of peptide **1**: 7.51 (s,1H, aromatic proton),7.26-7.24 (d, 10H, aromatic proton),6.39 (d, 2H, amide NH), 5.01 (m, 2H, CαH), 3.76 (s, 6H, OCH_3), 3.27 (m, 2H, CβH) 3.12 (m, 2H, CβH), 2.48 (s,6H, CH_3 proton),

^{13}C-NMR (125 MHz, $CDCl_3$, δ ppm) of peptide **1**: 171.79, 167.03, 157.20, 135.76, 133.97, 129.21, 128.61, 127.42, 126.83, 53.57, 52.38, 37.50, 22.90

ESI-MS (MeOH): m/z (Calc): $C_{29}H_{31}N_3O_6$ $[M+Na]^+$ = 540.22; found: 540.20.

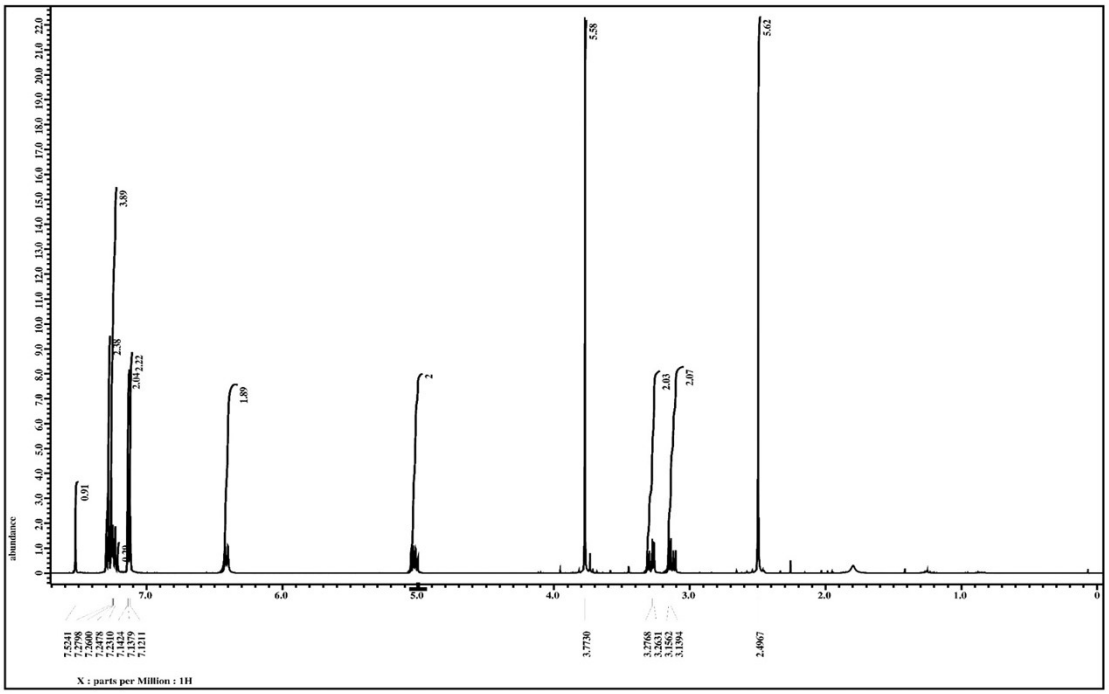


Fig. S10: ^{1}H NMR of compound 1.

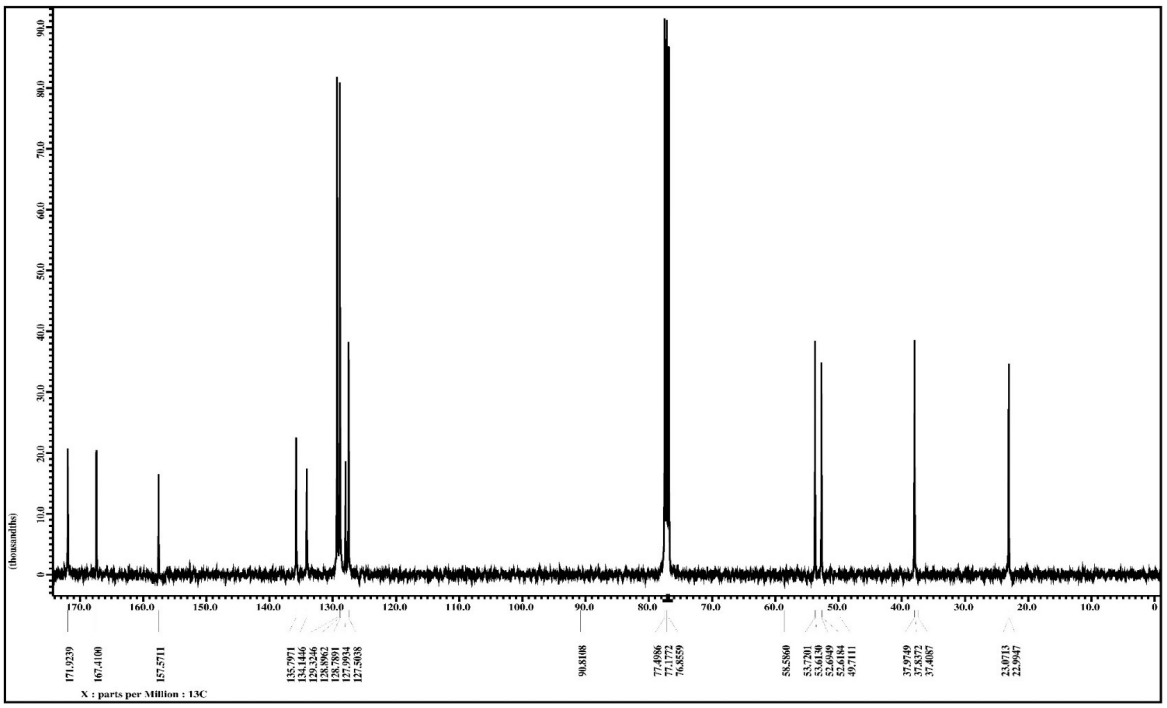


Fig. S11: ^{13}C NMR of compound 1.

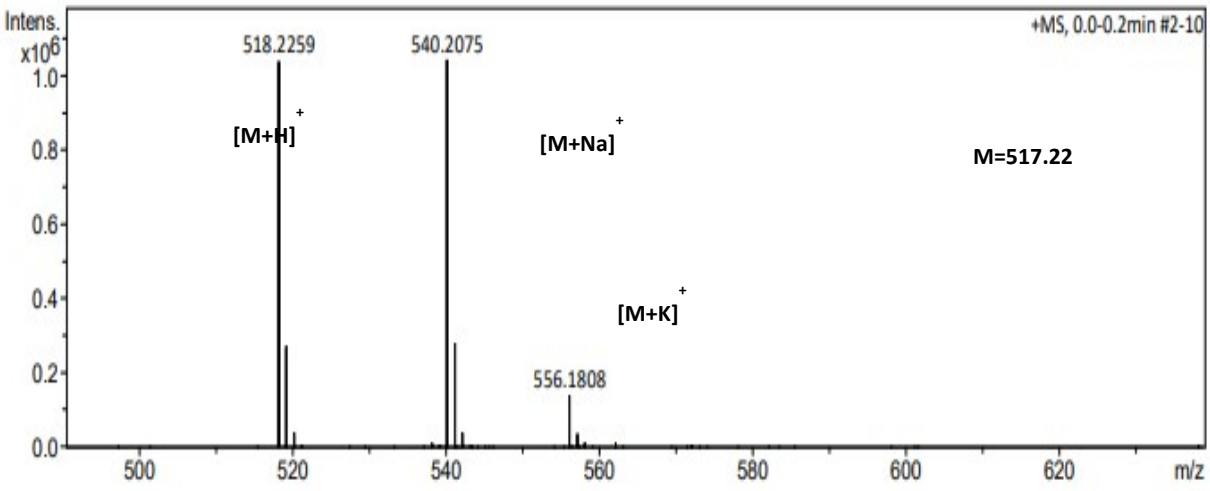


Fig. S12: Mass spectrum of compound 1.