Experiment section

Reagents and general methods

All reagents were purchased from commercial suppliers and were dried and purified when necessary, and 4a, 4c, 4e-f, 5a, 5c, 5e-h, 5k, 5l, 5o-p, 6a, 6c, 6e-h, 6k, 6l, 6o-p, 7a, 7c, 7e-h, 7k, 7l and 7o-p were prepared as previously described by our group.

ESI-MS spectra were obtained from VG ZAB-HS spectrometer. 1H NMR and 13C NMR spectra were recorded on a AVANCE III 400MHz spectrometer at 400 MHz and 100 MHz and a Varian INOVA 500NB spectrometer at 500 MHz and 125 MHz, respectively, using TMS as internal standard and CDCl3 or DMSO-d6 as solvent and chemical shifts (d) were expressed in ppm. HRMS were obtained from ESI-Q-TOF maxis 4G spectrometer. Silica gel F254 were used in analytical thin-layer chromatography (TLC) and silica gel were used in column chromatography respectively.

General procedure for the preparation of 1-substituted-1,2,3,4-tetrahydro-β-carboline-3-carboxylic acid (2)

A mixture of L-tryptophan (40.8g, 200mmol), acetic acid (300ml) and the appropriate aldehydes (210mmol) was refluxed for 3 h, then cooled and adjusted pH to 5 with concentrated ammonium hydroxide, the precipitated product was collected by filtration and washed well with water and dried to provide the intermediates 2. Further purification was not necessary and used directly for the next steps.

General procedure for the preparation of ethyl 1-substituted-1,2,3,4-tetrahydro-β-carboline-3-carboxylate (3)

1-substituted 1,2,3,4-tetrahydro-β-carboline-3-carboxylic acid 2 (100mmol), anhydrous
ethanol (300ml) and SOCl₂ (20ml) was heated at reflux for 4 h, and then evaporated in reduced pressure. The resulting mixture was poured into H₂O (200ml) and neutralized with sodium hydrogen carbonate. The solution was extracted with ethyl acetate (3 × 150 ml). The organic phase was washed with water and brine, then dried over anhydrous sodium sulfate, filtered and evaporated to give intermediates 3. Further purification was not necessary and used directly for the next steps.

**General procedure for the preparation of ethyl 1-substituted-β-carboline-3-carboxylate (4)**

Ethyl 1-substituted-1,2,3,4-tetrahydro-β-carboline-3-carboxylate 3 (100mmol) and sulfur (9.6g, 300mmol) in xylene (200ml) was heated at reflux for 8 h. Completion of the reaction as indicated by TLC. The solution was cooled and stored at 4 °C for 3 h, and then filtered and washed generously with petroleum ether, the solid was purified by column chromatography with ethyl acetate and petroleum ether (1:1), ethyl acetate as the eluent to successfully afford the intermediates 4.

**Ethyl 1-isopropyl-β-carboline-3-carboxylate (4b)**

Starting from ethyl 1-isopropyl-1,2,3,4-tetrahydro-β-carboline-3-carboxylate 3b (28.6g, 100mmol) and sulfur (9.6g, 300mmol), white solid was obtained (12.0g, 42%). ¹H NMR (400 MHz, CDCl₃): δ 9.55 (s, 1H), 8.76 (s, 1H), 8.16 (d, J = 8.0 Hz, 1H), 7.51-7.59 (m, 2H), 7.29-7.33 (m, 1H), 4.49 (q, J = 7.2 Hz, 2H), 3.43- 3.53 (m, 1H), 1.44 (t, J = 7.2 Hz, 3H), 1.32 (d, J = 6.8 Hz, 6H). ¹³C NMR (100 MHz, CDCl₃): δ 166.8, 150.7, 140.5, 137.2, 135.0, 128.5, 122.1, 121.6, 120.6, 116.2, 112.2, 61.4, 32.8, 21.0, 14.5.

**Ethyl 1-(4-chlorophenyl)-β-carboline-3-carboxylate (4d)**

Starting from ethyl 1-(4-chlorophenyl)-1,2,3,4-tetrahydro-β-carboline-3-carboxylate 3e
(35.4g, 100mmol) and sulfur (9.6g, 300mmol), yellow solid was obtained (18.5g, 53%). $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 8.30 (d, $J = 7.6$ Hz, 1H), 7.61 (d, $J = 8.0$ Hz, 1H), 7.55 (d, $J = 6.0$ Hz, 1H), 7.48 (dd, $J = 8.0$, 1.2 Hz, 1H), 7.27-7.31 (m, 2H), 7.18-7.24 (m, 3H), 7.03-7.07 (m, 1H), 4.21 (q, $J = 7.1$ Hz, 2H), 1.29 (t, $J = 7.1$ Hz, 4H).

**General procedure for the preparation of ethyl 1,9-disubstituted-β-carboline-3-carboxylate (5)**

Ethyl 1-substituted-β-carboline-3-carboxylate 4 (10mmol) and anhydrous DMF (50ml) was stirred at RT until clear, and then 60% NaH (0.6g, 15mmol) and halogenated alkane (20-40mmol) were added. The mixture was stirred at RT for 0.5-2 h. After completion of the reaction as indicated by TLC, the solution was poured into H$_2$O (150ml), and extracted with ethyl acetate. The organic phase was washed with water and brine, filtered and evaporated. The resulting oil was crystallized from ethyl ether or ethyl ether-petroleum ether to provide compounds 5.

**Ethyl 9-isopropyl-1-methyl-β-carboline-3-carboxylate (5b)**

Starting from ethyl 1-methyl-β-carboline-3-carboxylate 4a (2.54g, 10mmol) and 2-bromopropane (30mmol), white solid was obtained (2.1 g, 71%). ESI-MS m/z: 297 (100) [M+H]$^+$. $^1$H NMR (300 MHz, CDCl$_3$): $\delta$ 8.72 (1H, s, ArH), 8.18 (1H, d, $J = 7.8$Hz), 7.73 (1H, d, $J = 8.4$Hz),7.51-7.57(1H, m, ArH), 7.29-7.33 (1H, m, ArH), 5.57-5.67 (1H, m, CH[CH$_3$]$_2$), 4.51 (2H, q, $J = 7.2$Hz, OCH$_2$CH$_3$), 3.13 (3H, s, CH$_3$), 1.77 (6H, d, $J = 6.9$Hz, CH[CH$_3$]$_2$), 1.49 (3H, t, $J = 7.2$Hz, OCH$_2$CH$_3$). $^{13}$C NMR (75 MHz, CDCl$_3$): $\delta$ 166.3, 141.3, 140.3, 137.3, 136.8, 128.9, 128.0, 123.1, 122.0, 120.4, 116.2, 113.8, 61.8, 48.9, 25.8, 21.8(2C), 14.9.

**Ethyl 9-isobutyl-1-methyl-β-carboline-3-carboxylate (5d)**
Starting from ethyl 1-methyl-β-carboline-3-carboxylate 4a (2.54g, 10mmol) and 1-bromo-2-methyl-propane (30mmol), white solid was obtained (2.4 g, 77%). ESI-MS m/z: 311 (100) [M+H]+. 1H NMR (300 MHz, CDCl3): δ 8.75 (1H, s, ArH), 8.18 (1H, d, J = 7.8 Hz), 7.57-7.62 (1H, m, ArH), 7.49-7.51 (1H, m, ArH), 7.30-7.35 (1H, m, ArH), 4.52 (2H, q, J = 7.2 Hz, OCH2CH3), 4.21 (2H, d, J = 7.5 Hz, CH2CH(CH3)2), 3.12 (3H, s, CH3), 2.21-2.34 (1H, m, CH2C(CH3)2), 1.50 (3H, t, J = 7.2 Hz, OCH2CH3), 0.94 (6H, d, J = 6.6 Hz, CH2CH[CH3]2).

Ethyl 9-butyl-1-isopropyl-β-carboline-3-carboxylate (5i)

Starting from ethyl 1-isopropyl-β-carboline-3-carboxylate 4b (2.82g, 10mmol) and 1-bromobutane (30mmol), yellow oil was obtained (1.93g, 57%). ESI-MS m/z: 339 (100) [M+H]+. 1H NMR (400 MHz, CDCl3): δ 8.72 (s, 1H), 8.13 (d, J = 7.6 Hz, 1H), 7.54 (d, J = 7.2 Hz, 1H), 7.44 (d, J = 8.0 Hz, 1H), 7.25-7.28 (m, 1H), 4.46-4.52 (m, 4H), 3.69-3.79 (m, 1H), 1.74-1.84 (m, 2H), 1.54 (d, J = 7.2 Hz, 6H), 1.48 (t, J = 7.2 Hz, 3H), 1.36-1.44 (m, 2H), 0.95 (t, J = 7.2 Hz, 3H).

13C NMR (100 MHz, CDCl3): δ 166.4, 150.1, 142.0, 137.1, 135.0, 129.5, 128.3, 121.8, 121.4, 120.4, 115.5, 110.1, 61.1, 45.2, 32.5, 31.9, 22.4, 20.2, 14.5, 13.8.

Ethyl 9-benzyl-1-isopropyl-β-carboline-3-carboxylate (5j)

Starting from ethyl 1-isopropyl-β-carboline-3-carboxylate 4b (2.82g, 10mmol) and benzyl bromide (15mmol), white solid was obtained (1.6g, 43%). ESI-MS m/z: 373 (100) [M+H]+. Mp 135.7 -136.2°C; 1H NMR (400 MHz, CDCl3): δ 8.77 (s, 1H), 8.24 (d, J = 7.6 Hz, 1H), 7.57 (t, J = 7.6 Hz, 1H), 7.42 (d, J = 8.4 Hz, 1H), 7.36 (t, J = 7.2 Hz, 1H), 7.20-7.32 (m, 3H), 6.98 (d, J = 6.0 Hz, 2H), 5.83 (s, 2H), 4.50 (q, J = 7.2 Hz, 2H), 3.57-3.67 (m, 1H), 1.49 (t, J = 7.2 Hz, 3H), 1.37 (d, J = 6.8 Hz, 6H). 13C NMR (100 MHz, CDCl3): δ 166.3, 150.6, 142.5, 137.6, 137.3, 135.6, 129.7, 129.0, 128.7, 127.7, 125.4, 121.9, 121.5, 120.8, 115.6, 110.2, 61.2, 48.9, 31.6, 22.5, 14.5.
**Ethyl 9-butyl-1-(4-chlorophenyl)-β-carboline-3-carboxylate (5m)**

Starting from ethyl 1-(4-chlorophenyl)-β-carboline-3-carboxylate 4d (3.51g, 10mmol) and 1-bromobutane (30mmol), white solid was obtained (1.87g, 46%). ESI-MS m/z: 408 (100) [M+H]+.

$^1$H NMR (400 MHz, CDCl$_3$): δ 8.89 (s, 1H), 8.26 (d, $J = 7.6$ Hz, 1H), 7.59-7.66 (m, 3H), 7.47 – 7.51 (m, 3H), 7.36 – 7.40 (m, 1H), 4.52 (q, $J = 7.2$ Hz, 2H), 3.99 (t, $J = 8.0$ Hz, 2H), 1.47 (t, $J = 7.2$ Hz, 3H), 1.32-1.40 (m, 2H), 0.84-0.93 (m, 2H), 0.67 (t, $J = 7.2$ Hz, 3H). $^{13}$C NMR (100 MHz, CDCl$_3$): δ 166.0, 142.7, 142.5, 137.9, 137.3, 135.6, 134.9, 131.1, 130.6, 128.9, 128.4, 121.8, 121.7, 120.9, 116.8, 110.6, 61.6, 44.6, 31.1, 19.8, 14.5, 13.5.

**Ethyl 9-benzyl-1-isopropyl-β-carboline-3-carboxylate (5n)**

Starting from ethyl 1-(4-chlorophenyl)-β-carboline-3-carboxylate 4d (3.51g, 10mmol) and benzyl bromide (15mmol), yellow solid was obtained (1.68g, 38%). ESI-MS m/z: 442 (100) [M+H]+. $^1$H NMR (400 MHz, CDCl$_3$): δ 8.93 (s, 1H), 8.30 (d, $J = 8.0$ Hz, 1H), 7.59 (t, $J = 8.0$ Hz, 1H), 7.37-7.42 (m, 2H), 7.32 (dd, $J = 8.4$, 2.0 Hz, 2H), 7.23 (dd, $J = 8.4$, 2.0 Hz, 2H), 7.11-7.17 (m, 3H), 6.55 (d, $J = 7.2$ Hz, 2H), 5.25 (s, 2H), 4.51 (q, $J = 7.2$ Hz, 2H), 1.46 (t, $J = 7.2$ Hz, 3H). $^{13}$C NMR (101 MHz, CDCl$_3$): δ 136.0, 135.6, 131.2, 130.8, 130.5, 130.0, 128.8, 128.7, 128.5, 128.3, 127.7, 127.5, 125.4, 125.3, 122.4, 122.1, 121.7, 121.2, 117.2, 111.1, 62.1, 29.7, 14.5.

**Ethyl 9-hexyl-1-(4-methoxyphenyl)-β-carboline-3-carboxylate (5q)**

Starting from ethyl 1-(4-methoxyphenyl)-β-carboline-3-carboxylate 4e (3.46g, 10mmol) and 1-bromohexane (30mmol), white solid was obtained (1.89g, 44%). ESI-MS m/z: 431 (100) [M+H]+. $^1$H NMR (400 MHz, CDCl$_3$): δ 8.86 (s, 1H), 8.24 (d, $J = 7.2$ Hz, 1H), 7.59-7.63 (m, 1H), 7.56 (d, $J = 8.8$ Hz, 2H), 7.47 (d, $J = 8.4$ Hz, 1H), 7.33 – 7.37 (m, 1H), 7.03 (d, $J = 8.8$ Hz, 2H), 4.51 (q, $J = 7.2$ Hz, 2H), 4.00 (t, $J = 8.0$ Hz, 2H), 3.89 (s, 3H), 1.47 (t, $J = 7.2$ Hz, 3H), 1.33-1.41
(m, 2H), 1.08 – 1.15 (m, 2H), 0.98 – 1.03 (m, 2H), 0.82-0.89 (m, 2H), 0.78 (t, \( J = 7.2 \) Hz, 3H). \( ^{13} \)C NMR (100 MHz, CDCl\(_3\)): \( \delta \) 166.3, 160.1, 144.0, 142.4, 137.2, 135.9, 132.0, 130.9, 130.2, 128.6, 121.8, 121.7, 120.6, 116.4, 113.7, 110.6, 61.5, 55.5, 44.7, 31.2, 29.0, 26.2, 22.4, 14.5, 13.9.

**General procedure for the preparation of 1,9-disubstituted-3-hydroxymethyl-β-carboline (6).**

A fine suspension of compounds 6 (10mmol) in dry THF (100ml) was treated with LiBH\(_4\) (30mmol), and the mixture was stirred at room temperature for 6 h. The reaction was cooled, treated with 10% aq. HCl (20ml), and stirred for 4 h. The reaction mixture was neutralized with 10% aq. NaOH solution and extracted with ethyl acetate. The organic phase was washed with water and brine, then dried over anhydrous sodium sulfate, filtered and evaporated. The residue obtained was purified by silica column chromatography with ethyl acetate as the eluent. Upon recrystallization, white crystals were obtained.

**9-Isopropyl-3-hydroxymethyl-1-methyl-β-carboline (6b)**

Starting from ethyl 9-isopropyl-1-methyl-β-carboline-3-carboxylate 5b (2.96g, 10mmol), white solid was obtained (1.6 g, 63%). ESI-MS m/z: 255 (100) [M+H]+. \(^1\)H NMR (300 MHz, CDCl\(_3\)): \( \delta \) 8.09 (1H, d, \( J = 7.8 \)MHz, ArH), 7.78 (1H, s, ArH), 7.53-7.61 (2H, m, ArH), 7.24-7.29 (2H, m, ArH), 4.99-5.08 (1H, m, CH\([\text{CH}_3]\)_2), 4.94 (2H, s, CH\(_2\)OH), 1.75 (2H, d, \( J =6.9 \)Hz, CH\([\text{CH}_3]\)_2). \( ^{13} \)C NMR (75 MHz, CDCl\(_3\)): \( \delta \) 147.6, 140.5, 140.2, 135.2, 130.2, 127.7, 122.8, 121.9, 119.5, 113.4, 109.9, 65.0, 48.5, 24.9, 21.7.

**9-Isobutyl-3-hydroxymethyl-1-methyl-β-carboline (6d)**

Starting from ethyl 9-isobutyl-1-methyl-β-carboline-3-carboxylate 5d (3.10g, 10mmol), white solid was obtained (2.0g, 75%). ESI-MS m/z: 269 (100) [M+H]+. \(^1\)H NMR (300 MHz, CDCl\(_3\)): \( \delta \) 8.08 (1H, d, \( J=7.8 \)Hz, ArH), 7.78 (1H, s, ArH), 7.53-7.58 (1H, m, ArH), 7.44 (1H, d,
Starting from ethyl 9-butyl-1-isopropyl-β-carboline-3-carboxylate 5i (3.4g, 10mmol), white solid was obtained (2.5g, 86%). ESI-MS m/z: 297 (100) [M+H]+. ¹H NMR (400 MHz, CDCl₃): δ 8.11 (1H, d, J = 8.0 Hz), 7.70 (1H, s), 7.55-7.59 (1H, m), 7.46 (1H, d, J = 8.0 Hz), 7.23-7.27 (1H, m), 4.90 (2H, s), 4.48 (2H, t, J = 8.0 Hz), 3.74-3.77 (1H, m), 1.78-1.86 (2H, m), 1.43-1.50 (9H, m), 0.88 (3H, t, J = 7.2 Hz).

Starting from ethyl 9-benzyl-1-isopropyl-β-carboline-3-carboxylate 5j (3.7g, 10mmol), white solid was obtained (2.7g, 83%). ESI-MS m/z: 331 (100) [M+H]+. ¹H NMR (400 MHz, CDCl₃): δ 8.14 (1H, d, J = 8.0 Hz), 7.75 (1H, s), 7.52-7.56 (1H, m), 7.37 (1H, d, J = 8.0 Hz), 7.22-7.30 (4H, m), 7.01 (1H, d, J = 7.6 Hz), 6.99-7.01 (2H, d, J = 8.0 Hz), 5.76 (2H, s), 4.91 (2H, s), 3.58-3.62 (1H, m), 1.29 (6H, d, J = 6.8 Hz).

Starting from ethyl 9-butyl-1-(4-chlorophenyl)-β-carboline 5m (4.1g, 10mmol), white solid was obtained (2.9g, 79%). ESI-MS m/z: 365 (100) [M+H]+. ¹H NMR (400 MHz, CDCl₃): δ 8.17 (1H, d, J = 8.0 Hz), 7.95 (1H, s), 7.55-7.62 (3H, m), 7.49-7.52 (2H, m), 7.44 (1H, d, J = 8.4 Hz), 7.28-7.32 (1H, m), 4.95 (2H, s), 3.97 (2H, t, J = 8.0 Hz), 1.28-1.36 (2H, m), 0.85 – 0.91 (2H, m), 0.66 (3H, t, J = 7.2 Hz).
**9-Benzyl-3-hydroxymethyl-1-(4-chlorophenyl)-β-carboline (6n)**

Starting from ethyl 9-benzyl-1-(4-chlorophenyl)-β-carboline-3-carboxylate 5n (4.4g, 10mmol), white solid was obtained (2.86g, 72%). ESI-MS m/z: 399 (100) [M+H]+. 1H NMR (400 MHz, CDCl₃): δ 8.21 (1H, d, J = 8.0 Hz), 7.99 (1H, s), 7.52-7.57 (1H, m), 7.23-7.34 (6H, m), 7.09-7.16 (3H, m), 6.57 (2H, d, J = 8.0 Hz), 5.21 (2H, s), 4.94 (2H, s).

**9-Hexyl-3-hydroxymethyl-1-(4-methoxyphenyl)-β-carboline (6q)**

Starting from ethyl 9-hexyl-1-(4-methoxylphenyl)-β-carboline-3-carboxylate 5q (4.3g, 10mmol), white solid was obtained (2.91g, 75%). EI-MS m/z: 389 [M+H]+. 1H NMR (400 MHz, CDCl₃): δ 8.17 (1H, d, J = 8.0 Hz), 7.93 (1H, s), 7.55-7.62 (3H, m), 7.44 (1H, d, J = 8.4 Hz), 7.28-7.32 (1H, m), 7.04-7.07 (2H, m), 4.97 (2H, s), 3.98 (2H, t, J = 8.0 Hz), 3.90 (3H, s), 1.32-1.36 (2H, m), 1.08-1.12 (2H, m), 0.96-1.01 (2H, m), 0.84-0.87 (2H, m), 0.77 (3H, t, J = 7.2 Hz).

**General procedure for the preparation of 1,9-disubstituted-β-carboline-3-carbaldehyde (7).**

To a solution of compounds 6 (10mmol) in CH₃CN (120 ml) was added activated MnO₂ (50 mmol). The suspension was refluxed for 2 h and then cooled and filtered through Celite. The filtrate was passed through silica gel and washed with dichloromethane, and the solvent was removed under reduced pressure. The residue was crystallized from acetone or acetone-petroleum ether to afford white crystals 7.

**9-Isopropyl-1-methyl-β-carboline-3-carbaldehyde (7b)**

Starting from 9-isopropyl-3-hydroxymethyl-1-methyl-β-carboline 6b (2.54g, 10mmol), white solid was obtained (1.7g, 67%). EI-MS m/z: 253 [M+H]+. 1H NMR (300 MHz, CDCl₃): δ 10.15 (1H, s, CHO), 8.58 (1H, s, ArH), 8.19 (1H, d, J = 7.8Hz, ArH), 7.76 (1H, d, J=8.4Hz, ArH), 7.55-7.60 (1H, m, ArH), 7.31-7.36 (1H, m, ArH), 5.58-5.72 (1H, m, CH[CH₃]₂), 3.14 (3H, s, CH₃),...
1.80 (2H, d, $J = 6.9$ Hz, CH$_2$). $^{13}$C NMR (75 MHz, CDCl$_3$): $\delta$ 193.0, 142.9, 141.5, 140.2, 138.0, 128.8, 128.3, 123.2, 122.0, 120.8, 113.9, 113.5, 49.0, 25.6, 21.8.

9-Isobutyl-1-methyl-β-carboline-3-carbaldehyde (7d)

Starting from 9-isobutyl-3-hydroxymethyl-1-methyl-β-carboline 6d (2.68 g, 10 mmol), white solid was obtained (1.8 g, 68%). EI-MS m/z: 267 [M+H]$^+$. $^1$H NMR (300 MHz, CDCl$_3$): $\delta$ 10.17 (1H, s, CHO), 8.60 (1H, s, ArH), 8.17 (1H, d, $J = 7.8$ Hz, ArH), 7.59-7.65 (1H, m, ArH), 7.51 (1H, d, $J = 8.4$ Hz, ArH), 7.32-7.38 (1H, m, ArH), 4.43 (2H, d, $J = 6.9$ Hz, CH$_2$CH[CH$_3$]$_2$), 3.12 (3H, s, CH$_3$), 2.23-2.37 (1H, m, CH$_2$C(CH$_3$)$_2$), 0.97 (2H, d, $J = 6.9$ Hz, CH$_2$CH[CH$_3$]$_2$). $^{13}$C NMR (75 MHz, CDCl$_3$): $\delta$ 193.0, 143.2, 142.4, 141.7, 137.7, 129.0, 128.8, 121.7, 121.0, 113.5, 111.2, 52.1, 31.0, 24.3, 20.5.

9-Butyl-1-isopropyl-β-carboline-3-carbaldehyde (7i)

Starting from 9-butyl-3-hydroxymethyl-1-isopropyl-β-carboline 6i (2.98 g, 10 mmol), white solid was obtained (2.1 g, 74%). EI-MS m/z: 295 [M+H]$^+$. $^1$H NMR (400 MHz, CDCl$_3$): $\delta$ 10.22 (1H, s), 8.58 (1H, s), 8.18 (1H, d, $J = 8.0$ Hz), 7.61-7.65 (1H, m), 7.51 (1H, d, $J = 8.0$ Hz), 7.33-7.37 (1H, m), 4.45 (2H, t, $J = 8.0$ Hz), 3.74-3.81 (1H, m), 1.83–1.91 (2H, m), 1.43-1.54 (8H, m), 1.01 (3H, t, $J = 7.2$ Hz).

9-Benzyl-1-isopropyl-β-carboline-3-carbaldehyde (7j)

Starting from 9-benzyl-3-hydroxymethyl-1-isopropyl-β-carboline 6j (3.30 g, 10 mmol), white solid was obtained (2.8 g, 86%). EI-MS m/z: 329 [M+H]$^+$. $^1$H NMR (400 MHz, CDCl$_3$): $\delta$ 10.24 (1H, s), 8.64 (1H, s), 8.23 (1H, d, $J = 8.0$ Hz), 7.56-7.60 (1H, m), 7.36-7.43 (2H, m), 7.27-7.32 (3H, m), 7.01 (2H, d, $J = 8.0$ Hz), 5.83 (2H, s), 3.63-3.66 (1H, m), 1.36 (6H, d, $J = 6.4$ Hz).

9-Butyl-1-(4-chlorophenyl)-β-carboline-3-carbaldehyde (7m)
Starting from 9-butyl-3-hydroxymethyl-1-(4-chlorophenyl)-β-carboline 6m (3.64g, 10mmol), white solid was obtained (3.22g, 89%). EI-MS m/z: 363 [M+H]+. 1H NMR (400 MHz, CDCl3): δ 10.33 (1H, s), 8.79 (1H, s), 8.26 (1H, d, J = 8.0 Hz), 7.66-7.70 (1H, m), 7.50-7.63 (5H, m), 7.40-7.44 (1H, m), 4.04 (2H, t, J = 8.0 Hz), 1.37-1.43 (2H, m), 0.90-0.96 (2H, m), 0.70 (3H, t, J = 7.2 Hz).

9-Benzyl-1-(4-chlorophenyl)-β-carboline-3-carbaldehyde (7n)

Starting from 9-benzyl-3-hydroxymethyl-1-(4-chlorophenyl)-β-carboline 6n (3.98g, 10mmol), white solid was obtained (2.85g, 72%). EI-MS m/z: 397 [M+H]+. 1H NMR (400 MHz, CDCl3): δ 10.24 (1H, s), 8.80 (1H, s), 8.30 (1H, d, J = 8.0 Hz), 7.58-7.62 (1H, m), 7.38-7.45 (2H, m), 7.27 – 7.33 (4H, m), 7.12-7.18 (3H, m), 6.58 (2H, d, J = 8.0 Hz), 5.28 (2H, s).

9-Hexyl-1-(4-methoxyphenyl)-β-carboline-3-carbaldehyde (7q)

Starting from 9-hexyl-3-hydroxymethyl-1-(4-methoxyphenyl)-β-carboline 6q (3.88g, 10mmol), white solid was obtained (2.75g, 71%). EI-MS m/z: 387 [M+H]+. 1H NMR (400 MHz, CDCl3): δ 10.30 (1H, s), 8.75 (1H, s), 8.26 (1H, d, J = 8.0 Hz), 7.63-7.67 (1H, m), 7.56-7.59 (2H, m), 7.51 (1H, d, J = 8.4 Hz), 7.40 (1H, t, J = 7.6Hz), 7.08 (2H, d, J = 8.0 Hz), 4.03 (2H, t, J = 8.0 Hz), 3.92 (3H, s), 1.40-1.44 (2H, m), 1.12-1.17 (2H, m), 0.98-1.06 (2H, m), 0.87-0.91 (2H, m), 0.80 (3H, t, J = 7.2 Hz).

General procedure for the preparation of bivalent β-carbolines 8a-ae.

A mixture of β-carboline-3-carboxaldehydes 7 (2.2 mmol), anhydrous methanol (30mL) and anhydrous CH₂Cl₂ (10 mL) was stirred at room temperature for 10 min, and the corresponding diamine (1.0 mmol) was added. The mixture was refluxed for 2 hrs, and the solvent was evaporated under vacuum to give the crude schiff base, which was used directly in the next step.
without further purification.

NaBH₃CN (5 mmol) was added to a solution of the above-mentioned crude Schiff base in anhydrous CH₃OH (30 mL) at 0 °C. The mixture was stirred at room temperature for 4-6 h. After completion of the reaction as indicated by TLC, the reaction mixture was concentrated under vacuum. The residue was dissolved in CH₂Cl₂ (150 mL) and washed with aqueous Na₂CO₃ (pH 10, 50 mL). The organic layer was separated, dried over anhydrous Na₂SO₄, filtered, and concentrated under vacuum. The residue was purified by flash chromatography on silica gel (CH₂Cl₂/CH₃OH/NH₄OH, 100:1:0.8) to provide target products.

**N,N-Bis[(1,9-dimethyl-β-carboline-3-yl)methyl]butane-1,4-diamine (8a).**

Starting from 1,9-dimethyl-β-carboline-3-carboxaldehyde and 1,4-diamino-butane, compound 8a was obtained as white solid (0.75 g, 68%). EI-MS m/z: 505.1 [M+H]⁺. ¹H NMR (300 MHz, CDCl₃): δ 8.04 (2H, d, J =7.8Hz), 7.75(2H, s), 7.52-7.58(2H, m), 7.35(2H, d, J =7.8Hz), 7.20-7.23(2H, m), 4.02(4H, s), 3.96(6H, s), 2.99(6H, s), 2.81(4H, t, J =6.3Hz), 1.71-1.75(4H, m). ¹³C NMR (75 MHz, CDCl₃): δ 147.4, 142.4, 141.1, 134.9, 129.4, 128.1, 121.6, 121.2, 119.5, 111.2, 109.4, 55.5, 49.8, 32.3,28.4, 23.8. HRMS calcd for C₃₂H₃₆N₆ [M+H]⁺ 505.3074, found 505.3077.

**N,N-Bis[(1,9-dimethyl-β-carboline-3-yl)methyl]hexane-1,6-diamine (8b).**

Starting from 1,9-dimethyl-β-carboline-3-carboxaldehyde and 1,4-diaminohexane, compound 8b was obtained as white solid (0.70 g, 60%). EI-MS m/z: 533.1 [M+H]⁺. ¹H NMR (300 MHz, CDCl₃): δ 8.07 (2H, d, J =7.5Hz), 7.80(2H, s), 7.53-7.58(2H, m), 7.40(2H, d, J =8.1Hz), 7.21-7.23(2H, m), 4.11 (4H, s), 4.02(6H, s), 3.06(6H, s), 2.71(4H, t, J =7.2Hz), 1.55-1.64(4H, m), 1.37-1.41(4H, m). ¹³C NMR (75 MHz, CDCl₃): δ 148.1, 142.6, 141.2, 135.1, 129.6,
HRMS calcd for C₃₄H₄₀N₆ [M+H]⁺ 533.3387, found 533.3393.

N,N-Bis[(9-isopropyl-1-methyl-β-carboline-3-yl)methyl]butane-1,4-diamine (8c).

Starting from 9-isopropyl-1-methyl-β-carboline-3-carboxaldehyde and 1,4-diaminohexane, compound 8c was obtained as yellow oil (0.39 g, 70%). EI-MS m/z: 561.1 [M+H]⁺. ¹H NMR (300 MHz, CDCl₃): δ 8.09 (2H, d, J = 7.8Hz), 7.80 (2H, s), 7.66 (2H, d, J = 8.7Hz), 7.43-7.51 (2H, m), 7.18-7.24 (2H, m), 4.46-5.55 (2H, m), 4.02 (4H, s), 3.02 (4H, s), 2.76 (4H, t, J = 6.0Hz), 1.74 (6H, s), 1.72 (6H, s), 1.65-1.70 (4H, m). ¹³C NMR (75 MHz, CDCl₃): δ 147.3, 140.7, 140.3, 135.0, 129.8, 127.5, 122.9, 121.9, 119.4, 113.3, 111.3, 111.3, 55.5, 49.8, 48.5, 28.4, 25.3, 21.8. HRMS calcd for C₃₆H₄₄N₆ [M+H]⁺ 561.3700, found 561.3709.

N,N-Bis[(9-butyl-1-methyl-β-carboline-3-yl)methyl]butane-1,4-diamine (8d).

Starting from 9-butyl-1-methyl-β-carboline-3-carboxaldehyde and 1,4-diaminohexane, compound 8d was obtained as white solid (0.32 g, 25%). EI-MS m/z: 589.2 [M+H]⁺. ¹H NMR (300 MHz, CDCl₃): δ 8.07 (2H, d, J = 7.8Hz), 7.80 (2H, s), 7.51-7.56 (2H, m), 7.41(2H, d, J = 7.8Hz), 7.19-7.22 (2H, m), 4.47(4H, t, J = 6.6Hz), 4.02 (4H, s), 3.01(6H, s), 2.76 (4H, t, J = 6.3Hz), 1.75-1.85(4H, m), 1.65-1.70 (4H, m), 1.37-1.49(4H, m), 0.97(6H, t, J = 7.2Hz). ¹³C NMR (75 MHz, CDCl₃): δ 147.8, 141.9, 140.7, 134.2, 129.8, 128.0, 121.6, 121.5, 119.5, 111.2, 109.8, 55.8, 49.9, 44.8, 33.1, 28.4, 23.8, 20.5, 14.2. HRMS calcd for C₃₈H₄₈N₆ [M+H]⁺ 589.4013, found 589.4018.

N,N-Bis[(9-isobutyl-1-methyl-β-carboline-3-yl)methyl]propane-1,3-diamine (8e).

Starting from 9-isobutyl-1-methyl-β-carboline-3-carboxaldehyde and 1,3-diaminopropane, compound 8e was obtained as yellow oil (0.57 g, 45%). EI-MS m/z: 575.2 [M+H]⁺. ¹H NMR (300 MHz, CDCl₃): δ 8.12 (2H, d, J = 8.6Hz), 7.80 (2H, s), 7.50(2H, d, J = 8.6Hz), 7.23 (2H, m), 4.47(2H, t, J = 6.6Hz), 3.96 (4H, s), 3.01(6H, s), 2.76 (4H, t, J = 6.6Hz), 1.61-1.83 (4H, m), 1.56-1.70 (4H, m), 1.37-1.49(4H, m), 0.97(6H, t, J = 7.2Hz). ¹³C NMR (75 MHz, CDCl₃): δ 147.8, 141.9, 140.7, 134.2, 129.8, 128.0, 121.6, 121.5, 119.5, 111.2, 109.8, 55.8, 49.9, 44.8, 33.1, 28.4, 23.8, 20.5, 14.2. HRMS calcd for C₃₆H₄₈N₆ [M+H]⁺ 575.1768, found 575.1779.
MHz, CDCl$_3$): $\delta$ 7.93 (2H, d, $J=7.8$Hz), 7.83(2H, s), 7.46-7.51 (2H, m), 7.35(2H, d, $J=7.8$Hz), 7.09-7.14 (2H, m), 4.13(4H, s), 4.09 (4H, d, $J=7.5$Hz), 3.11(4H, t, $J=5.4$Hz), 2.82 (6H, s), 2.03-2.17(4H, m), 0.85(6H, s), 0.83(6H, s). $^{13}$C NMR (75 MHz, CDCl$_3$): $\delta$ 143.5, 142.3, 141.1, 134.7, 129.8, 128.1, 121.6, 121.0, 119.7, 112.3, 110.6, 53.7, 51.8, 49.2, 31.0, 25.6, 23.9, 20.5. HRMS caled for C$_{37}$H$_{46}$N$_6$ [M+H]$^+$ 575.3857, found 575.3877.

**N,N-Bis[(9-isobutyl-1-methyl-β-carboline-3-yl)methyl]butane-1,4-diamine (8f).**

Starting from 9-isobutyl-1-methyl-β-carboline-3-carboxaldehyde and 1,4-diaminobutane, compound 8f was obtained as yellow oil (0.52 g, 40%). EI-MS m/z: 589.2 [M+H]$^+$. $^1$H NMR (300 MHz, CDCl$_3$): $\delta$ 8.06 (2H, d, $J=7.8$Hz), 7.82(2H, s), 7.48-7.53 (2H, m), 7.40 (2H, d, $J=7.8$Hz), 7.18-7.23 (2H, m), 4.28 (4H, d, $J=7.5$Hz), 4.02(4H, s), 2.99 (6H, s), 2.77(4H, t, $J=6.0$Hz), 2.19-2.28(2H, m), 1.65-1.70 (2H, m), 0.92 (6H, s), 0.90 (6H, s). $^{13}$C NMR (75 MHz, CDCl$_3$): $\delta$ 147.9, 142.4, 140.8, 134.5, 129.9, 127.9, 121.6, 121.3, 119.4, 111.3, 110.5, 55.8, 51.9, 50.0, 30.9, 28.4, 24.1, 20.5. HRMS caled for C$_{38}$H$_{48}$N$_6$ [M+H]$^+$ 589.4013, found 589.4020.

**N,N-Bis[(9-benzyl-1-methyl-β-carboline-3-yl)methyl]propane-1,3-diamine (8g).**

Starting from 9-benzyl-1-methyl-β-carboline-3-carboxaldehyde and 1,3-diaminopropane, compound 8g was obtained as yellow oil (0.37 g, 58%). EI-MS m/z: 643.4 [M+H]$^+$. $^1$H NMR (300 MHz, CDCl$_3$): $\delta$ 8.08 (2H, d, $J=7.8$Hz), 7.87 (2H, s), 7.46-7.51 (2H, m), 7.31 (2H, d, $J=8.4$Hz), 7.20-7.24 (8H, m), 6.94-6.98 (4H, m), 5.71(4H, s), 4.05(4H, s), 2.88 (4H, t, $J=6.9$Hz), 2.82 (6H, s), 1.85-1.94 (2H, m). $^{13}$C NMR (75 MHz, CDCl$_3$): $\delta$ 148.1, 142.4, 141.2, 138.2, 134.7, 130.0, 129.1, 128.5, 127.6, 125.6, 121.8, 121.6, 120.1, 111.6, 110.0, 55.8, 48.6, 48.4, 30.5, 23.5. HRMS caled for C$_{43}$H$_{42}$N$_6$ [M+H]$^+$ 643.3544, found 643.3550.

**N,N-Bis[(9-benzyl-1-methyl-β-carboline-3-yl)methyl]butane-1,4-diamine (8h).**
Starting from 9-benzyl-1-methyl-β-carboline-3-carboxaldehyde and 1,4-diaminobutane, compound 8h was obtained as yellow oil (0.36 g, 60%). EI-MS m/z: 657.4 [M+H]+. 1H NMR (300 MHz, CDCl3): δ 8.12 (2H, d, J =7.8Hz), 7.86 (2H, s), 7.48-7.53 (2H, m), 7.31 (2H, d, J =8.4Hz), 7.22-7.26 (8H, m), 6.94-6.97 (4H, m), 5.71(4H, s), 4.04(4H, s), 2.82 (6H, s), 2.77 (4H, t, J =6.0Hz), 1.68-1.72 (4H, m). 13C NMR (75 MHz, CDCl3) : δ 148.0, 142.4, 141.2, 138.2, 134.8, 130.0, 129.2, 128.5, 127.7, 125.6, 121.8, 121.6, 120.1, 111.6, 110.0, 55.6, 49.9, 48.4, 28.4, 23.5. HRMS calcd for C44H44N6 [M+H]+ 657.3700, found 657.3700.

N,N-Bis[(9-(3-chlorobenzyl)-1-methyl-β-carboline-3-yl)methyl]propane-1,3-diamine (8i).

Starting from 9-(3-chlorobenzyl)-1-methyl-β-carboline-3-carboxaldehyde and 1,3-diaminopropane, compound 8i was obtained as white solid (0.91 g, 58%). EI-MS m/z: 711.0 [M+H]+. 1H NMR (300 MHz, CDCl3): δ 8.07 (2H, d, J =7.8Hz), 7.87 (2H, s), 7.46-7.51 (2H, m), 7.13-7.26 (8H, m), 7.00 (2H, s), 6.76 (2H, d, J =7.5Hz), 5.63(4H, s), 4.06 (4H, s), 2.89 (4H, t, J =6.9Hz), 2.79 (6H, s), 1.85-1.92 (2H, m). 13C NMR (75 MHz, CDCl3) : δ 148.5, 142.4, 141.0, 140.4, 135.1, 134.6, 130.5, 130.1, 128.6, 128.0, 125.8, 123.8, 121.8, 121.7, 120.3, 111.5, 109.8, 55.7, 48.6, 47.9, 30.5, 23.5. HRMS calcd for C43H40Cl2N6 [M+H]+ 711.2764, found 711.2761.

N,N-Bis[(9-(3-propylphenyl)-1-methyl-β-carboline-3-yl)methyl]propane-1,3-diamine (8j).

Starting from 9-(3-propylphenyl)-1-methyl-β-carboline-3-carboxaldehyde and 1,3-diaminopropane, compound 8j was obtained as yellow oil (0.58 g, 38%). EI-MS m/z: 698.8 [M+H]+. 1H NMR (300 MHz, CDCl3): δ 8.02 (2H, d, J =7.5Hz), 7.80 (2H, s), 7.46-7.52 (2H, m), 7.15-7.31 (14H, m), 4.46(4H, t, J=8.1Hz), 4.03(4H, s), 2.86 (6H, s), 2.85(4H, t, J =6.6Hz), 2.73 (4H, t, J =7.5 Hz), 2.07-2.15 (4H, m), 1.83-1.89 (2H, m). 13C NMR (75 MHz, CDCl3) : δ 147.7, 141.9, 140.8, 134.2, 129.9, 128.8, 128.6, 128.2, 126.5, 121.7, 121.6, 119.7, 111.5, 109.8, 55.7,
N,N-Bis[1-isopropyl-β-carboline-3-yl)methyl]pentane-1,5-diamine (8k).

Starting from 1-isopropyl-β-carboline-3-carboxaldehyde and 1,5-diaminopentane, compound 8k was obtained as yellow solid (0.32 g, 27%). ESI-MS m/z: 547 [M+1]+. 1H NMR (400 MHz, DMSO): δ 8.16 (2H, d, J = 8.0 Hz), 8.03 (2H, s), 7.61 (2H, d, J = 8.0 Hz), 7.52–7.56 (2H, m), 7.22–7.26 (2H, m), 4.24 (4H, s), 3.64-3.68 (2H, m), 2.90 (4H, t, J = 6.0 Hz), 1.64-1.68 (4H, m), 1.37-1.39 (14H, m). 13C NMR (100 MHz, DMSO): δ 149.8, 140.6, 132.4, 127.97, 127.93, 121.3, 120.7, 119.2, 111.9, 111.8, 51.7, 46.8, 30.8, 26.0, 23.4, 21.3. HRMS calcd for C35H42N6 [M+H]+ 547.3549, found 547.3553.

N,N-Bis[(9-butyl-1-isopropyl-β-carboline-3-yl)methyl]butane-1,4-diamine (8l).

Starting from 9-butyl-1-isopropyl-β-carboline-3-carboxaldehyde and 1,4-diaminobutane, compound 8l was obtained as yellow solid (0.37 g, 26%). ESI-MS m/z: 645 [M+1]+. 1H NMR (400 MHz, CDCl3): δ 9.21 (2H, s), 8.10 (2H, d, J = 8.0 Hz), 7.95 (2H, s), 7.55 (2H, d, J = 8.4 Hz), 7.43 (2H, d, J = 7.4 Hz), 5.08 (4H, s), 4.48 (4H, t, J = 6.4 Hz), 3.72–3.76 (2H, m), 2.95–2.98 (4H, t, J = 7.6 Hz), 1.98–2.02 (4H, m), 1.79–1.83 (4H, m), 1.41–1.46 (16H, m), 0.96–0.99 (6H, t, J = 7.6 Hz). 13C NMR (100 MHz, CDCl3): δ 150.1, 142.2, 139.0, 133.1, 130.7, 128.3, 121.6, 121.1, 119.7, 112.4, 109.6, 51.6, 46.9, 45.1, 32.4, 31.4, 28.7, 26.7, 24.2, 22.7, 20.2, 13.8.

N,N-Bis[(9-butyl-1-isopropyl-β-carboline-3-yl)methyl]pentane-1,5-diamine (8m).

Starting from 9-butyl-1-isopropyl-β-carboline-3-carboxaldehyde and 1,5-diaminopentane, compound 8m was obtained as yellow solid (0.46 g, 32%). ESI-MS m/z: 659 [M+1]+. 1H NMR (400 MHz, CDCl3): δ 9.19 (2H, s), 8.41 (2H, d, J = 8.0 Hz), 7.78 (2H, t, J = 7.6 Hz), 7.56 (2H, d, J = 8.4 Hz), 7.42 (2H, t, J = 7.4 Hz), 5.11 (4H, s), 4.54 (4H, t, J = 6.4 Hz), 3.99-4.06 (2H, m), 3.41
N,N-Bis[(9-benzyl-1-isopropyl-β-carboline-3-yl)methyl]propane-1,3-diamine (8n).

Starting from 9-benzyl-1-isopropyl-β-carboline-3-carboxaldehyde and 1,3-diaminopropane, compound 8n was obtained as white solid (0.49 g, 32%). ESI-MS m/z: 699.4 [M+1]+. 1H NMR (400 MHz, DMSO): δ 8.50 (2H, s), 8.32 (2H, d, J = 7.6 Hz), 7.80 (2H, d, J = 8.0 Hz), 7.68 (2H, t, J = 7.2 Hz), 7.40 (2H, t, J = 7.2 Hz), 7.21-7.31 (6H, m), 6.93 (4H, d, J = 6.8 Hz), 5.96 (4H, s), 4.54 (4H, s), 3.71-3.76 (2H, m), 3.19-3.22 (4H, t, J = 7.6 Hz), 2.25-2.29 (2H, m), 1.24 (12H, d, J = 6.8 Hz). 13C NMR (100 MHz, DMSO): δ 149.4, 143.2, 138.5, 137.7, 132.3, 128.7, 127.2, 125.2, 121.8, 120.8, 119.9, 110.8, 48.0, 43.8, 30.1, 30.0, 22.2, 22.0. HRMS calcd for C47H50N6 [M+H]+ 699.4175, found 699.4168.

N,N-Bis[(9-benzyl-1-isopropyl-β-carboline-3-yl)methyl]hexane-1,6-diamine (8o).

Starting from 9-benzyl-1-isopropyl-β-carboline-3-carboxaldehyde and 1,3-diaminohexane, compound 8o was obtained as white solid (0.70 g, 43%). ESI-MS m/z: 741 [M+1]+. 1H NMR (400 MHz, CDCl3): δ 9.19 (2H, s), 8.45 (2H, d, J = 7.6 Hz), 7.79 (2H, d, J = 8.0 Hz), 7.56 (2H, t, J = 7.2 Hz), 7.48(2H, t, J = 7.2 Hz), 7.31-7.35 (6H, m), 7.01 (4H, d, J = 6.8 Hz), 5.84 (4H, s), 5.01 (4H, s), 3.89 (2H, m), 3.31-3.35 (4H, m), 2.58 (4H, m), 1.96-1.98 (4H, m), 1.59 (12H, d, J = 6.8 Hz). 13C NMR (100 MHz, DMSO): δ 148.9, 143.7, 137.9, 136.2, 132.6, 127.9, 127.1, 125.8, 122.1, 120.4, 119.3, 111.3, 55.4, 48.3, 42.7, 33.4, 31.2, 28.1, 22.7. HRMS calcd for C50H56N6 [M+H]+ 741.4645, found 741.4639.
N,N-Bis[(9-methyl-1-phenyl-β-carboline-3-yl)methyl]butane-1,4-diamine (8p).

Starting from 9-methyl-1-phenyl-β-carboline-3-carboxaldehyde and 1,4-diaminobutane, compound 8p was obtained as yellow solid (0.58 g, 42%). ESI-MS m/z: 629 [M+1]+. 1H NMR (400 MHz, D2O): δ 8.85 (2H, s), 8.60 (2H, d, J = 8.0 Hz), 7.85 -8.11 (14H, m), 7.74 (2H, t, J = 7.6 Hz), 5.02 (4H, s), 3.64 (6H, s), 3.54 (4H, t, J = 6.0 Hz), 2.20-2.24 (4H, m). 13C NMR (100 MHz, D2O): δ 146.3, 142.0, 134.8, 134.7, 133.6, 132.9, 132.6, 132.1, 130.9, 129.9, 123.6, 122.9, 120.4, 118.1, 112.0, 49.4, 47.8, 33.4, 23.7. HRMS calcd for C42H40N6 [M+H]+ 629.3393, found 629.3389.

N,N-Bis[(9-methyl-1-phenyl-β-carboline-3-yl)methyl]hexane-1,6-diamine (8q).

Starting from 9-methyl-1-phenyl-β-carboline-3-carboxaldehyde and 1,6-diaminohexane, compound 8q was obtained as yellow solid (0.39 g, 27%). ESI-MS m/z: 657 [M+1]+. 1H NMR (400 MHz, DMSO): δ 8.74 (2H, s), 8.37 (2H, d, J = 8.0 Hz), 7.75-7.81 (8H, m), 7.60-7.66 (6H, m), 7.43 (2H, t, J = 7.6 Hz), 4.55 (4H, s), 3.50 (6H, s), 3.02 (4H, t, J = 6.0 Hz), 1.71-1.75 (4H, m), 1.33-1.38 (4H, m). 13C NMR (100 MHz, D2O): δ 148.1, 142.3, 138.4, 134.2, 133.6, 132.2, 130.5, 129.3, 126.8, 123.9, 122.4, 121.7, 119.2, 117.8, 111.0, 51.4, 49.2, 33.8, 26.1, 24.4. HRMS calcd for C44H44N6 [M+H]+ 657.3706, found 657.3705.

N,N-Bis[(9-benzyl-1-phenyl-β-carboline-3-yl)methyl]propane-1,3-diamine (8r).

Starting from 9-benzyl-1-phenyl-β-carboline-3-carboxaldehyde and 1,3-diaminopropane, compound 8r was obtained as yellow solid (0.54 g, 32%). ESI-MS m/z: 767 [M+1]+. 1H NMR (400 MHz, CDCl3): δ 8.19 (2H, s), 8.11 (2H, d, J = 8.0 Hz), 7.47-7.51 (2H, m), 7.29-7.33 (2H, m), 7.07-7.25 (18H, m), 6.54 (4H, d, J = 8.0Hz), 5.05 (4H, s), 4.19 (4H, s), 3.08 (4H, t, J = 6.0 Hz), 2.25-2.28(2H, m). 13C NMR (100 MHz, CDCl3): δ 143.9, 143.2, 142.9, 139.2, 136.8, 133.9, 131.3,
N,N-Bis[(9-benzyl-1-phenyl-β-carboline-3-yl)methyl]hexane-1,6-diamine (8s).

Starting from 9-benzyl-1-phenyl-β-carboline-3-carboxaldehyde and 1,6-diaminohexane, compound 8s was obtained as yellow solid (0.52 g, 29%). ESI-MS m/z: 809 [M+1]+. 1H NMR (400 MHz, DMSO) δ 8.92 (2H, s), 8.43 (2H, d, J = 8.0 Hz), 7.74-7.76 (4H, m), 7.56-7.60 (6H, m), 7.44-7.49 (6H, m), 7.06-7.12 (6H, m), 6.47 (4H, d, J = 8.0Hz), 5.37 (4H, s), 4.58 (4H, s), 3.02-3.05 (4H, t, J = 6.0 Hz), 1.71-1.74 (4H, m), 1.36–1.42 (4H, m), 1.05 (2H, t, J = 7.0 Hz). 13C NMR (100 MHz, CDCl3) δ 145.0, 135.5, 134.9, 134.4, 133.3, 133.1, 132.9, 132.7, 132.6, 129.9, 128.3, 127.5, 124.4, 122.7, 120.7, 120.1, 110.5, 47.1, 46.8, 44.7, 31.3, 24.4, 19.9, 13.3. HRMS calcd for C56H65N6 [M+H]+ 809.4332, found 809.4324.

N,N-Bis[(1-(4-chlorophenyl)-9-butyl-β-carboline-3-yl)methyl]propane-1,3-diamine (8t).

Starting from 1-(4-chlorophenyl)-9-butyl-β-carboline-3-carboxaldehyde and 1,3-diaminopropane, compound 8t was obtained as yellow solid (0.71 g, 42%). ESI-MS m/z: 767.5 [M+1]+. 1H NMR (400 MHz, DMSO): δ 8.61 (2H, d, J = 7.6 Hz), 8.32 (2H, s), 7.66 –7.79 (12H, m), 7.37-7.40 (2H, t, J = 7.2 Hz), 4.49(4H, s), 4.05 (4H, t, J = 8.0Hz), 3.16 (4H, t, J = 6.0 Hz), 2.23-2.26 (2H, m), 1.21-1.25 (4H, m), 0.81-0.83 (4H, m), 0.57 (6H, t, J = 7.2 Hz). 13C NMR (100 MHz, DMSO): δ 142.7, 140.9, 138.4, 133.9, 132.8, 131.5, 131.3, 129.6, 128.1, 121.8, 120.6, 119.9, 115.3, 111.2, 49.7, 43.9, 43.7, 30.3, 22.0, 19.0, 13.1. HRMS calcd for C47H48Cl2N6 [M+H]+ 767.3396, found 767.3390.

N,N-Bis[(1-(4-chlorophenyl)-9-butyl-β-carboline-3-yl)methyl]butane-1,4-diamine (8u).

Starting from 1-(4-chlorophenyl)-9-butyl-β-carboline-3-carboxaldehyde and 1,4-
diaminobutane, compound 8u was obtained as yellow solid (0.31 g, 18%). ESI-MS m/z: 781 [M+1]+. $^1$H NMR (400 MHz, CDCl$_3$): $\delta$ 8.13 (2H, d, $J = 7.6$ Hz), 7.99 (2H, s), 7.39-7.59 (12H, m), 7.25-7.28 (2H, t, $J = 7.2$Hz), 4.08 (4H, s), 3.87 (4H, t, $J = 8.0$Hz), 2.76 (4H, t, $J = 6.0$Hz), 1.67-1.69 (4H, m), 1.27-1.31 (4H, m), 0.83 -0.89 (4H, m), 0.63 (6H, t, $J = 7.2$ Hz). $^{13}$C NMR (100 MHz, CDCl$_3$): $\delta$ 142.5, 142.0, 138.6, 134.4, 133.2, 131.4, 130.7, 128.3, 121.7, 121.3, 119.8, 112.4, 110.1, 65.8, 54.9, 49.3, 44.3, 30.8, 28.0, 19.8, 13.5. HRMS calcd for C$_{48}$H$_{50}$Cl$_2$N$_6$ [M+H]$^+$ 781.3552, found 781.3547.

N,N-Bis[(1-(4-chlorophenyl)-9-benzyl-β-carboline-3-yl)methyl]pentane-1,5-diamine (8v).

Starting from 1-(4-chlorophenyl)-9-benzyl-β-carboline-3-carboxaldehyde and 1,5-diaminopentane, compound 8v was obtained as yellow solid (0.45 g, 24%). ESI-MS m/z: 863 [M+1]+. $^1$H NMR (400 MHz, DMSO): $\delta$ 8.62 (2H, s), 8.37 (2H, d, $J = 7.6$ Hz), 7.74 (2H, d, $J = 8.4$ Hz), 7.67 (2H, t, $J = 7.7$ Hz), 7.33-7.59 (12H, m), 7.01-7.16 (8H, m), 6.45 (4H, d, $J = 6.6$ Hz), 4.47 (4H, s), 2.97 (4H, t, $J = 6.0$ Hz), 1.68-1.72 (4H, m), 1.36-1.40 (2H, m). $^{13}$C NMR (100 MHz, DMSO): $\delta$ 143.1, 141.2, 139.4, 136.7, 133.7, 133.1, 131.5, 131.3, 129.7, 128.2, 127.8, 127.0, 125.2, 121.8, 120.9, 120.2, 115.0, 111.3, 47.3, 46.4, 33.9, 24.6, 22.9. HRMS calcd for C$_{55}$H$_{48}$Cl$_2$N$_6$ [M+H]$^+$ 863.3396, found 863.3384.

N,N-Bis[(1-(4-chlorophenyl)-9-benzyl-β-carboline-3-yl)methyl]hexane-1,6-diamine (8w).

Starting from 1-(4-chlorophenyl)-9-benzyl-β-carboline-3-carboxaldehyde and 1,6-diaminohexane, compound 8w was obtained as yellow solid (0.44 g, 23%). ESI-MS m/z: 877.4 [M+1]+. $^1$H NMR (400 MHz, DMSO): $\delta$ 8.56 (2H, s), 8.41 (2H, d, $J = 7.6$ Hz), 7.62 (2H, d, $J = 8.4$ Hz), 7.57 (2H, t, $J = 7.7$ Hz), 7.36-7.51 (10H, m), 6.92-7.13 (10H, m), 6.36 (4H, d, $J = 6.4$ Hz), 4.22 (4H, s), 2.68 (4H, t, $J = 6.0$ Hz), 1.45-1.53 (4H, m), 1.12-1.21 (4H, m). $^{13}$C NMR (100 MHz,
N,N-Bis[1-(4-methoxyphenyl-β-carboline-3-yl)methyl]butane-1,4-diamine (8x).

Starting from 1-(4-methoxyphenyl)-β-carboline-3-carboxaldehyde and 1,4-diaminobutane, compound 8x was obtained as yellow solid (0.64 g, 44%). ESI-MS m/z: 661 [M+1]⁺. ¹H NMR (400 MHz, CDCl₃): δ 8.44 (2H, s), 7.98 (2H, d, J = 8.0 Hz), 7.76 (4H, d, J = 8.4 Hz), 7.66 (2H, s), 7.40-7.51 (4H, m), 7.43 (2H, d, J = 8.1 Hz), 7.20-7.25 (2H, m), 6.99 (4H, t, J = 8.8 Hz), 4.02 (4H, s), 3.83 (6H, s), 2.82 (4H, t, J = 6.0 Hz), 1.73-1.76 (4H, m). ¹³C NMR (100 MHz, CDCl₃): δ 160.0, 141.7, 140.6, 132.3, 130.9, 130.3, 129.3, 128.2, 121.8, 120.0, 114.4, 111.6, 111.3, 111.1, 55.3, 54.3, 49.0, 27.9. HRMS calcd for C₄₂H₄₀N₆O₂ [M+H]⁺ 661.3291, found 661.3286.

N,N-Bis[1-(4-methoxyphenyl)-9-methyl-β-carboline-3-yl)methyl]-butane-1,4-diamine (8y).

Starting from 1-(4-methoxyphenyl)-9-methyl-β-carboline-3-carboxaldehyde and 1,4-diaminobutane, compound 8y was obtained as yellow solid (0.44 g, 30%). ESI-MS m/z: 689 [M+1]⁺. ¹H NMR (400 MHz, CDCl₃): δ 8.07 (2H, d, J = 7.6 Hz), 7.84 (2H, s), 7.48-7.58 (2H, m), 7.34-7.37 (6H, m), 7.24-7.28 (2H, m), 6.94 (4H, d, J = 8.4 Hz), 4.08 (4H, s), 3.84 (6H, s), 3.31 (6H, s), 2.86-2.88 (4H, m), 1.76-1.78 (4H, m). ¹³C NMR (100 MHz, CDCl₃): δ 159.7, 147.1, 143.2, 134.2, 132.3, 130.7, 128.3, 121.6, 121.1, 119.6, 113.5, 111.8, 109.6, 65.8, 55.1, 53.4, 49.2, 32.7, 28.0, 15.2. HRMS calcd for C₄₄H₄₄N₆O₂ [M+H]⁺ 689.3604, found 689.3608.

N,N-Bis[1-(4-methoxyphenyl)-9-methyl-β-carboline-3-yl)methyl]-pentane-1,5-diamine (8z).

Starting from 1-(4-methoxyphenyl)-9-methyl-β-carboline-3-carboxaldehyde and 1,5-diaminopentane, compound 8z was obtained as yellow solid (0.43 g, 28%). ESI-
MS m/z: 703 [M+1]+. $^1$H NMR (400 MHz, CDCl$_3$): $\delta$ 8.12 (2H, d, $J = 7.6$ Hz), 8.01 (2H, s), 7.49-7.58 (2H, m), 7.47-7.51 (4H, m), 7.35 (2H, d, $J = 8.4$ Hz), 7.24-7.28 (2H, m), 6.98 (4H, d, $J = 8.4$ Hz), 4.20 (4H, s), 3.86 (6H, s), 3.40 (6H, s), 2.84 (4H, t, $J = 6.8$ Hz), 1.68-1.74 (4H, m), 1.44-1.45 (2H, m). $^{13}$C NMR (100 MHz, CDCl$_3$): $\delta$ 159.8, 143.3, 134.5, 131.8, 130.9, 130.9, 121.8, 121.0, 119.9, 113.6, 112.7, 109.7, 32.8, 31.9, 29.7, 26.9, 23.8, 22.7. HRMS calcd for C$_{45}$H$_{46}$N$_6$O$_2$ [M+H]+ 703.3760, found 703.3760.

**N,N-Bis[(9-hexyl-1-(4-methoxyphenyl)-β-carboline-3-yl)methyl]-hexane-1,6-diamine (8aa).**

Starting from 9-hexyl-1-(4-methoxyphenyl)-β-carboline-3-carboxaldehyde and 1, 6-diaminohexane, compound 8aa was obtained as yellow solid (0.62 g, 33%).

ESI-MS m/z: 857 [M+1]+. $^1$H NMR (400 MHz, CDCl$_3$): $\delta$ 8.14 (2H, d, $J = 7.6$ Hz), 7.99 (2H, s), 7.47-7.57 (6H, m), 7.47-7.51 (4H, m), 7.38-7.41 (2H, d, $J = 8.4$ Hz), 7.24-7.28 (2H, m), 7.00-7.03 (4H, d, $J = 8.4$ Hz), 4.12 (4H, s), 3.90 (4H, t, $J = 8.0$ Hz), 3.87 (6H, s), 2.72 (4H, t, $J = 7.2$ Hz), 1.58-1.61 (4H, m), 1.25 -1.36 (8H, m), 1.09 –1.14 (4H, m), 0.94 -1.02 (4H, m), 0.82 –0.88 (4H, m), 0.75 (6H, t, $J = 7.2$ Hz). $^{13}$C NMR (100 MHz, CDCl$_3$): $\delta$ 159.8, 146.1, 143.4, 142.5, 133.5, 132.4, 131.1, 130.5, 128.2, 121.5, 121.3, 119.6, 113.6, 112.1, 110.1, 55.4, 54.7, 49.2, 44.4, 31.1, 26.2, 22.4. HRMS calcd for C$_{56}$H$_{68}$N$_6$O$_2$ [M+H]+ 857.5482, found 857.5467.

**N,N-Bis[(9-benzyl-1-(4-methoxyphenyl)-β-carboline-3-yl)methyl]-pentane-1,5-diamine (8ab).**

Starting from 9-butyl-1-(4-methoxyphenyl)-β-carboline-3-carboxaldehyde and 1,5-diaminopentane, compound 8ab was obtained as white solid (0.53 g, 31%).

ESI-MS m/z: 856 [M+1]+. $^1$H NMR (400 MHz, CDCl$_3$): $\delta$ 9.24 (2H, s), 8.43 (2H, d, $J = 8.0$ Hz), 7.69 (2H, t, $J = 7.6$ Hz), 7.38-7.51 (8H, m), 7.12-7.21 (6H, m), 6.85 (4H, d, $J = 8.4$ Hz), 6.58 (4H, d, $J = 6.8$ Hz), 5.26 (4H, s), 4.97 (4H, s), 3.78 (6H, s), 3.27-2.30 (4H, m), 1.91-1.94 (4H, m), 1.67-1.70 (2H, m). $^{13}$C
NMR (100 MHz, CDCl$_3$): $\delta$ 161.9, 145.5, 140.0, 135.3, 135.1, 134.0, 133.4, 132.4, 131.7, 128.8, 127.8, 125.3, 124.0, 122.8, 120.4, 119.8, 114.1, 111.2, 55.5, 48.5, 47.3, 46.9, 29.7, 24.1. HRMS calcd for C$_{57}$H$_{54}$N$_6$O$_2$ [M+H]$^+$ 855.4387, found 855.4381.

N,N-Bis[(9-benzyl-1-(4-methoxyphenyl)-β-carboline-3-yl)methyl]-hexane-1,6-diamine (8ac).

Starting from 9-benzyl-1-(4-methoxyphenyl)-β-carboline-3-carboxaldehyde and 1,6-diaminohexane, compound 8ac was obtained as yellow solid (0.71 g, 37%). ESI-MS m/z: 869 [M+1]$^+$. $^1$H NMR (400 MHz, DMSO): $\delta$ 8.79 (2H, s), 8.40 (2H, d, J = 8.0 Hz), 7.69-7.78 (4H, m), 7.53 (4H, d, J = 8.4 Hz), 7.45 (2H, t, J = 7.2 Hz), 7.06 – 7.12 (6H, m), 7.02 (4H, d, J = 8.4 Hz), 6.51 (4H, d, J = 6.8 Hz), 5.42 (4H, s), 4.55 (4H, s), 3.84 (6H, s), 2.88-3.02 (4H, m), 1.73-1.76 (4H, m), 1.33-1.36 (4H, m). $^{13}$C NMR (100 MHz, DMSO): $\delta$ 160.2, 143.7, 136.6, 133.0, 131.2, 130.4, 128.2, 127.1, 125.4, 122.2, 121.3, 120.0, 113.4, 111.6, 55.3, 47.3, 46.6, 33.9, 25.4, 25.0. HRMS calcd for C$_{57}$H$_{54}$N$_6$O$_2$ [M+H]$^+$ 869.4543, found 869.4538.

N,N-Bis[1-(3,4,5-trimethoxy)-9-ethyl-β-carboline-3-yl)methyl]propane-1,3-diamine (8ad).

Starting from 1-(3,4,5-trimethoxy)-9-ethyl-β-carboline-3-carboxaldehyde and 1,3-diaminopropane, compound 8ad was obtained as yellow oil (0.20 g, 21%). EI-MS m/z: 823 [M+H]$^+$. $^1$H NMR (300 MHz, CDCl$_3$): $\delta$ 8.10 (2H, d, J =7.5Hz), 8.01 (2H, s), 7.53-7.59 (2H, m), 7.40(2H, d, J=8.4Hz), 7.20-7.24(2H, m), 6.78(4H, s), 4.11(4H, q, J=7.2Hz), 3.99(4H, q, J=7.2Hz), 3.90 (6H, s), 3.86 (12H, s), 2.90 (4H, t, J=6.9Hz), 1.85-1.94 (2H, m), 1.03(6H, t, J=6.9Hz). $^{13}$C NMR (75 MHz, CDCl$_3$): $\delta$ 153.2, 147.5, 143.4, 142.2, 138.2, 135.8, 133.1, 131.3, 128.6, 121.9, 121.6, 119.6, 112.6, 110.2, 106.5, 61.2, 56.5, 55.7, 48.7, 39.4, 30.2, 14.7. HRMS calcd for C$_{49}$H$_{54}$N$_6$O$_6$ [M+H]$^+$ 823.4178, found 823.4176.

N,N-Bis[1-(3,4,5-trimethoxy)-9-(3-propylphenyl)-β-carboline-3-yl)methyl]-propane-1,3-di-
amine (8ae).

Starting from 1-(3,4,5-trimethoxy)-9-(3-propylphenyl)-β-carboline-3-carboxaldehyde and 1,3-diaminopropane, compound 8ae was obtained as yellow oil (0.20 g, 76%). EI-MS m/z:1045.3 [M+H]+. 1H NMR (300 MHz, CDCl3): δ 8.15 (2H, d, J=7.8Hz), 8.04 (2H, s), 7.51-7.56 (2H, m), 7.30 (2H, d, J=8.7Hz), 7.12-7.26 (8H, m), 6.96 (4H, d, J=6.9Hz), 6.81 (4H, s), 4.13 (4H, s), 3.97 (4H, t, J=7.8Hz), 3.94 (6H, s), 3.86 (12H, s), 2.77 (4H, t, J=7.2Hz), 2.23 (4H, t, J=7.8Hz), 1.70-1.81 (4H, m), 1.58-1.63 (4H, m), 1.33-1.41 (4H, m). 13C NMR (75 MHz, CDCl3) : δ 153.3, 147.1, 143.4, 142.5, 140.8, 138.4, 135.7, 133.4, 131.4, 128.6, 128.1, 126.2, 122.0, 121.6, 120.1, 112.8, 110.2, 106.9, 61.3, 56.6, 55.4, 49.8, 44.6, 33.3, 31.2, 30.0, 27.6. HRMS calcd for C66H72N6O6 [M+H]+ 1045.5586, found 1045.5589.