In search for novel agents in therapy of tropical diseases and human immunodeficiency virus

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Supporting material

Content:

Dimethyl (2*R*,6*S*)-4-oxo-2,6-di(pyridin-2-yl)piperidine-3,5-dicarboxylate (1) $C_{19}H_{19}N_3O_5$ (369.4 g/mol), yield: 33 % (67 %) ; **^{1}H NMR** (DMSO-d_6, δ = ppm, J = Hz) 2.94 (t, 1H, $^3J = 12.3$, N***H***); 3.53 (s, 6H, COOC***H₃***); 4.25 (d, 2H, $^3J_{aa} = 10.5$, C***H***C=O); 4.62 (dd, 2H, $^3J = 12.3$, $^3J_{aa} = 10.5$, C***H***NH); 7.32 (ddd, 2H, $J = 1.0$, $J = 4.8$, $J = 7.6$, ***H6'*** or ***H4'***); 7.45 (d, 2H, $J = 7.8$, ***H6'*** or ***H4'***); 7.78 (dt, 2H, $J = 7.6$, $J = 1.8$, ***H5'***); 8.50-8.56 (m, 2H, ***H3'***). **^{13}C NMR** (DMSO-d_6, δ = ppm) 51.6 (COO***C***H_3); 61.6 (***C***HC=O); 63.0 (***C***HNH); 123.2 (***C4'***/***C6'***); 137.0 (***C5'***); 148.9 (***C3'***); 158.0 (***C1'***); 168.6 (***C***$OOCH_3$); 202.1 (***C***=O). **IR** (cm^{-1}) 3296; 3021; 2954; 1739; 1701; 1432; 1335; 1213; 1110; 816; 776. mp. 175 °C.

Dimethyl (2*R*,6*S*)-1-allyl-4-oxo-2,6-di(pyridin-2-yl)piperidine-3,5-dicarboxylate (2) $C_{22}H_{23}N_3O_5$ (409.5 g/mol), yield: 87 % ; **^{1}H NMR** ($CDCl_3$, δ = ppm, J = Hz) 3.00 (m, 2H, NC***H₂***); 3.59 (s, 3H, COOC***H₃***); 3.74 (s, 3H, COOC***H₃***); 4.18 (d, 1H, J = 10.3, C***H***C=O); 4.68 (d, 1H, $J = 10.3$, C***H***NH); 4.97 (s, 1H, NC***H***Cq); 5.19 (ddd, 2H, J = 17.3, J = 10.1, J = 1.2, =C***H***$_2$), 5.79 (m, 1H, J = 17.3, J = 10.1, NCH_2C***H***=); 7.07- 7.19 (m, 2H, ***H***$_{aromat.}$); 7.29 (m, 1H, ***H***$_{aromat.}$); 7.52- 7.71 (m, 3H, ***H***$_{aromat.}$); 8.43 (m, 1H, ***H***$_{aromat.}$); 8.60 (m, 1H, ***H***$_{aromat.}$); 12.52 (s, O***H***). **^{13}C NMR** ($CDCl_3$, δ = ppm) 44.32 (***C***HC=O); 50.53 (N***C***H_2); 51.76, 52.5 (COO***C***H_3); 59.43 (***C***$HNCH_2$); 60.38 (H_2CN***C***H); 97.78; 117.68 (=***C***H_2); 121.84; 122.20; 122.76; 123.06 (***C4'***/***C6'***); 135.86 (NCH_2***C***H=); 136.02; 136.12 (***C5'***); 148.13; 148.83 (***C3'***); 158.24 (***C1'***); 161.32 (***C1'***); 167.33 (***C***$OOCH_3$); 171.12, 172.05 (***C***$OOCH_3$). **IR** (cm^{-1}) 3040; 3000; 1720; 1650; 1430; 1360; 1250; 1005; 980; 825; 770. mp. 133 °C.

Dimethyl (2R,6S)-1-(2-hydroxyethyl)-4-oxo-2,6-di(pyridin-2-yl)piperidine-3,5-dicarboxylate (3) $C_{21}H_{23}N_3O_6$ (413.4 g/mol), yield: 55 % ; **^{1}H NMR** ($CDCl_3$, δ = ppm, J = Hz) 2.58-2.68 (m, 2H, CH_2C***H***$_2$OH); 3.35-3.43 (m, 1H, C***H***$_2CH_2OH$); 3.63 (s, 3H, CqCOOC***H₃***); 3.67-3.76 (m, 1H, C***H***$_2CH_2OH$); 3.74 (s, 3H, CHCOOC***H₃***); 4.26 (d, 1H, $J = 10.6$, CHC***H***$COOCH_3$); 4.46 (s, 1H, CH_2CH_2O***H***); 4.55 (d, 1H, J = 10.6, C***H***$CHCOOCH_3$) 5.03 (s,1H, CqC***H***); 7.08-7.14 (m, 2H, ***H3''*** and ***H5''***); 7.19-7.25 (m, 1H, ***H5'***); 7.33 (d, 1H, J = 7.8, ***H3'***); 7.55 (td, 1H, J = 7.7, J = 1.8, ***H4''***); 7.69 (td, 1H, J = 7.7, J = 1.8, ***H4'***); 8.40-8.47 (m, 1H, ***H6''***); 8.65-8.72 (m, 1H, ***H6'***). **^{13}C NMR** ($CDCl_3$, δ = ppm) 44.4 (CH***C***$HCOOCH_3$); 48.6 (CH_2***C***H_2OH); 52.0 (CqCOO***C***H_3); 52.7 (CHCOO***C***H_3); 59.3 (***C***$HCHCOOCH_3$); 60.2 (***C***H_2CH_2OH); 61.2 (Cq***C***H); 97.1 (***Cq***=C-

OH); 121.8 (***C3'***); 122.4 (***C5'***); 1227, 124.1 (***C3''/ C5''***); 136.6 (***C4'/ C4''***); 148.4 (***C6''***); 149.8 (***C6'***); 157.5, 161.6 (***C2'/ C2''***); 169.6 (Cq=***C***OH); 171.3, 172.1 (***C***=O). **IR** (cm^{-1}) 3333; 2930; 1726; 1437. mp. 135 °C.

Dimethyl (2*R*,6*S*)-1-(2-hydroxypropyl)-4-oxo-2,6-di(pyridin-2-yl)piperidine-3,5-dicarboxylate (4) $C_{22}H_{25}N_3O_6$ (427.4 g/mol), yield: 39 % ; keto-enol ratio: 1:3. **^{1}H NMR** ($CDCl_3$, δ = ppm, *J* = Hz) 1.49 (qu, 2H, J = 6.8, $CH_2C\boldsymbol{H_2}CH_2OH$, ketone); 1.59 (qu, 2H, *J = 6.7*, $CH_2C\boldsymbol{H_2}CH_2OH$, enol); 2.23-2.35 (m, 2H, $C\boldsymbol{H_2}CH_2CH_2OH$, ketone); 2.23-2.35, 2.42-2.49 (2m, each 1H, $C\boldsymbol{H_2}CH_2CH_2OH$, enol); 3.15-3.30 (m 2H, $CH_2CH_2C\boldsymbol{H_2}OH$, ketone); 3.15-3.30, 3.36-3.42 (2m, each 1H, $CH_2CH_2C\boldsymbol{H_2}OH$, enol); 3.59 (2s, each 3H, $COOC\boldsymbol{H_3}$, enol); 3.64 (s, 6H, $COOC\mathbf{H_3}$, ketone); 4.10 (dd, 1H, *J = 0.8, J = 10.6*, $C\boldsymbol{H}COOCH_3$, enol); 4.25 (d, J = 6.6, $C\boldsymbol{H}COOCH_3$, ketone); 4.27-4.32 (m, 1H, $CH_2O\boldsymbol{H}$, enol); 4.37 (d, 1H, J = 10.6, NC***H***CH, enol); 4.73 (d, 2H, J = 6.6, NC***H***CH, ketone); 4.93 (s, 1H, NC***H***Cq, enol); 7.22-7.36 (m, 2H, ***H3''*** and ***H5''***, enol, 1H, ***H5'***, enol, 2H, ***H5***, ketone); 7.49 (d, 2H, J = 7.8, ***H3***, ketone); 7.67 (d, 2H, J = 8.1, ***H3'***, enol); 7.73 (td, 1H, *J = 7.7*, J = 1.9, ***H4''***, enol); 7.82-7.89 (m, 2H, H4, ketone, 1H, ***H4'***, enol); 8.39-8.44 (m, 1H, ***H6''***, enol); 8.49-8.54 (m, 2H, H6, ketone, 1H, *H6'*, enol); 12.21(s, 1H, C=C-O***H***). **^{13}C NMR** ($CDCl_3$, δ = ppm) 30.6 ($CH_2\boldsymbol{C}H_2CH_2OH$, ketone); 31.4 ($CH_2\boldsymbol{C}H_2CH_2OH$, enol); 42.7 (***C***HC-OH, enol); 43.7 ($N\boldsymbol{C}H_2CH_2CH_2OH$, enol); 44.6 ($N\boldsymbol{C}H_2CH_2CH_2OH$, ketone); 51.6 51.7 ($O\boldsymbol{C}H_3$, enol); 52.0 ($O\boldsymbol{C}H_3$, ketone); 56.5 (***C***HC=O, ketone); 58.3 ($CH_2CH_2\boldsymbol{C}H_2OH$, ketone); 58.7 ($CH_2CH_2\boldsymbol{C}H_2OH$, enol); 59.3 (N***C***HCH, enol); 60.0 (N***C***HqC, enol); 63.2 (N***C***HCH, ketone); 98.0 (***Cq***=COH, enol); 122.2, 122.5, 122.7, 123.0 (***C3'/ C3'', C5'/ C5''***, enol); 123.0, 123.4 (***C3***, ***C5***, ketone); 136.6, 136.7 (***C4'/ C4''***, enol); 137.1 (***C4***, ketone); 148.0; 148.3 (***C6'/ C6''***, enol); 148.5 (***C6***, ketone); 157.4 (***C2***, ketone); 161.4, 157.9 (***C2'/ C2''***, enol); 166.2 (**C**$OOCH_3$, ketone); 169.0 (Cq=***C***-OH, enol); 170.6, 171.8 (**C**$OOCH_3$, enol); 198.6 (**C**=O, ketone); **IR** (cm^{-1}) 3524; 2957; 1736; 1438. mp. 136 °C.

Dimethyl (2*R*,6*S*)-1-[2-(2-hydroxyethoxy)ethyl]-4-oxo-2,6-di(pyridin-2-yl)piperidine-3,5-dicarboxylate (5): $C_{23}H_{27}N_3O_7$ (457.5 g/mol), yield: 63 %; **^{1}H NMR** ($CDCl_3$, δ = ppm, *J* = Hz) 2.44- 2.51 (m, 1H,); 2.67- 2.76 (m, 1H, $NCH_2C\boldsymbol{H_2}$); 3.44- 3.58 (m, 3H, $NC\boldsymbol{H_2}CH_2OC\boldsymbol{H_2}$); 3.60 (s, 3H, $COOC\boldsymbol{H_3}$); 3.75 (s, 3H, $COOC\boldsymbol{H_3}$); 3.77- 3.80 (m, 2H,); 3.62- 3.69 (m, 1H,); 4.20 (d, 1H, J = 10.6, O=CC***H***COH); 4.59 (d, 1H, J = 10.6,

C***H***NCH); 5.41 (s, 1H, NC***H***Cq); 7.08 (t, 1H, ***H4''***); 7.22- 7.29 (m, 2H, ***H6''/ H4'***); 7.45 (d, 1H, ***H6'***); 7.53 (dt, 1H, ***H5''***); 7.72 (t, 1H, ***H5'***); 8.42 (d, 1H, ***H3''***); 8.68 (d, 1H, **H3''**); 12.57 (s, O***H***). **^{13}C NMR** ($CDCl_3$, δ = ppm) 45.29 (O=C***C***HCOH); 48.63 (N***C***H_2CH_2); 53.37, 53.96 (COO***C***H_3); 60.97 (***C***HNCH); 62.74 ($NCH_2CH_2OCH_2$***C***H_2OH); 64.36 (N***C***HCq); 73.18 (NCH_2***C***H_2); 73.98 (NCH_2CH_2O***C***H_2CH_2OH); 98.83 (***C***qCOH); 123.82 (***C6'***); 123.87 (***C4'***); 123.94 (***C6''***); 125.20 (***C4''***); 137.67 (***C5'***); 138.38 (***C5''***); 149.57 (***C3''***); 150.61 (***C3'***); 159.61 (***C1'***); 162.15 (***C1''***); 170.17 (***Cq***OH); 173.02 , 173.58 (***C***$OOCH_3$). **IR** (cm^{-1}) 3020; 3000; 2830; 1610; 1520; 1370; 1117; 821; 740. mp. 175°C.

4-[(2R,6S)-3,5-bis(methoxycarbonyl)-4-oxo-2,6-di(pyridin-2-yl)piperidin-1-yl]butanoic acid (6): $C_{23}H_{25}N_3O_7$ (455.5 g/mol), yield: 70%; **^{1}H NMR** ($CDCl_3$, δ = ppm, J = Hz) 1.71- 1.83 (m, 1H, NCH_2C***H***$_2$), 1.89- 2.40 (m, 2H, NCH_2C***H***$_2C$***H***$_2$), 2.28- 2.47 (m, 2H, NC***H***$_2CH_2C$***H***$_2$), 2.51- 2.61 (m, 1H, NC***H***$_2$), 3.61 (s, 3H, COOC***H***$_3$); 3.74 (s, 3H, COOC***H***$_3$); 4.23 (d, 1H, J = 10.6, C***H***C=O); 4.52 (d, 1H, J = 10.6, C***H***NH); 5.06 (s, 1H, NC***H***Cq); 7.08- 7.18 (m, 2H, ***H***$_{aromat.}$); 7.28- 7.32 (t, 1H, ***H***$_{aromat.}$); 7.50- 7.59 (m, 2H, ***H***$_{aromat.}$); 7,78 (dt, 1H, ***H***$_{aromat.}$); 8.42 (d, 1H, ***H***$_{aromat.}$); 8.71 (d, 1H, ***H***$_{aromat.}$); 12.54 (s, O***H***). **^{13}C NMR** ($CDCl_3$, δ = ppm) 23.70 (NCH_2***C***H_2); 32.59 (NCH_2CH_2***C***H_2); 43.96 (***C***HCqOH); 46.76 (N***C***H_2); 52.12, 52.71 (COO***C***H_3); 59.64 (***C***$HNCH_2$); 60.50 (H_2CN***C***H); 97.10 (NCH***Cq***); 122.73 (***C6''***); 122.97 (***C4'***); 123.31 (***C6'***); 124.02 (***C4''***); 136.59 (***C5''***); 137.74 (***C5'***); 148.33 (***C3''***); 148.75 (***C3'***); 157.79 (***C1''***); 160.26 ***C1'***); 168.98 (***Cq***OH); 171.50 , 172.04 (***C***$OOCH_3$); 176.83 (***C***OOH). **IR** (cm^{-1}) 3030; 2980; 1710; 1620; 1430; 1350; 1210; 950; 845; 700. mp. 169°C.

8-[(2R,6S)-3,5-bis(methoxycarbonyl)-4-oxo-2,6-di(pyridin-2-yl)piperidin-1-yl]octanoic acid (7): $C_{25}H_{29}N_3O_7$ (483.5 g/mol), yield: 43 %; **^{1}H NMR** ($CDCl_3$, δ = ppm, J = Hz) keto-enol ratio: 1:5, **^{1}H NMR** ($CDCl_3$, δ = ppm, *J = Hz*) 0.99- 1.09 (m, 2H, C***H***$_2$, enol); 1.16- 1.34 (m, 2H, C***H***$_2$, enol); 1.36- 1.45 (m, 2H, C***H***$_2$, enol); 2.05- 2.10 (m, 2H, ***CH***$_2$, enol); 2.14- 2.21 (m, 2H, ***CH***$_2$, enol); 2.39- 2.45 (m, 2H, NC***H***$_2CH_2$, enol); 3.58 (s, 6H, COOC***H***$_3$, enol); 3.64 (s, 6H, COOC***H***$_3$, ketone); 4.11 (d, 1H, J = 10.5, C***H***CqOH, enol); 4.27 (d, 2H, J = 6.8, C***H***C=O, ketone); 4.36 (d, 1H, C***H***NCH, J = 10.5, ketone, C***H***NCH, enol); 4.71 (d, 2H, J = 6.8, NC***H***CH, ketone); 4.89 (s, 1H, NC***H***Cq, enol); 7.20-7.35 (m, 2H, ***H6'/H6''***, enol, 2H, ***H4'/H4''***, enol, 2H, ***H4'***, ketone); 7.48 (d,

2H, ***H6'***, ketone); 7.67- 7.75 (m, 2H, ***H6'/H6''***, enol, 1H, ***H5'/H5''***, enol); 7.82-7.88 (m, 2H, H5', ketone, 2H, ***H5'/H5''***, enol); 8.42 (d, 1H, ***H3'/H3''***, enol); 8.51 (m, 2H, ***H3'/H3''***, ketone and enole). **^{13}C NMR** ($CDCl_3$, δ = ppm) 24.0 (***C***H_2, enol); 25.6 (***C***H_2, ketone); 25.7 (***C***H_2, enol); 26.3 (***C***H_2, ketone); 26.8 (***C***H_2, ketone); 30.5 (***C***H_2, ketone); 30.7 (***C***H_2, enol); 33.6 (***C***H_2, enol); 46.0 (***C***H_2, ***C5'***, enol); 51.8 (***C***H_2, ***C5'***, ketone); 51.9 (COO***C***H_3, enol); 52.2 (COO***C***H_3, ketone); 56.6 (***C***HC=O, ketone); 59.5 (N***C***HCH, enol); 60.3 (N***C***HCq, enol); 63.3 (N***C***HCH, ketone); 98.0 (***Cq***=C-OH, enol), 122.2, 122.6, 122.7, 123.1 (***C3'/ C3''*** and ***C5'/ C5''***, enol); 123.0, 123.4 (***C3*** and ***C5***, ketone); 136.6, 136.7 (***C4'/ C4''***, enol); 137.1 (***C4***, ketone); 148.0, 148.2 (***C6'/ C6''***, enol); 148.5 (***C6***, ketone); 157.4 (***C2***, ketone); 157.9, 161.6 (***C2'/ C2''***, enol); 166.0 (Cq=***C***-OH, enol); 169.0 (***C***$OOCH_3$, ketone); 170.6, 171.8 (***C***$OOCH_3$, enol); 174.4 (***C***OOH); 198.6 (***C***=O). **IR** (cm^{-1}) 3013; 2940; 2858; 1737; 1254. mp. 130 °C.

Dimethyl (2*R*,6*S*)-4-oxo-2,6-di(pyridine-2-yl)-1-(pyridine-2-yl-methyl)-piperidine-3,5-dicarboxylate (8): $C_{25}H_{24}N_4O_5$ (460.5 g/mol), yield: 47%; **^{1}H NMR** ($CDCl_3$, δ = ppm, J = *Hz*) 3.51 (d, 1H, NC***H***$_2$); 3.53 (d, 1H, NC***H***$_2$); 3.61 (s, 6H, COOC***H$_3$***); 4.12 (d, 2H, $^3J_{aa}$ = 10.5, C***H***$COOCH_3$); 4.71 (d, 2H, $^3J_{aa}$ = 10.9, C***H***NC***H***); 7.17 (t, 2H, ***H5'/5"***); 7.26-7.31 (m, 2H, ***H6'/6"***); 7.66-8.10 (m, 2H, ***H3'/3"*** or ***H4'/4"***); 8.64 (t, 2H, ***H4'/4" or H3'/3"***). **^{13}C NMR** ($CDCl_3$, δ = ppm) 53.6 (COO***C***H_3); 55.8 (***C***H_2); 62.9 (***C***HC=O); 67.9 (N***C***H); 123.7, 123.9 (***C2'/2"/C4'/4"***); 130.3 (***C5'/5"***); 136.3 (***C6'/6"***); 145.3 (***C1'/1"***); 148.4 (***C3'/3"***); 170.1 (***C***$OOCH_3$); 192.4 (***C***=O). **IR** (cm^{-1}) 3020; 2980; 1710; 1640; 1500; 1405; 1310; 1119; 869; 727; 668. mp. 152-153 °C.

Dimethyl (2R,6S)-1-benzyl-4-oxo-2,6-di(pyridin-2-yl)piperidine-3,5-dicarboxylate (9): $C_{26}H_{25}N_3O_5$ (459.5 g/mol), yield: 65%; **^{1}H NMR** ($CDCl_3$, δ = ppm, J = *Hz*) 3.53 (s, 2H, NC***H$_2$***); 3.62 (s, 3H, COOC***H$_3$***); 3.68 (s, 3H, COOC***H$_3$***); 3.94 (d, 2H, C***H***$COOCH_3$); 4.72 (d, 2H, NC***H***); 6.69-6.75 (m, 2H, C***H$_{Benzyl}$***); 6.95-6.99 (m, 3H, C***H$_{Benzyl}$***); 7.27 (t, 2H, ***H5'/5"***); 7.46-7.51 (m, 2H, ***H6'/6"***); 7.96-8.13 (m, 2H, ***H3'/3"*** or ***H4'/4"***); 8.36 (t, 2H, ***H4'/4" or H3'/3"***). **^{13}C NMR** ($CDCl_3$, δ = ppm) 53.2 (COO***C***H_3); 54.8 (***C***H_2); 64.6 (***C***HC=O); 69.7 (N***C***H); 122.7, 123.0 (***C2'/2"/C4'/4"***); 127.4, 128.3, 128.5 (***C***H_{Benzyl}); 134.3 (***C5'/5"***); 135.4 (***C6'/6"***); 138.6 (***Cq$_{Benzyl}$***); 143.1 (***C1'/1"***); 147.2 (***C3'/3"***); 169.7 (***C***$OOCH_3$); 193.9 (***C***=O). **IR** (cm^{-1}) 2980; 1728; 1657; 1531; 1342; 1146; 836; 791; 726. mp. 154 °C.

Dimethyl (2*R*,6*S*)-1-allyl-4-hydroxy-2,6-bis(4-nitrophenyl)-1,2,3,6-tetrahydropyridine-3,5- dicarboxylate (10): $C_{24}H_{23}N_3O_9$ (497.5 g/mol); yield: 39 %; **^{1}H NMR** ($CDCl_3$, δ = ppm, J = *Hz*) 2.70-2.96 (NC***H*****$_2$**CH=CH_2); 3.54, 3.59 (2s, 3H, COOC***H*****$_3$**); 3.90 (dd, 2H, $^3J_{aa}$ = 9.9, ^3J = 2.0, C***H***$COOCH_3$); 4.42 (d, 2H, J = 9.6, NC***H*****$_2$**CH=CH_2); 4.86-4.95 (m, 2H, NC***H***Cq, ***H*****$_B$**); 5.23 (dd, 1H, $^3J_{AC}$ = 10.2, $^2J_{AB}$ = 1.4, ***H*****$_A$**); 5.71-5.86 (m, 1H, ***H*****$_C$**); 7.53-7.59 (m, 4H, ***H3'/3"***, ***H5'/H5"***); 8.15-8.24 (m, 4H, ***H6'/6"***, ***H2'/H2"***); 12.24 (O***H***). **^{13}C NMR** ($CDCl_3$, δ = ppm) 51.5 (N***C***H_2CH=CH_2); 51.9, 52.7 (COO***C***H_3); 55.3 (***C***HCOH); 59.7 (N***C***HCq); 62.6 (N***C***HCH); 101.4 (***Cq***=COH); 121.1 (NCH$_2$CH=***C***H_2); 123.4, 124.2 (***C6'/6"***, ***C2'/2"***); 129.6, 130.1 (***C5'/5"***, ***C3'/3"***); 130.2 (NCH$_2$***C***H=CH_2); 145.9, 151.0 (***C4'/4"***); 147.4, 148.2, (***C1'/1"***); 165.6 (Cq=***C***OH); 168.6, 170.5 (***C***=O). **IR** (cm^{-1}) 2953; 1733; 1665; 1518; 1439; 1346; 1243; 696. mp.154-155 °C.

Diethyl (2*R*,6*S*)-1-allyl-4-hydroxy-2,6-bis(4-nitrophenyl)-1,2,3,6-tetrahydropyridine-3,5-dicarboxylate (11): $C_{26}H_{27}N_3O_9$, (525.5 g/mol) yield: 28 %; **^{1}H NMR** ($CDCl_3$, δ = ppm, J = Hz) 1.00-1.07 (m, 6H, $COOCH_2C$***H*****$_3$**); 2.81-2.98 (m, 2H, NC***H*****$_2$**); 3.95-4.07 (m, 5H, COOC***H*****$_2$**CH_3, C***H***C-OH); 4.44 (d, 2H, $^3J_{aa}$ = 9.9, NC***H***CH); 4.86-4.95 (m, 2H; NC***H***Cq, ***H*****$_B$**); 5.25 (dd, 1H, $^3J_{AC}$ = 12.2, $^2J_{AB}$ = 0.9, ***H*****$_A$**); 5.75-5.88 (m, 1H, ***H*****$_C$**); 7.57-7.67 (m, 4H, ***H3'/3"***, ***H5'/5"***); 8.17-8,25 (m, 4H, ***H2'/2"***, ***H6'/6"***); 12.38 (O***H***). **^{13}C NMR** ($CDCl_3$, δ = ppm) 14.0, 14.1 ($COOCH_2$***C***H_3); 51.4 (N***C***H_2); 55.1 (NCHC***H***); 61.4, 61.8 (COO***C***H_2CH_3); 62.2, 63.0 (N***C***H); 101.0 (***C***=COH); 123.3, 124.1 (***C2'/2"***, ***C6'/6"***); 123.9 (NCH***C***H=CH_2); 129.8 (NCHCH=***C***H_2); 130.0, 130.5 (***C3'/3"***, ***C5'/5"***); 147.5 (***C4'/4"***); 148.2 (***C1'/1"***); 165.9 (C=***C***OH); 168.1, 170.1 (***C***=O). **IR** (cm^{-1}) 2981; 2863; 1736; 1661; 1518; 1344; 1245; 700. mp.150-151 °C.

Dimethyl (2*R*,6*S*)-1-benzyl-4-hydroxy-2,6-bis(4-nitrophenyl)-1,2,3,6-tetrahydro-pyridine-3,5-dicarboxylate (12):

$C_{28}H_{25}N_3O_9$ (547.6 g/mol), yield: 12 %; **^{1}H NMR** ($CDCl_3$, δ = ppm, J = Hz) 3.52, 3.66 (2d, each 1H, NC***H*****$_2$**); 3.55, 3.59 (2s, each 3H, COOC***H*****$_3$**); 3.95 (dd, 1H, $^3J_{aa}$ = 9.6, ^3J = 1.8, NCHC***H***); 4.49 (d, 1H, $^3J_{aa}$ = 9.6, NC***H***CH); 4.79 (d, 1H, ^4J = 1.5, NC***H***Cq); 6.78-6.83 (m, 2H, C***H*****$_{Benzyl}$**); 7.05-7.15 (m, 3H, C***H*****$_{Benzyl}$**); 7.42-7.52 (m, 4H, ***H3'/H3"***, ***H5'/H5"***); 8.06-8.11 (m, 4H, ***H2'/H2"***, ***H6'/H6"***); 12.27 (s, 1H, O***H***). **^{13}C NMR** ($CDCl_3$, δ = ppm) 52.0; 52.7 (COO***C***H_3); 54.5 (NCH***C***H); 56.5 (N***C***H_2); 61.6 (N***C***HCH); 64.7

(N***C***HCq); 101.3 (***C***=COH); 123.2, 123.8 (***C2'/C2"***, ***C6'/C6"***); 127.5, 128.4, 129.0 (***C***H_{Benzyl}); 129.7, 130.0 (***C3'/C3"***, ***C5'/C5"***); 137.0 (***Cq***$_{Benzyl}$); 146.4 (***C4'/C4"***); 151.3 (***C1'/C1"***); 165.8 (C=***C***OH); 168.5, 170.4 (***C***=O). **IR** (cm^{-1}) 2833; 1740; 1657; 1516; 1444; 1344; 1253; 731; 695. mp. 163-171 °C.

Diethyl (2*R*,6*S*)-1-benzyl-4-hydroxy-2,6-bis(4-nitrophenyl)-1,2,3,6-tetrahydropyridine-3,5-dicarboxylate (13): $C_{30}H_{29}N_3O_9$ (575.7 g/mol), yield: 7 %; **^{1}H NMR** ($CDCl_3$, δ = ppm, J = Hz) 1.10-1.11 (m, 6H, $COOCH_2C$***H*****$_3$**); 3.49-3.72 (2d, each 1H, ^2J = *14.9*, N***H*****$_2$**); 3.95-4.10 (m, 5H, $COOCH_2CH_3$, NCHC***H***); 4.48 (d, 1H, $^3J_{aa}$ = 9.6, NC***H***CH); 4.86 (d, 1H, ^{4}J = 1.5, NC***H***Cq); 6.74-6.80 (m, 2H, C***H*****$_{Benzyl}$**); 7.02-7.13 (m, 3H, C***H*****$_{Benzyl}$**); 7.43-7.54 (m, 4H, ***H3'/3"***, ***H5'/5"***); 8.04-8.12 (m, 4H, ***H2'/2"***, ***H6'/6"***); 12.39 (O***H***). **^{13}C NMR** ($CDCl_3$, δ = ppm) 14.0, 14.1 (CH_2***C***H_3); 54.7 (***C***HCOH); 56.5 (N***C***$H_{2\ Benzyl}$); 61.4, 61.8 (***C***H_2CH_3); 62.2 (N***C***HCH); 65.1 (N***C***HCq); 101.2 (***C***=COH); 123.2, 123.7 (***C2'/2"***, ***C6'/6"***); 127.4, 128.3, 128.8 (***C***H_{Benzyl}); 130.0, 130.3 (***C3'/3"***, ***C5'/5"***); 137.0 (***Cq***$_{Benzyl}$); 146.1, 151.2 (***C1'/1"***); 147.1, 148.0 (***C4'/4"***); 166.1 (C=***C***OH); 168.0, 170.1 (***C***=O). **IR** (cm^{-1}) 2988; 2857; 1740; 1655; 1516; 1345; 1243; 749; 698. mp. 181-184 °C.

Dimethyl (2*R*,6*S*)-1-(4-chlorobenzyl)-2,6-bis(3-nitrophenyl)-4-oxopiperidine-3,5-dicarboxylate (14): $C_{28}H_{24}N_3O_9Cl$ (582.0 g/mol), yield: 41 %; **^{1}H NMR** ($CDCl_3$, δ = ppm, J = Hz) 3.47 (s, 2H, NC***H*****$_2$**); 3.55 (s, 3H, COOC***H*****$_3$**); 3.58 (s, 3H, COOC***H*****$_3$**); 4.02 (d, 2H, $^3J_{aa}$ = 10.8, C***H***$COOCH_3$); 4.59 (d, 2H, $^3J_{aa}$ = 10.8, NC***H***); 6.55-6.74 (m, 4H, C***H*****$_{Benzyl}$**); 7.49 (t, 2H, J = 7.3, ***H5'/5"***); 7.78- 7.82 (m, 2H, ***H6'/6"***); 8.09- 8.13 (m, 2H, ***H4'/4"***); 8.35 (t, 2H, ***H2'/2"***). **^{13}C NMR** ($CDCl_3$, δ = ppm) 52.7 (COO***C***H_3); 55.4 (N***C***H_2); 63.9 (***C***HC=O); 68.1 (N***C***H); 113.9, 123.7, 123.9, 128.8, 129.9, 133.2, (***C2'/2"***, ***C4'/4"***, ***C5'/5"***, ***C6'/6"***, ***C***H_{Benzyl}); 139.3 (***Cq***$_{Benzyl}$Cl); 140.8, 141.1, 148.3, 157.8 (***Cq***$_{ar}$); 166.6 (***C***$COOCH_3$); 195.8 (***C***=O). **IR** (cm^{-1}) 3025; 2980; 1738; 1650; 1518; 1420; 1347; 1239; 880; 745; 697. mp. 144-146 °C.

Dimethyl (2*R*,6*S*)-1-(4-methoxybenzyl)-2,6-bis(3-nitrophenyl)-4-oxopiperidine-3,5-dicarboxylate (15): $C_{29}H_{27}N_3O_{10}$ (577.5 g/mol), yield: 29 %; **^{1}H NMR** ($CDCl_3$, δ = ppm, J = H*z*) 3.49 (s, 2H, NC***H*****$_2$**); 3.56 (s, 6H, COOC***H*****$_3$**); 3.71 (s, 3H, OC***H*****$_3$**); 4.01 (d, 2H, $^3J_{aa}$ = 11.1, C***H***C=O); 4.56 (d, 2H, $^3J_{aa}$ = 11.1, NC***H***); 6.57-6.62 (m, 4H, C***H*****$_{Benzyl}$**); 7.52 (t, 2H, J = 7.6, ***H5'/5"***); 7.84 (m, 2H, ***H6'/6"***); 8.12 (m, 2H, ***H2'/2"*** or ***H4'/4"***); 8.36 (s, 2H,

H4'/4" or ***H2'/2"***). **^{13}C NMR** ($CDCl_3$, δ = ppm) 52.6 (COO***C***H_3); 54.4 (N***C***H_2); 55.4 (O***C***H_3); 63.9 (***C***HC=O); 67.5 (N***C***H); 113.8, 123.8, 123.9 129.8, 129.9, 135.0, (***C2'/2"***, ***C4'/4"***, ***C5'/5"***, ***C6'/6"***, ***C***H_{Benzyl}); 137.3 (***Cq***$_{Benzyl}$$CH_3$); 141.1, 141.4, 148.5, 158.8 (***Cq***$_{ar}$); 166.6 (***C***$OOCH_3$); 195.6 (***C***=O). **IR** (cm^{-1}) 3536; 3088; 2957; 1732; 1524; 1436; 1352; 1248; 1172; 813; 741; 694. mp. 159-161 °C.

Dimethyl (2*R*,6*S*)-1-(4-methylbenzyl)-2,6-bis(3-nitrophenyl)-4-oxopiperidine 3,5-dicarboxylate (16): $C_{29}H_{27}N_3O_9$ (561.6 g/mol), yield: 41 %; **^{1}H NMR** ($CDCl_3$, δ = ppm, J = Hz) 2.19 (s, 3H, CqC***H$_3$***); 3.52 (s, 2H, NC***H$_2$***); 3.56 (s, 6H, COOC***H$_3$***); 4.07 (d, 2H, $^3J_{aa}$ = 11.1, C***H***C=O); 4.57 (d, 2H, $^3J_{aa}$ = 11.1, NC***H***); 6.57 (d, 2H, J = 7.8, ***H3/5***$_{Benzyl}$); 6.84 (d, 2H, J = 7.8, ***H2/6***$_{Benzyl}$); 7.50 (t, 2H, J = 7.1, ***H5'/5"***); 7.87 (m, 2H, ***H6'/6"***); 8.08-8.15 (m, 2H, ***H2'/2"*** or ***H4'/4"***); 8.34 (s, 2H, ***H4'/4"*** or ***H2'/2"***). **^{13}C NMR** ($CDCl_3$, δ = ppm) 20.9 (***C***H_3); 52.7 (O***C***H_3); 55.0 (N***C***H_2); 63.8 (***C***HC=O); 67.9 (N***C***H); 123.9, 124.0 (***C2'/2"/C4'/4"***); 128.4, 129.1 (***C***H_{Benzyl}); 129.9 (***C5'/5"***); 135.1 (CH_2***Cq***$_{Benzyl}$, ***C6'/6"***); 137.3 (***Cq***$_{Benzyl}$$CH_3$); 141.1 (***C1'/1"***); 148.5 (***C3'/3"***); 166.6 (***C***$OOCH_3$); 195.5 (***C***=O). **IR** (cm^{-1}) 2956; 1732; 1530; 1437; 1350; 1259; 1171; 810; 736; 695. mp. 170-172 °C.

Dimethyl (2*R*,6*S*)-1-benzyl-2,6-bis(3-nitrophenyl)-4-oxopiperidine-3,5-dicarboxylate (17): $C_{28}H_{25}N_3O_9$ (547.5 g/mol), yield: 15 %; **^{1}H NMR** ($CDCl_3$, δ = ppm, J = Hz) 3.52 (s, 2H, NC***H$_2$***); 3.57 (s, 6H, COOC***H$_3$***); 4.01 (d, 2H, $^3J_{aa}$ = 10.9, C***H***$COOCH_3$); 4.55 (d, 2H, $^3J_{aa}$ = 10.9, NC***H***); 6.65-6.72 (m, 2H, C***H***$_{Benzyl}$); 6.98-7.02 (m, 3H, C***H***$_{Benzyl}$); 7.47 (t, 2H, J = 8.0, ***H5'/5"***); 7.76-7.81 (m, 2H, ***H6'/6"***); 8.06-8.10 (m, 2H, ***H2'/2"*** or ***H4'/4"***); 8.34 (t, 2H, J = 1.9, ***H4'/4"*** *or* ***H2'/2"***). **^{13}C NMR** ($CDCl_3$, δ = ppm) 52.6 (COO***C***H_3); 55.6 (***C***H_2); 63.9 (***C***HC=O); 68.3 (N***C***H); 123.8, 123.9 (***C2'/2"/C4'/4"***); 127.1, 128.2, 128.3 (***C***H_{Benzyl}); 129.8 (***C5'/5"***); 135.1 (***C6'/6"***); 137.0 (***Cq***$_{Benzyl}$); 141.3 (***C1'/1"***); 148.4 (***C3'/3"***); 166.6 (***C***$OOCH_3$); 195.7 (***C***=O). **IR** (cm^{-1}) 2953; 1748; 1528; 1441; 1348; 1242; 805; 741; 693. mp. 144-146 °C.

Dimethyl (2*R*,6*S*)-1-allyl-4-oxo-2,6-diphenylpiperidine-3,5-dicarboxylate (18): $C_{24}H_{25}NO_5$ (407.5 g/mol), yield: 81 %; keto-enol ratio: 4:3, **^{1}H NMR** ($CDCl_3$, δ = ppm, J = Hz), 2.79-2.86 (m, 4H, NC***H$_2$***$CH=CH_2$, ketone, NC***H$_2$***$CH=CH_2$, enol); 3.53 (s, 6H, COOC***H$_3$***, ketone); 3.64, 3.68 (2s, each 3H, COOC***H$_3$***, enol); 3.81-3.90 (m, 2H, C***H***C=O, ketone); 3.94 (d, 1H, $^3J_{aa}$ = 10.1, C***H***C-OH, enol); 4.35-4.45 (m, 3H, NC***H***, ketone, NC***H***CH, enol); 4.59-4.66 (m, 1H, $NCH_2CH=C$***H$_2$***, ketone); 4.84 (s, 1H, NC***H***Cq, enol);

5.06-5.19 (m, 3H, $NCH_2CH=C\boldsymbol{H_2}$, ketone, $NCH_2CH=C\boldsymbol{H_2}$, enol); 5.67-5.87 (m, 2H, $NCH_2C\boldsymbol{H}=CH_2$, ketone, $NCH_2C\boldsymbol{H}=CH_2$, enol); 7.20-7.49 (m, 20H, $C\boldsymbol{H_{ar}}$, ketone, $C\boldsymbol{H_{ar}}$, enol); 12.45 (O***H***, enol). **^{13}C NMR** ($CDCl_3$, δ = ppm) 46.8 (C***H***C-OH, enol); 49.6, 50.9 (N***C***$H_2CH=CH_2$, ketone and enol); 52.0, 52.7 (COO***C***H_3, enol); 52.2 (COO***C***H_3, ketone); 57.8, 57.9 (N***C***H, ketone); 64.9, 66.3 (N***C***H, enol); 99.0 (***C***=C-OH, enol); 117.7 ($NCH_2CH=\boldsymbol{C}H_2$, ketone); 120.5 ($NCH_2CH=\boldsymbol{C}H_2$, enol); 127.2, 127.8, 128.1, 128.2, 128.4, 128.5, 128.5, 128.9, 129.2, 130.1 ($NCH_2\boldsymbol{C}H=CH_2$, enol and $\boldsymbol{C}H_{ar}$, ketone and enol); 136.8 ($NCH_2\boldsymbol{C}H=CH_2$, ketone); 138.8, 139.5, 141,8 ($\boldsymbol{Cq_{ar}}$, ketone and enol); 167.4 (C=***C***-OH, enol and ***C***$OOCH_3$, ketone); 171.1, 172.3 (***C***=O, enol); 197.5 (***C***=O, ketone). **IR** (cm^{-1}) 2951; 2847; 1738; 1653; 1438; 1273; 1209; 764; 698. mp. 142 °C.

Dimethyl (2*R*,6*S*)-4,4-dihydroxy-2,6-dimethyl-piperidinium-3,5-dicarboxylate hydrobromide (30a): $C_{11}H_{20}NO_6Br$ (342.2 g/mol), yield: 62 %; **^{1}H NMR** ($DMSO\text{-}d_6$, δ = ppm, J = Hz) 1.16 (d, 6H, J = 6.6, CHC$\boldsymbol{H_3}$); 2.81 (d, 2H, $^3J_{aa}$ = 11.6, C***H***$COOCH_3$); 3.57 (m, 2H, C***H***CH_3); 3.67 (s, 6H, COOC$\boldsymbol{H_3}$); 5.70, 6.43 (2s, each 1H, O***H***); 8.83, 9.17 (2s, each 1H, N$\boldsymbol{H_2}^+$). **^{13}C NMR** ($DMSO\text{-}d_6$, δ = ppm) 16.4 (CH***C***H_3); 50.4 (***C***HCH_3); 52.1 (COO***C***H_3); 55.9 (***C***$HCOOCH_3$); 92.3 (HO-**C**-OH); 168.7 (***C***=O). **IR** (cm^{-1}) 3489; 2943; 2888; 2780; 2736; 2477; 1744; 1719; 1383; 1221; 1024. mp. 178-182 °C.

Dimethyl (2*RS*,6*RS*)-4-hydroxy-2,6-diethyl-piperidine-3,5-dicarboxylate (30b): $C_{13}H_{21}NO_5$ (271.3 g/mol), yield: 97 % (oil); keto-enol ratio: 1:2. **^{1}H NMR** ($CDCl_3$, δ = ppm, J = Hz) 0.84 (t, 3H, J = 7.6, $CHCH_2C\boldsymbol{H_3}$, enol); 0.93 (t, 3H, J = 7.5, $CHCH_2C\boldsymbol{H_3}$, enol); 0.94 (t, 3H, J = 7.3, $CHCH_2C\boldsymbol{H_3}$, ketone); 0.96 (t, 3H, J = 7.3, $CHCH_2C\boldsymbol{H_3}$, ketone); 1.24-1.66 (m, 7H, $C\boldsymbol{H_2}CH_3$, ketone, $C\boldsymbol{H_2}CH_3$, enol); 1.74-1.85 (m, 1H, $C\boldsymbol{H_2}CH_3$, enol); 2.61-2.68 (m, 1H, CHC***H***CH_2CH_3, enol); 2.84-2.89, 3.06-3.13 (2m, each 1H, C***H***CH_2CH_3, ketone); 3.22 (dd, 1H, $^3J_{ae}$ = 3.8, ^3J = 1.5, C***H***$COOCH_3$, enol); 3.43 (d, 1H, $^3J_{ae}$ = 3.3, C***H***$COOCH_3$, ketone); 3.58-3.64 (m, 2H, CHC***H***CH_2CH_3, enol, C***H***$COOCH_3$, ketone); 3.64, 3.68 (2s, each 3H, COOC$\boldsymbol{H_3}$, ketone); 3.67, 3.72 (2s, each 3H, COOC$\boldsymbol{H_3}$, enol); 11.9 (brs, 1H, O***H***). **^{13}C NMR** ($CDCl_3$, δ = ppm) 9.3 ($CHCH_2\boldsymbol{C}H_3$, enol); 9.9 ($CHCH_2\boldsymbol{C}H_3$, ketone); 11.0 ($CHCH_2\boldsymbol{C}H_3$, enol and $CHCH_2\boldsymbol{C}H_3$, ketone); 26.6, 27.9 (CH***C***H_2CH_3, enol); 26.8, 28.3 (CH***C***H_2CH_3, ketone); 48.3 (***C***$HCOOCH_3$, enol); 51.6, 52.2 (COO***C***H_3, enol); 52.0, 52.3 (COO***C***H_3, ketone); 53.5 (Cq***C***HCH_2CH_3, enol); 56.2

(CH***C***HCH$_2$CH$_3$, enol); 60.7, 61.5 (***C***HCOOCH$_3$, ketone); 60.9, 62.2 (***C***HCH$_2$CH$_3$, ketone); 103.4 (***Cq***=C-OH); 166.9 (Cq=***C***-OH, enol); 168.5, 169.8 (***C***OOCH$_3$, ketone); 170.8, 172.3 (***C***OOCH$_3$, enol); 200.5 (C=O, ketone).

Dimethyl (2*RS*,6*RS*)-4-hydroxy-2,6-dipropyl-piperidinium-3,5-dicarboxylate hydrobromide (30c): $C_{15}H_{26}NO_5Br$ (380.3 g/mol), yield: 50 %. **^{1}H NMR** ($CDCl_3$, δ = ppm, J = Hz) 0.96 (t, 3H, J = 7.2, CqCHCH$_2$CH$_2$C***H$_3$***); 0.98 (t, 3H, J = 7.2, CHCHCH$_2$CH$_2$C***H$_3$***); 1.28-1.73 (m, 4H, CH$_2$C***H$_2$***CH$_3$ and 1H, CHCHC***H$_2$***CH$_2$CH$_3$); 1.93-2.19 (m, 2H, CqCHC***H$_2$***CH$_2$CH$_3$); 2.45-2.57 (m, 1H, CHCHC***H$_2$***CH$_2$CH$_3$); 3.42-3.52 (m, 1H, CHC***H***CH$_2$CH$_2$CH$_3$); 3.52-3.57 (d, 1H, $^3J_{ae}$ = 2.8, C***H***COOCH$_3$); 3.84 (s, 3H, CqCOOC***H$_3$***); 3.89 (s, 3H, CHCOOC***H$_3$***); 4.57-4.67 (m, 1H, CqC***H***CH$_2$CH$_2$CH$_3$); 7.86, 11.45 (2s, each 1H, N***H$_2^+$***); 12.23 (s, 1H, O***H***). **^{13}C NMR** ($CDCl_3$, δ = ppm) 13.6, 14.0 (CH$_2$***C***H$_3$); 17.2, 18.8 (***C***H$_2$CH$_3$); 31.4, 34.8 (***C***H$_2$CH$_2$CH$_3$); 45.5 (***C***HCOOCH$_3$); 52.7 (CqCOO***C***H$_3$); 52.9 (Cq***C***HCH$_2$CH$_3$); 52.6 (CHCOO***C***H$_3$); 53.5 (CH***C***HCH$_2$CH$_3$); 98.9 (***Cq***=C-OH); 164.6 (Cq=***C***-OH); 169.1 (CH***C***OOCH$_3$); 169.8 (Cq***C***OOCH$_3$). **IR** (cm^{-1}) 3064; 2958, 2933; 2756; 2633; 1747; 1678; 1630; 1533; 1437. mp. 142-143 °C.

Dimethyl (2*RS*,6*RS*)-4-hydroxy -2,6-dibutyl-3,5-piperidinium-dicarboxylate hydrobromide (30d): $C_{17}H_{30}NO_5Br$ (408.3 g/mol), yield: 24 %; **^{1}H NMR** ($CDCl_3$, δ = ppm, J = Hz) 0.91 (t, 6H, J = 7.2, CHCH$_2$CH$_2$C*H$_3$*); 1.19-1.63, 1.97-2.19 and 2.55-2.66 (3m, 12H, CHC*H$_2$*C*H$_2$*C*H$_2$*CH$_3$); 3.39-3.49 (m, 1H, CHC*H*CH$_2$CH$_2$CH$_2$CH$_3$); 3.54-3.58 (d, 1H, $^3J_{ae}$ = 3.3, C*H*COOCH$_3$); 3.85 (s, 3H, CqCOOC*H$_3$*); 3.90 (s, 3H, CHCOOC*H$_3$*); 4.58-4.71 (m, 1H, CqC*H*CH$_2$CH$_2$CH$_3$); 6.52, 11.85 (2s, each 1H, N*H$_2^+$*); 12.27 (s, 1H, O*H*). **^{13}C NMR** ($CDCl_3$, δ = ppm) 13.8, 13.9 (CH$_2$*C*H$_3$); 22.1, 22.4 (*C*H$_2$CH$_3$); 25.4, 27.5 (*C*H$_2$CH$_2$CH$_3$); 29.2, 32.3 (*C*H$_2$CH$_2$CH$_2$CH$_3$); 44.8 (*C*HCOOCH$_3$); 52.8 (CqCOO*C*H$_3$); 52.9 (Cq*C*HCH$_2$CH$_2$CH$_2$CH$_3$); 54.2 (CHCOO*C*H$_3$); 54.5 (CH*C*HCH$_2$CH$_2$CH$_2$CH$_3$); 98.5 (*Cq*=C-OH); 164.1 (Cq=*C*-OH); 170.1 (CH*C*OOCH$_3$); 170.3 (Cq*C*OOCH$_3$). **IR** (cm^{-1}) 3080; 2957; 2929; 2864; 2638; 1748; 1666; 1630; 1534; 1440. mp. 144-146 °C.

(2*R*,6*S*)-2,6-Dimethyl-4-oxopiperidinium chloride (31a): $C_7H_{12}NOCl$ (163.7 g/mol), yield: 95 %; **^{1}H NMR** (DMSO-d$_6$, δ = ppm, J = Hz) 1.36 (d, 6H, J = 6.3, CHC***H$_3$***); 2.44 (dd, 2H, ^{2}J = 15.4, $^3J_{ae}$ = 2. 8, C***H$_2$***); 2.62 (dd, 2H, ^{2}J = 15.4, $^3J_{aa}$ = 12.9, C***H$_2$***,); 3.61 (m, 2H, C***H***); 9.38, 9.46 (2s, each 1H, N***H$_2^+$***). **^{13}C NMR** (DMSO-d$_6$, δ = ppm) 18.5 (CH***C***H$_3$);

44.2 (***C***H_2); 50.8 (***C***H); 202.9 (***C***=O). **IR** (cm^{-1}) 2929; 2781; 2723; 2665; 2569; 1726; 1666; 1579; 1451; 1406. mp.: 227-229 °C.

(2*R*,6*S*)/(2*RS*,6*RS*)-2,6-Diethyl-4-oxopiperidinium chloride (31b): $C_9H_{18}NOCl$ (191.7 g/mol), yield: 93 %; *cis-/trans* ratio: 5:1 **^{1}H NMR** (DMSO, δ = ppm, J = Hz) *cis*-isomer*:* 0.92 (t, 6H, $CH_2C\boldsymbol{H_3}$, *J = 7.6*); 1.43-1.98 (m, 4H, $C\boldsymbol{H_2}CH_3$); 2.45-2.63 (m, 4H, $C\boldsymbol{H_2}C$=O); 3.54-3.57 (m, $C\boldsymbol{H}CH_2CH_3$); 8.87-9.23 (m, 2H, $N\boldsymbol{H_2}^+$), *trans*-isomer*:* 0.92 (t, 6H, J = 7.5, $CH_2C\boldsymbol{H_3}$); 1.43-1.98 (m, 4H, $C\boldsymbol{H_2}CH_3$); 2.45-2.63 (m, 2H, $C\boldsymbol{H_2}C$=O); 2.72 (dd, 2H^{2}J = 15.3, $^3J_{ae}$ = 4.7, $C\boldsymbol{H_2}C$=O,); 3.61-3.67 (m, $C\boldsymbol{H}CH_2CH_3$); 9.23-9.32 (m, 2H, $N\boldsymbol{H_2}^+$). **^{13}C NMR** (DMSO, δ = ppm) *cis*-isomer*:* 9.2 ($CH_2\boldsymbol{C}H_3$); 25.4 ($\boldsymbol{C}H_2CH_3$); 41.8 ($\boldsymbol{C}H_2C$=O); 56.1 ($\boldsymbol{C}HCH_2CH_3$); 202.9 (***C***=O), *trans*-isomer*:* 9.5 ($CH_2\boldsymbol{C}H_3$); 24.3 ($\boldsymbol{C}H_2CH_3$); 41.5 ($\boldsymbol{C}H_2C$=O); 52.9 ($\boldsymbol{C}HCH_2CH_3$); 203.5 (***C***=O). **IR** (cm^{-1}) 2929; 2781, 2723; 2665; 2569; 1726; 1666; 1579; 1451; 1406. mp. 181-183 °C.

(2*R*,6*S*)-/ (2*RS*,6*RS*)-2,6-Dipropyl-4-oxopiperidinium chloride (31c): $C_{11}H_{22}NOCl$ (219.8 g/mol), yield: 92 %; *cis-/trans* ratio: 4:1 **^{1}H NMR** (DMSO, δ = ppm, J = Hz), *cis*-isomer*:* 0.88 (t, 6H, J = 7.3, $CH_2C\boldsymbol{H_3}$); 1.21-1.90 (m, 8H, $C\boldsymbol{H_2}C\boldsymbol{H_2}CH_3$); 2.42-2.52 (m, 2H, $C\boldsymbol{H_2}C$=O); 2.61 (dd, 2H, ^{2}J = 15.3, $^3J_{aa}$ = 12.8, $C\boldsymbol{H_2}C$=O); 3.54-3.65 (m, $C\boldsymbol{H}CH_2CH_2CH_3$); 8.88-9.35 (m, 2H, $N\boldsymbol{H_2}^+$), *trans*-isomer*:* 0.88 (t, 6H, J = 7.3, $CH_2C\boldsymbol{H_3}$); 1.21-1.90 (m, 4H, $C\boldsymbol{H_2}C\boldsymbol{H_2}CH_3$); 2.42-2.52 (m, 2H, $C\boldsymbol{H_2}C$=O); 2.72 (dd, 2H, ^{2}J = 15.4, $^3J_{ae}$ = 4.8, $C\boldsymbol{H_2}C$=O); 3.61-3.78 (m, $C\boldsymbol{H}CH_2CH_3$); 9.35-9.48 (m, 2H, $N\boldsymbol{H_2}^+$). **^{13}C NMR** (DMSO, δ = ppm) *cis*-isomer*:* 13.5 ($CH_2\boldsymbol{C}H_3$); 17.5 ($\boldsymbol{C}H_2CH_3$); 34.3 ($\boldsymbol{C}H_2CH_2CH_3$); 42.2 ($\boldsymbol{C}H_2C$=O); 54.4 ($\boldsymbol{C}HCH_2CH_3$); 202.8 (***C***=O), *trans*-isomer*:* 13.6 ($CH_2\boldsymbol{C}H_3$); 17.9 ($\boldsymbol{C}H_2CH_3$); 33.2 ($\boldsymbol{C}H_2CH_2CH_3$); 41.9 ($\boldsymbol{C}H_2C$=O); 51.4 ($\boldsymbol{C}HCH_2CH_3$); 203.5 (***C***=O). **IR** (cm^{-1}) 2929; 2791; 1726; 1596; 1408. mp. 194 °C.

(2*R*,6*S*)-/ (2*RS*,6*RS*)-2,6-Dibutyl-4-oxopiperidinium chloride (31d): $C_{13}H_{26}NOCl$ (247.9 g/mol), yield: 90 %; *cis-/trans* ratio: 2:1 **^{1}H NMR** (DMSO-d_6, δ = ppm, , J = Hz) *cis*-isomer*:* 0.88 (t, 6H, J = 6.8, $CH_2C\boldsymbol{H_3}$); 1.19-1.97 (m, 12H, $C\boldsymbol{H_2}C\boldsymbol{H_2}C\boldsymbol{H_2}CH_3$); 2.44-2.52 (m, 2H, $C\boldsymbol{H_2}C$=O); 2.59 (dd, 2H, ^{2}J = 15.3, $^3J_{aa}$ = 12.8, $C\boldsymbol{H_2}C$=O); 3.47-3.61 (m, $C\boldsymbol{H}CH_2CH_2CH_2CH_3$); 8.92-9.39 (m, 2H, $N\boldsymbol{H_2}^+$), *trans*-isomer*:* 0.87 (t, 6H, J = 6.7, $CH_2C\boldsymbol{H_3}$); 1.19-1.97 (m, 12H, $C\boldsymbol{H_2}C\boldsymbol{H_2}C\boldsymbol{H_2}CH_3$); 2.44-2.52 (m, 2H, $C\boldsymbol{H_2}C$=O); 2.71 (dd, 2H, ^{2}J = 15.3, $^3J_{ae}$ = 4.7, $C\boldsymbol{H_2}C$=O); 3.65-3.72 (m, $C\boldsymbol{H}CH_2CH_2CH_2CH_3$); 9.39-9.50 (m, 2H, $N\boldsymbol{H_2}^+$). **^{13}C NMR** (DMSO-d_6, δ = ppm) *cis*-isomer: 13.6 ($CH_2\boldsymbol{C}H_3$); 21.7, 26.1, 32.0

(***C***H_2***C***H_2***C***H_2CH_3); 42.3 (***C***H_2C=O); 54.7 (***C***$HCH_2CH_2CH_2CH_3$); 202.8 (***C***=O), *trans*-isomer*:* 13.6 (CH_2***C***H_3); 21.7, 26.5, 30.8 (***C***H_2***C***H_2***C***H_2CH_3); 41.9 (***C***H_2C=O); 51.5 (***C***$HCH_2CH_2CH_2CH_3$); 203.5 (***C***=O). **IR** (cm^{-1}) 2928; 2780, 2723; 1726; 1664; 1579; 1448; 1406. mp. 212 °C.

(2*R*,6*S*)-2,6-Dimethyl-4-phenylamino-piperidine-4-carbonitrile (32a): $C_{14}H_{19}N_3$ (229.3 g/mol), yield: 71 %; **^{1}H NMR** ($CDCl_3$, δ = ppm, J = *Hz*) 1.16 (d, 6H, *J = 6.3*, C***H*****$_3$**); 1.27 (dd, 2H, ^{2}J = 12.6, $^3J_{aa}$ = 11.6, C***H*****$_2$**); 1.57 (brs, N***H***); 2.36 (d, 2H, ***^2J = 12.6***, C***H*****$_2$**); 3.08-3.18 (m, 2H, C***H***); 3.62 (s, 1H, N***H***); 6.89-6.97 (t, 3H, J = 8.1, C***H***$_{ar}$); 7.22-7.29 (m, 2H, C***H***$_{ar}$). **^{13}C NMR** ($CDCl_3$, δ = ppm) 22.0 (***C***H_3); 44.2 (***C***H_2); 48.6 (***C***H); 54.7 (***C***-CN); 121.1 (***C***N); 118.3, 121.2, 129.4 (***C***H_{ar}); 143.4 (***Cq*****$_{ar}$**). **IR** (cm^{-1}) 3368; 3304; 2965; 2928; 2874; 2228; 1602; 1499; 1317; 1163; 752; 695. mp. 126 – 128 ^{o}C.

(2*R*,6*S*)-4-Benzylamino-2,6-dimethylpiperidine-4-carbonitrile (32b): $C_{15}H_{21}N_3$ (243.4 g/mol), yield: 68 % (oil); ratio of rotamers: 4:1. **^{1}H NMR** ($CDCl_3$, δ = ppm, J = *Hz*) isomer A: 1.13 (t, 6H, *J = 6.1*, CHC***H*****$_3$**); 1.22 (dd, 2H, ^{2}J = 12.6, $^3J_{aa}$ = 11.6, C***H*****$_2$**-Cq); 2.02 (d, 2H, ***^2J = 12.6***, C***H*****$_2$**- Cq); 3.01-3.11 (m, 2H, C***H***); 3.91 (s, 2H, NHC***H*****$_2$**); 7.24-7.38 (m, 5H, C***H*****$_{ar}$**), isomer B: 1.04 (t, 6H, *J = 6.3,* CH_2C***H*****$_3$**); 1.53 (dd, 2H, ^{2}J = 13.9, $^3J_{aa}$ = 10.9, C***H*****$_2$**-Cq); 1.94 (d, 2H, ***^2J = 13.9***, C***H*****$_2$**-Cq); 3.15-3.25 (m, 2H, C***H***); 3.85 (s, 2H, NHC***H*****$_2$**); 7.24-7.38 (m, 5H, C***H***$_{ar}$). **^{13}C NMR** ($CDCl_3$, δ = ppm) isomer A: 22.1 (***C***H_3); 43.6 (***C***H_2-Cq); 48.4 (NH***C***H_2); 48.6 (***C***H); 57.3 (***Cq***); 122.0 (***C***N); 127.5, 128.4, 128.6 (***C***H_{ar}); 139.2 (***Cq***$_{ar}$), isomer B: 22.1 (***C***H_3); 42.1 (***C***H_2-Cq); 48.8 (NH***C***H_2); 45.5 (***C***H); 54.6 (***Cq***); 122.3 (***C***N); 127.5, 128.4, 128.6 (***C***H_{ar}); 139.3 (***Cq***$_{ar}$). **IR** (cm^{-1}) 3311; 2962; 2927; 2841; 2218; 1454; 1376; 1318; 1159; 739; 701. mp. 126-128 °C.

(2*R*,6*S*)-2,6-Diethyl-4-phenylamino-piperidine-4-carbonitrile (32c): $C_{16}H_{23}N_3$ (257.4 g/mol), yield: 52 %; **^{1}H NMR** ($CDCl_3$, δ = ppm, J = Hz) 0.98 (t, 6H, J = 7.6, C***H*****$_3$**); 1.51-1.71 (m, 6H, C***H*****$_2$**CH_3, Cq-C***H*****$_2$**); 2.44-2.50 (d, 2H, ***^2J = 13.1,*** Cq-C***H*****$_2$**); 2.95-3.06 (m, 2H, C***H***); 6.91-6.98 (m, 3H, C***H*****$_{ar}$**); 7.23-7.28 (m, 2H, C***H*****$_{ar}$**). **^{13}C NMR** ($CDCl_3$, δ = ppm) 10.2 (***C***H_3); 27.7 (***C***H_2); 40.7 (***C***H_2); 54.2 (***C***H); 55.2 (***Cq***); 120.7 (***C***N); 118.2, 121.3, 129.5 (***C***H_{ar}); 143.4 (***Cq*****$_{ar}$**). **IR** (cm^{-1}) 3258; 2971; 2940; 2225; 1603; 1557; 1497; 1404; 1319; 1258; 748; 695. mp. 142-143 °C.

(2*R*,6*S*)-4-Benzylamino-2,6-diethylpiperidine-4-carbonitrile (32d): $C_{17}H_{25}N_3$ (271.4 g/mol), yield: 47 %; ratio of rotamers: 5:1. **^{1}H NMR** ($CDCl_3$, δ = ppm, J = *Hz*) isomer A: 0.96 (t, 6H, *J = 7.5*, CH_2CH_3); 1.20 (dd, 2H, ^2J = 12.9, $^3J_{aa}$ = 11.6, CH_2-Cq); 1.34-1.58 (m, 4H, CH_2CH_3); 2.09 (d, 2H, *^2J = 12.9,* CH_2Cq); 2.78-2.87 (m, 2H, CH); 3.94 (s, 2H, CH_2NH); 7.26-7.39 (m, 5H, CH_{ar}), isomer B: 0.88 (t, 6H, J = 7.5, CH_2CH_3); 1.63 (dd, 2H, *^2J = 13.6, $^3J_{aa}$ = 11.6*, CH_2-Cq); 1.34-1.58 (m, 4H, CH_2CH_3); 2.04 (d, 2H, ^2J = 13.6, CH_2 Cq); 2.97-3.03 (m, 2H, CH); 3.87 (s, 2H, NHCH_2); 7.26-7.39 (m, 5H, CH_{ar}). **^{13}C NMR** ($CDCl_3$, δ = ppm) isomer A: 10.3 (CH_3); 29.1 (CH_2CH_3); 41.9 (CH_2 Cq); 48.6 (NHCH_2); 54.7 (CH); 57.4 (Cq); 122.0 (CN); 127.6, 128.5, 128.7 (CH_{ar}); 139.2 (Cq_{ar}), isomer B: 10.2 (CH_3); 28.8 (CH_2CH_3); 40.0 (CH_2 Cq); 49.0 (NHCH_2); 51.6 (CH); 54.5 (Cq); 122.3 (CN); 127.7, 128.6, 128.7 (CH_{ar}); 139.3 (Cq_{ar}). **IR** (cm^{-1}) 3304; 3237; 2963; 2923; 2877; 2218; 1558; 1456; 13.81; 1329; 1142; 1093; 740; 699. mp. 109-111 °C.

(2*R*,6*S*)-4-Phenylamino-2,6-dipropylpiperidine-4-carbonitrile (32e): $C_{18}H_{27}N_3$ (285.4 g/mol), yield: 27 %; **^{1}H NMR** ($CDCl_3$, δ = ppm, J = *Hz*) 0.89 (t, 6H, *J = 6.9*, CH_3); 1.16 (dd, 2H, ^2J = 12.5, $^3J_{aa}$ = 12.0, CqCH_2); 1.30-1.42 (m, 8H, $CH_2CH_2CH_3$); 2.34 (d, 2H, ^2J = 12.5, CqCH_2); 2.70-2.79 (m, 2H, CH); 6.72 (t, 1H, J = 7.3, CH_{ar}); 6.86 (d, 2H, J = 7.8, CH_{ar}); 7.16 (2t, each 1H, J = 7.7, J = 7.6, CH_{ar}). **^{13}C NMR** ($CDCl_3$, δ = ppm) 14.1 (CH_3); 18.4, 37.8 ($CH_2CH_2CH_3$); 41.9 (CqCH_2); 52.3 (CH); 53.6 (Cq); 121.2 (CN); 115.7, 118.3, 128.8 (CH_{ar}); 144.8 (Cq_{ar}). **IR** (cm^{-1}) 3371; 2958; 2928; 2870; 2230; 1603; 1500; 1321; 1256; 1156; 751; 693. mp. 94 °C.

(2R,6S)-2,6-Dibutyl-4-phenylamino-piperidine-4-carbonitrile (32f): $C_{20}H_{31}N_3$ (313.5 g/mol), yield: 21 %; **^{1}H NMR** ($CDCl_3$, δ = ppm, J = Hz) 0.91 (t, 6H, J = 6.9, CH_3); 1.27-1.41, 1.56-1.91 (2m, 14H, $CH_2CH_2CH_2CH_3$, Cq-CH_2 axial); 2.48-2.55 (d, 2H, *^2J = 12.9*, Cq-CH_2 äquatorial); 3.11-3.22 (m, 2H, CH); 6.92-6.99 (m, 3H, CH_{ar}); 7.24-7.29 (m, 2H, CH_{ar}). **^{13}C NMR** ($CDCl_3$, δ = ppm) 14.1 (CH_3); 22.6 (CH_2); 27.9 (CH_2); 33.8 (CH_2); 40.6 (CH_2); 54.0 (CH); 54.2 (Cq); 120.4 (CN); 118.5, 121.6, 129.6 (CH_{ar}); 143.1 (Cq_{ar}). **IR** (cm^{-1}) 3370; 2958; 2928; 2870; 2230; 1603; 1500; 1321; 1257; 1156; 751; 694. mp. 79 °C.

(2*R*,6*S*)-7,9-Dimethyl-1-phenyl-1,3,8-triaza-spiro[4.5]decane-2,4-dione (33): $C_{15}H_{19}N_3O_2$ (273.3 g/mol), yield: 52 %; **^{1}H NMR** ($CDCl_3$, δ = ppm, J = Hz) 1.05 (d, 6H,

J = 6.3, C***H₃***); 1.33 (dd, 2H, ^{2}J = 12.5, $^{3}J_{aa}$ = 12.3, C***H₂*** Cq); 1.87 (d, 2H, *^{2}J = 12.5*, C***H₂*** Cq); 3.45-3.58 (m, 2H, C***H***); 7.15-7.19 (m, 2H, C***H*****$_{ar}$**); 7.41-7.47 (m, 3H, C***H*****$_{ar}$**). **^{13}C NMR** ($CDCl_3$, δ = ppm) 22.3 (***C***H_3); 39.5 (Cq***C***H_2); 46.6 (***C***H); 65.7 ***(Cq)***; 129.4, 129.8, 130.9 (***C***H_{ar}); 132.6 (***Cq*****$_{ar}$**); 154.9 (***C***=O); 176.2 (Cq-***C***=O). **IR** (cm^{-1}) 2978; 2942; 2716; 1716; 1410; 1386; 1152; 706; 629. mp. 256 °C.

(2*R*,6*S*)-1-Benzyl-7,9-diethyl-1,3,8-triaza-spiro[4.5]decane-2,4-dione (34):
$C_{18}H_{25}N_3O_2$ (315.4 g/mol), yield: 84 %; ratio of rotamers: 5:1 **^{1}H NMR** ($CDCl_3$, δ = ppm, J = Hz) rotamere A: 0.86 (t, 6H, J = 7.5, CH_2C***H₃***); 1.13-1.78 (m, 4H, C***H₂***CH_3, 4H, C***H₂***-Cq); 3.17-3.29 (m, 2H, C***H***); 4.51 (s, 2H,); 7.20-7.36 (m, 5H, C***H***$_{ar}$), rotamere B: 0.64 (t, 6H, J = 7.5, CH_2C***H₃***); 1.13-1.78 (m, 4H, C***H₂***CH_3, 4H, C***H₂***-Cq); 2.51-2.62 (m, 2H, C***H***); 4.87 (s, 2H, NC***H₂ Benzyl***); 7.20-7.36 (m, 5H, C***H***$_{ar}$). **^{13}C NMR** ($CDCl_3$, δ = ppm) rotamere A: 10.2 (***C***H_3); 29.5 (***C***H_2CH_3); 37.4 (***C***H_2-Cq); 42.0 (NH-***C***H_2); 52.4 (***C***H); 64.5 (***Cq***); 127.6, 127.6, 128.7 (***C***H_{ar}); 138.0 (***Cq***$_{ar}$); 155.0 (Cq-***C***=O); 179.8 (***C***=O), rotamere B: 9.9 (***C***H_3); 30.1 (***C***H_2CH_3); 38.8 (***C***H_2-Cq); 45.5 (NH-***C***H_2); 53.9 (***C***H); 65.9 (***Cq***); 129.9, 127.6, 128.8 (***C***H_{ar}); 137.8 (***Cq***$_{ar}$); 156.9 (Cq-***C***=O); 177.0 (***C***=O). **IR** (cm^{-1})3291; 2963; 2925; 2876; 1709; 1413; 1131; 703; 623. mp. 284-286 °C

(2*R*,6*S*)-1-Phenyl-7,9-dipropyl-1,3,8-triaza-spiro[4.5]decane-2,4-dione (35):
$C_{19}H_{27}N_3O_2$ (329.5 g/mol), yield: 66 %; **^{1}H NMR** (DMSO, δ = ppm, J = Hz) 0.84 (t, 6H, J = 7.1, C***H₃***); 1.17-1.32 (m, 10H, C***H₂***C***H₂***CH_3, CqC***H₂***); 1.78-1.89 (m, 2H, CqC***H₂***); 3.21-3.33 (m, 2H, C***H***); 6.96-7.14 (m, 2H, C***H*****$_{ar}$**); 7.33-7.54 (m, 3H, C***H*****$_{ar}$**). **^{13}C NMR** (DMSO, δ = ppm) 14.3 (***C***H_3), 19.1 (CH_2***C***H_2CH_3); 38.6 (***C***$H_2CH_2CH_3$); 39.2 (Cq***C***H_2); 50.7 (***C***H); 65.9 (***Cq***); 129.3, 129.8, 130.9 (***C***H_{ar}); 132.6 (***Cq*****$_{ar}$**); 154.7 (Cq***C***=O); 176.1 (N***C***=ON). **IR** (cm^{-1}) 3270; 2961; 2924; 2871; 1709; 1387; 1152; 700; 625. mp. 216-218 °C.

(2*R*,6*S*)-7,9-Dibutyl-1-phenyl-1,3,8-triaza-spiro[4.5]decane-2,4-dione (36):
$C_{21}H_{31}N_3O_2$ (357.5 g/mol), yield: 42 %; **^{1}H NMR** (DMSO, δ = ppm, J = Hz) 0.87 (t, 6H, J = 6.8, CH_2C***H₃***); 1.18-1.40 and 1.74-1.86 (2m, 12H, C***H₂***C***H₂***C***H₂***CH_3); 1.54 (dd, 2H, ^{2}J = 13.9, $^{3}J_{aa}$ = 12.4, C***H₂***-Cq); 2.41 (d, 2H, *^{2}J = 13.9,* C***H₂***-Cq); 3.53-3.65 (m, 2H, C***H***); 7.30-7.36 (m, 2H, C***H***$_{ar}$); 7.42-7.53 (m, 2H, C***H***$_{ar}$). **^{13}C NMR** (DMSO, δ = ppm) 13.7 (***C***H_3); 21.7 (CH_2CH_2***C***H_2CH_3); 26.5 (CH_2***C***$H_2CH_2CH_3$); 31.9 (***C***$H_2CH_2CH_2CH_3$); 33.1 (***C***H_2-Cq); 51.5 (***C***H); 62.0 (***Cq***); 128.7, 129.4, 131.0 (***C***H_{ar}); 133.0 (***Cq***$_{ar}$); 154.7 (Cq-

C=O); 176.1 (N***C***=ON). **IR** (cm^{-1}) 3502; 3387; 2957; 2932; 2862; 2726; 1715; 1397; 1150; 705; 625. mp. 305 °C.

(2*R*,6*S*)-8-Benzyl-7,9-diethyl-1-phenyl-1,3,8-triaza-spiro[4.5]decane-2,4-dione (44): $C_{24}H_{29}N_3O_2$ (391.5 g/mol), yield: 59 %; **^{1}H NMR** (DMSO, δ = ppm, J = Hz) 0.70 (t, 6H, J = 7.3, $CH_2C\boldsymbol{H_3}$); 0.95-1.07 (m, 2H, $C\boldsymbol{H_2}CH_3$); 1.31-1.46 (m, 2H, $C\boldsymbol{H_2}$-Cq axial, 2H, $C\boldsymbol{H_2}CH_3$); 1.68 (d, 2H, ^{2}J = 12.6, $C\boldsymbol{H_2}$-Cq äquatorial); 3.32-3.42 (m, 2H, $NC\boldsymbol{H_2}$, 2H, C***H***); 7.09 (t, 1H, J = 7.2, $C\boldsymbol{H}_{ar}$); 7.20 (t, 2H, J = 7.5, $C\boldsymbol{H}_{ar}$); 7.26 (t, 4H, J = 8.0, $C\boldsymbol{H}_{ar}$); 7.35 (t, 1H, J = 7.3, $C\boldsymbol{H}_{ar}$); 7.45 (t, 2H, J = 7.6, $C\boldsymbol{H}_{ar}$). **^{13}C NMR** (DMSO, δ = ppm) 10.9 ($\boldsymbol{C}H_3$); 27.3 ($\boldsymbol{C}H_2CH_3$); 32.6 ($\boldsymbol{C}H_2$-Cq); 47.7 ($N\boldsymbol{C}H_2$); 59.1 (***C***H); 63.9 (***Cq***); 125.7, 127.1, 127.7, 128.9, 130.1, ($\boldsymbol{C}H_{ar}$); 136.0, 143.4 ($\boldsymbol{Cq}_{ar}$); 157.7 (***C***=O); 183.5 (Cq-***C***=O). **IR** (cm^{-1}) 2963; 2930; 2865; 1734; 1603; 1494; 1367; 1135; 727; 696. mp. 294-295 °C.

(2*R*,6*S*)-1-Benzyl-3-(2-hydroxy-ethyl)-7,9-dimethyl-1,3,8-triaza-spiro[4.5]decane-2,4-dione (37): $C_{18}H_{25}N_3O_3$ (331.4 g/mol), yield: 48 %; **^{1}H NMR** ($CDCl_3$, δ = ppm, J = Hz) 1.06 (d, 6H, J = 6.3, $C\boldsymbol{H_3}$); 1.48 (dd, 2H, ^{2}J = 13.3, $^3J_{aa}$ = 11.0, $CqC\boldsymbol{H_2}$); 1.59 (dd, 2H, ^{2}J = 13.3, $^3J_{ae}$ = 1.9, $CqC\boldsymbol{H_2}$); 3.46-3.56 (m, 2H, C***H***CH_3); 3.74-3.78 (m, 2H, $NCH_2C\boldsymbol{H_2}OH$); 3.80-3.84 (m, 2H, $NC\boldsymbol{H_2}CH_2OH$); 4.53 (s, 2H, $NC\boldsymbol{H_2}$); 7.25-7.32 (m, 5H, $C\boldsymbol{H}_{ar}$). **^{13}C NMR** ($CDCl_3$, δ = ppm) 22.2 ($\boldsymbol{C}H_3$); 38.8 ($Cq\boldsymbol{C}H_2$); 41.9 ($CH_2\boldsymbol{C}H_2OH$); 42.4 ($N\boldsymbol{C}H_2$); 46.7 ($N\boldsymbol{C}H$); 61.2 ($\boldsymbol{C}H_2CH_2OH$); 63.5 (***Cq***); 127.5, 127.7, 128.8 ($\boldsymbol{C}H_{ar}$); 156.6 (N***C***=ON); 176.4 (Cq***C***=O). **IR** (cm^{-1}) 3302; 2963; 2934; 2853; 1695; 1447; 1048; 700. mp. 195-196 °C.

(2*R*,6*S*)-3-Benzyl-7,9-diethyl-1-phenyl-1,3,8-triaza-spiro[4.5]decane-2,4-dione (38): $C_{24}H_{29}N_3O_2$ (391.5 g/mol), yield: 55 %; ratio of rotamers: 6:1. **^{1}H NMR** ($CDCl_3$, δ = ppm, J = Hz) rotamer A: 0.90 (t, 6H, J = 7.5, $CH_2C\boldsymbol{H_3}$); 1.20-1.45 (m, 6H, $C\boldsymbol{H_2}$-Cq axial, $C\boldsymbol{H_2}CH_3$); 1.82 (d, 2H, ^{2}J = 12.6, $C\boldsymbol{H_2}$-Cq äquatorial); 3.25-3.35 (m, 2H, C***H***); 4.73 (s, 2H, $C\boldsymbol{H_{2\ Benzyl}}$); 7.12-7.48 (m, 10H, $C\boldsymbol{H}_{ar}$), rotamer B: 0.81 (t, 6H, J = 7.5, $CH_2C\boldsymbol{H_3}$); 1.20-1.45 (4H, $C\boldsymbol{H_2}CH_3$); 1.73-1.79 (m, 2H, $C\boldsymbol{H_2}$-Cq axial); 1.97 (d, 2H, *^2J = 13.9,* $C\boldsymbol{H_2}$-Cq äquatorial); 2.22-2.31 (m, 2H, C***H***); 4.73 (s, 2H, $C\boldsymbol{H_{2\ Benzyl}}$); 7.12-7.48 (m, 10H, $C\boldsymbol{H}_{ar}$). **^{13}C NMR** ($CDCl_3$, δ = ppm) rotamer A: 10.3 ($\boldsymbol{C}H_3$); 29.4 ($\boldsymbol{C}H_2CH_3$); 38.0 ($\boldsymbol{C}H_2$-Cq); 42.4 ($\boldsymbol{C}H_{2\ Benzyl}$); 52.7 (***C***H); 64.3 (***Cq***); 127.9; 128.7; 128.8; 129.1, 129.7, 130.8 ($\boldsymbol{C}H_{ar}$); 132.9 (N-$\boldsymbol{Cq}_{ar}$); 136.3 (CH_2-$\boldsymbol{Cq}_{ar}$); 155.0 (N***C***=ON); 175.3 (Cq-***C***=O), rotamer B:

10.1 (***C***H_3); 30.0 (***C***H_2CH_3); 39.3 (***C***H_2-Cq); 43.0 (***C***$H_{2\ Benzyl}$); 52.9 (***C***H); 65.6 (***Cq***); 127.3; 128.0; 128.6; 129.4, 129.6, 131.0 (***C***H_{ar}); 136.2 (N-***Cq***$_{ar}$); 136.5 (CH_2-***Cq***$_{ar}$); 155.5 (N***C***=ON); 175.5 (Cq-***C***=O). **IR** (cm^{-1}) 2962; 2933; 1704; 1434; 1412; 1152; 743; 697. mp. 74-75 °C.

(2*R*,6*S*)-1-Benzyl-7,9-dimethyl-3-(4-nitro-benzyl)-1,3,8-triaza-spiro[4.5]decane-2,4-dione (39): $C_{23}H_{26}N_4O_4$ (422.5 g/mol), yield: 71 %; **^{1}H NMR** ($CDCl_3$, δ = ppm, J = Hz) 1.11 (d, 6H, J = 6.3, C***H*****$_3$**); 1.45 (d, 2H, ^{2}J = 12.4, C***H*****$_2$** Cq äquatorial); 1.80 (dd, 2H, ^{2}J = 12.4, $^3J_{aa}$ = 12.9, C***H*****$_2$**Cq); 3.52-3.62 (m, 2H, C***H***); 4.50 (s, 2H, C***H*****$_{2\ Benzyl}$**); 4.70 (s, 2H, C***H*****$_{2\ 4\text{-}Nitrobenzyl}$**); 7.17-7.31 (m, 5H, C***H*****$_{Benzyl}$**); 7.46-7.51 (m, 2H, C***H*****$_{4\text{-}Nitrobenzyl}$**); 8.11-8.17 (m, 2H, C***H*****$_{4\text{-}Nitrobenzyl}$**). **^{13}C NMR** ($CDCl_3$, δ = ppm) 20.6 (***C***H_3); 37.1 (CH***C***H_2); 41.7 (***C***$H_{2\ 4\text{-}Nitrobenzyl}$); 42.6 (***C***$H_{2\ Benzyl}$); 47.5 (***C***H); 62.7 (***Cq***); 124.2, 127.9, 127.9, 128.9, 129.5 (***C***H_{ar}); 137.6 (CH_2-***Cq*****$_{Benzyl}$**); 143.1 (CH_2-***Cq*****$_{4\text{-}Nitrobenzyl}$**); 147.9 (***Cq***-NO_2); 155.3 (N***C***=ON); 175.1 (Cq-***C***=O). **IR** (cm^{-1}) 2974; 2934; 1708; 1575; 1518; 1439; 1413; 1343; 703; 646. mp. 161-162 °C.

(2*R*,6*S*)-7,9-Diethyl-3-phenethyl-1-phenyl-1,3,8-triaza-spiro[4.5]decane-2,4-dione (40): $C_{25}H_{31}N_3O_2$ (405.5 g/mol), yield: 62 %; **^{1}H NMR** ($CDCl_3$, δ = ppm, J = Hz) 0.87 (t, 6H, *J = 7.6*, CH_2C***H*****$_3$**); 1.15-1.32 (m, 6H, C***H*****$_2$**-Cq axial, C***H*****$_2$**CH_3); 1.59 (d, 2H, *^2J = 12.4,* C***H*****$_2$**-Cq äquatorial); 3.03 (t, 2H, NCH_2C***H*****$_2$**); 3.09-3.18 (m, 2H, C***H***); 3.85 (t, 2H, NC***H*****$_2$**CH_2); 4.73 (s, 1H, N***H***); 7.05-7.44 (m, 10H, C***H***$_{ar}$). **^{13}C NMR** ($CDCl_3$, δ = ppm) 10.4 (***C***H_3); 29.8 (***C***H_2CH_3); 33.7 (NCH_2***C***H_2); 38.2 (***C***H_2-Cq); 39.3 (N***C***H_2CH_2); 52.4 (***C***H); 64.2 (***Cq***); 126.8; 128.5; 129.0; 129.3, 129.7, 130.8 (***C***H_{ar}); 133.0 (N-***Cq***$_{ar}$); 138.0 (CH_2-***Cq***$_{ar}$); 155.1 (N***C***=ON); 175.5 (Cq-***C***=O). **IR** (cm^{-1}) 2934; 2857; 1700; 1443; 1415; 1128; 739; 699; 623. mp. 146-147 °C.

(2*R*,6*S*)-7,9-Diethyl-1-phenyl-3-(3-phenyl-propyl)-1,3,8-triaza-spiro[4.5]decane-2,4-dione (41): $C_{26}H_{33}N_3O_2$ (419.6 g/mol), yield: 63 %; **^{1}H NMR** ($CDCl_3$, δ = ppm, J = Hz) 0.91 (t, 6H, J = 7.5, CH_2C***H*****$_3$**); 1.24-1.38 (m, 6H, C***H*****$_2$**-Cq axial, C***H*****$_2$**CH_3); 1.75 (d, 2H, *^2J = 12.1,* C***H*****$_2$**-Cq äquatorial); 2.05 (quin, 2H, J = 7.5, NCH_2C***H*****$_2$**CH_2); 2.69 (t, 2H, J = 7.7, NCH_2CH_2C***H*****$_2$**); 3.21-3.31 (m, 2H, C***H***); 3.64 (t, 2H, J = 7.3, NC***H*****$_2$**CH_2CH_2); 7.12-7.46 (m, 10H, C***H***$_{ar}$). **^{13}C NMR** ($CDCl_3$, δ = ppm) 10.4 (***C***H_3); 29.5 (NCH_2***C***H_2CH_2); 29.8 (***C***H_2CH_3); 33.3 (NCH_2CH_2***C***H_2); 38.4 (***C***H_2-Cq); 38.7 (N***C***$H_2CH_2CH_2$); 52.5 (***C***H); 64.3 (***Cq***); 126.2, 128.5, 128.6, 129.1, 129.7, 130.9 (***C***H_{ar}); 133.1 (N-***Cq***$_{ar}$); 141.3 (CH_2-***Cq***$_{ar}$);

155.3 (N***C***=ON); 175.9 (Cq-***C***=O). **IR** (cm^{-1}) 2958; 2914; 1704; 1450; 1416; 741; 695; 645. mp. 118-120 °C

(2*R*,6*S*)/(2*RS*,6*RS*)-1-Benzyl-2,6-diethyl-4-piperidone (42b): $C_{16}H_{23}NO$ (245.4 g/mol), yield: 91 % (oil); *cis*-*trans*-ratio: 2:1 **^{1}H NMR** ($CDCl_3$, δ = ppm, J = Hz) *cis*-isomer: 0.97 (t, 6H, J = 7.5, $CH_2C\boldsymbol{H_3}$); 1.36-1.66 (m, 4H, $C\boldsymbol{H_2}CH_3$); 2.09 (dd, 2H, ^2J = 13.9, $^3J_{aa}$ = 11.9, $C\boldsymbol{H_2}C$=O); 2.40 (dd, 2H, ^2J = 13.9, $^3J_{ae}$ = 1.8, $C\boldsymbol{H_2}C$=O); 2.72-2.82 (m, 2H, $C\boldsymbol{H}CH_2CH_3$); 3.08 (s, 2H, $NC\boldsymbol{H_2}$); 7.24-7.50 (m, 5H, $C\boldsymbol{H_{ar}}$), *trans*-isomer: 0.94 (t, 6H, J = 7.3, $CH_2C\boldsymbol{H_3}$); 1.36-1.66 (m, 4H, $C\boldsymbol{H_2}CH_3$); 2.20 (ddd, 2H, $^3J_{ae}$ = 1.4, $^3J_{aa}$ = 6.7, ^2J = 13.9, $C\boldsymbol{H_2}C$=O); 2.49 (ddd, 2H, $^3J_{ae}$ = 1.4, $^3J_{ee}$ = 4.7, ^2J = 13.9, $C\boldsymbol{H_2}C$=O); 3.02-3.13 (m, 2H $C\boldsymbol{H}CH_2CH_3$); 3.64, 4.02 (2d, 2H, J = 13.9, $NC\boldsymbol{H_2}$); 7.24-7.50 (m, 5H, $C\boldsymbol{H_{ar}}$). **^{13}C NMR** ($CDCl_3$, δ = ppm) *cis*-isomer: 10.0 (**C**H_3); 29.6 (***C***H_2CH_3); 47.9 (***C***H_2); 57.9 (***C***H_2); 64.6 (***C***HCH_2CH_3); 126.8, 128.2, 128.3, 129.1, 130.5, 133.3 (***C***H_{ar} *cis* and *trans*); 139.9 ($\boldsymbol{Cq_{ar}}$); 209.7 (***C***=O), *trans*-isomer: 10.7 (**C**H_3); 25.7 (***C***H_2CH_3); 42.6 (***C***H_2); 57.5 (***C***H_2); 63.2 (***C***HCH_2CH_3); 126.8, 128.2, 128.3, 129.1, 130.5, 133.3 (***C***H_{ar} *trans* and *cis*); 141.4 $\boldsymbol{Cq_{ar}}$); 210.2 (***C***=O). **IR** (cm^{-1}) 3028; 2963; 2874; 2801; 1707; 1453; 731; 698.

1-Benzyl-4-phenylamino-piperidine-4-carbonitrile (43a): $C_{19}H_{21}N_3$ (291.4 g/mol), yield: 62 %, mp. 146-148 °C.

(2*R*,6*S*)-1-Benzyl-2,6-diethyl-4-phenylamino-piperidine-4-carbonitrile (43b): $C_{23}H_{29}N_3$ (347.5 g/mol), yield: 59 %; **^{1}H NMR** (DMSO-d_6, δ = ppm, J = Hz) 0.79 ($C\boldsymbol{H_3}$); 1.26-1.39 (m, 2H, $C\boldsymbol{H_2}CH_3$); 1.48-1.60 (m, 4H, $C\boldsymbol{H_2}CH_3$, $CqC\boldsymbol{H_2}$ axial); 2.31 (d, 2H, ^2J = 13.4, $CqC\boldsymbol{H_2}$ äquatorial); 2.70-2.80 (C***H***); 3.70 (s, 2H, $NC\boldsymbol{H_2}$); 6.04 (s, 1H, N***H***); 6.75 (t, 1H, J = 7.3, $C\boldsymbol{H_{ar}}$); 6.88 (d, 2H, *J = 7.8*, $C\boldsymbol{H_{ar}}$); 7.14-7.23 (m, 4H, $C\boldsymbol{H_{ar}}$); 7.28 (t, 2H, *J = 7.6*, $C\boldsymbol{H_{ar}}$); 7.38 (d, 2H, *J = 7.6*, $C\boldsymbol{H_{ar}}$). **^{13}C-NMR** (DMSO-d_6, δ = ppm) 10.4 (***C***H_3); 26.5 (***C***H_2CH_3); 37.3 (Cq***C***H_2); 50.2 (N***C***H_2); 53.2 ($\boldsymbol{Cq}$); 60.8 (N***C***H); 121.1 (***C***N); 125.8, 118.5, 126.0, 127.2, 127.9, 129.0 (***C***H_{ar}); 142.3, 144.7 ($\boldsymbol{Cq_{ar}}$). **IR** (cm^{-1}) 3375; 2966; 2934; 2877; 2229; 1601; 1499; 1317; 759; 730; 696. mp. 123-125 °C.

(2*R*,6*S*)-8-Benzyl-7,9-diethyl-3-(4-nitro-benzyl)-1-phenyl-1,3,8-triaza-spiro[4.5]decane-2,4-dione (45): $C_{31}H_{34}N_4O_4$ (526.6 g/mol), yield: 46 %; **^{1}H NMR** ($CDCl_3$, δ = ppm, J = Hz) 0.76 (t, 6H, J = 7.3, $CH_2C\boldsymbol{H_3}$); 1.04-1.17 (m, 2H, $C\boldsymbol{H_2}CH_3$); 1.56-1.73 (m, 6H, $C\boldsymbol{H_2}CH_3$, $C\boldsymbol{H_2}$-Cq); 3.29-3.40 (m, 2H, C***H***); 3.44 (s, 2H, $CHNC\boldsymbol{H_2}$

Benzyl); 4.81 (s, 2H, O=CNC***H*****2** ***4-Nitrobenzyl***); 7.10-7.15 (m, 1H, ***H4*** *Anilin*); 7.17-7.53 (m, 9H, ***H2/3/5/6*** *Anilin*, C***H*** *Benzyl*); 7.56-7.62 (m, 2H, ***H2/6*** ***4-Nitrobenzyl***); 8.17-8.22 (m, 2H, ***H3/5*** ***4-Nitrobenzyl***). **^{13}C NMR** ($CDCl_3$, δ = ppm) 11.0 (***C***H_3); 27.8 (***C***H_2CH_3); 32.9 (***C***H_2-Cq); 41.7 (O=CN***C***H_2); 48.9 (CHN***C***H_2); 59.6 (***C***H); 64.7 (***Cq***); 124.1, 126.2; 127.3, 128.0, 129.3; 129.6, 129.9, 130.6 (***C***H_{ar}); 132.9 (N-***Cq*** *Anilin*); 142.8 (CH_2-***Cq***$_{ar}$); 143.4 (***Cq***$_{ar}$); 147.8 (***Cq***-NO_2); 154.7 (N-***C***=ON); 175.2 (Cq-***C***=O). **IR** (cm^{-1}) 2987; 2932; 2866; 1703; 1520; 1432; 1341; 742; 700. mp. 185-187 °C

8-Benzyl-1-phenyl-1,3,8-triaza-spiro[4.5]decane-4-one (47):

$C_{20}H_{23}N_3O$ (321.4 g/mol), yield: 68 %; **^{1}H NMR** (DMSO-d_6, δ = ppm, J = Hz) 1.57 (d, 2H, J = 13.6, CqC***H*****2**); 2.52-2.63 (m, 2H, CqC***H*****2**); 2.67-2.78 (m, 4H, NC***H*****2**CH_2); 3.52 (s, 2H, NC***H*****2** ***Benzyl***); 4.57 (s, 2H, NC***H*****2**N); 6.76 (t, 2H, J = 7.8, C***H*** *ar*); 6.87 (d, 1H, J = 7.1, C***H*** *ar*); 7.21-7.39 (m, 7H, C***H*** *ar*); 8.60 (s, 1H, N***H***). **^{13}C NMR** (DMSO-d_6, δ = ppm) 28.4 (Cq***C***H_2); 49.2 (N***C***H_2CH_2); 58.2 (N***C***H_2N); 58.7 (N***C***H_2 Benzyl); 62.1 (***Cq***); 114.3, 117.7, 126.8, 128.2, 128.7, 129.0 (***C***H_{ar}); 138.7, 143.3 (***Cq***$_{ar}$); 176.2 (***C***=ONH). **IR** (cm^{-1}) 3180; 3108; 3067; 2960; 2926; 2818; 1703; 1599; 1373; 1312; 1098; 1030; 796; 735; 689. mp. 234-237 °C.

1-(3-Phenylpropyl)-4-piperidine oxime (48):

Yield: 13.84 (59%). $C_{14}H_{20}N_2O$ (232.3 g/mol); **^{1}H NMR** (d_4-MeOH, δ = ppm, J = Hz): 7.14 – 7.18 (5 H, m, Ph-H), 3.21 – 3.14 (4 H, m, Ph-C***H*****2**-CH_2-C***H*****2**-N), 2.99 (2 H, t, J = 4.6, 2-H_{eq}, 6-H_{eq}), 2.77 - 2.64 (2 H, m, 2-H_{ax}, 6-H_{ax}), 2.60 - 2.49 (4 H, m, 3-H, 5-H), 2.03 – 1.95 (2 H, m, Ph-CH_2-C***H*****2**-CH_2-N). **^{13}C NMR** (d_4-MeOH, δ= ppm): 151.3 (–C=N), 141.6 (C-1 arom.), 129.7, 129.5 (C-2, C-2, C-2, C-6 arom.), 127.5 (C-4 arom.), 57.6 (Ph-CH_2-CH_2-***C***H_2-N), 53.7 and 52.5 (C-2, C-6, rotameres), 33.7 (Ph-***C***H_2-CH_2-CH_2-N), 29.3 (Ph-CH_2-***C***H_2-CH_2-N), 27.4 and 22.5 (C-3, C-5, rotameres), **IR** (ATR, cm^{-1}): 3147 (OH), 3074 (=C–H), 2946 (–CH_2), 1656 (–C=N), 1600 (–C=C- arom.), 954 (N-O), 763, 704 (out of plane). mp. 182.5 °C.

1-(2-Phenylpropyl)-4-oxo-piperidine O-(2,6-dichloro-benzyl)-oxime (49):

Yield: 0.68 g (28%). $C_{21}H_{24}N_2OCl_2$ (391.3 g/mol); **^{1}H NMR** ($CDCl_3$, δ = ppm): 7.13 – 7.04 (8 H, m, aromatic); 5.23 (2 H, s, O-CH_2), 2.58 – 2.42 (8 H, m, 2-H, 3-H, 5-H, 6-H); 2.41 – 2.31 (4 H, m, Ph-C***H*****$_2$**-CH_2-C***H*****$_2$**-N); 1.82 – 1.77 (2 H, m, Ph-CH_2-C***H*****$_2$**-CH_2-N). **^{13}C NMR** ($CDCl_3$, δ = ppm): 152.1 (–C=N), 136.1 (C-1''), 133.4 (C-1'), 130.2 (C-2'', C-6''), 128.5, 128.4, 128.2 (C-2', C-3' C-5', C-6', C-3'', C-5''), 125.8, 125.6 (C-4', C-4''), 57.5 (CH_2-O), 53.4 (Ph-CH_2-CH_2-***C***H_2-N), 52.4 (Ph-***C***H_2-CH_2-CH_2-N), 40.7 (C-2, C-6), 33.6 (C-3, C-5), 31.1 (Ph-***C***H_2-CH_2-CH_2-N). **IR** (ATR, cm^{-1}): 3026 (=C–H); 2945 and 2812 (–CH_2), 1660 (–C=N), 1563 (–C=C- arom.), 739, 705, 700, 642 (out of plane). mp. 147 °C.

4-(1,3-Dioxolan-2-yl)-*N*-(3-phenylpropyl)pyridinium bromide (50):

Yield: 1.78 g (37 %) colorless crystals. $C_{17}H_{20}NO_2Br$ (350.3 g/mol); **^{1}H NMR** ($CDCl_3$, δ = ppm): 9.45 (2 H, br, 2-H, 6-H pyridine), 7.94 (2 H, br, 3-H, 5-H pyridine), 7.21 – 7.06 (m, 5 H, Ph-H), 5.88 (s, 1H, O–CH–O), 5.01 (br, 2 H, Ph-CH_2-CH_2-C***H*****$_2$**-N), 4.04 – 3.94 (m, 4 H, O–$(CH_2)_2$–O), 2.74 (t, 2 H, J = 6.6, Ph-C***H*****$_2$**-CH_2-CH_2-N), 2.36 – 2.29 (m, 2 H, Ph-CH_2-C***H*****$_2$**-CH_2-N^+), **^{13}C NMR** ($CDCl_3$, δ= ppm): 156.8 (pyridine C-4), 145.5 (pyridine C-2, C-6), 139.5 (phenyl C-1), 128.7 und 128.4 (phenyl C-2, C-3, C-5, C-6), 126.5 (pyridine C-3, C-5), 125.5 (phenyl C-4), 100.0 (O–CH–O), 65.9 (O–$(CH_2)_2$–O), 61.4 (Ph-CH_2-CH_2-***C***H_2-N), 33.1 (Ph-***C***H_2-CH_2-CH_2-N), 32.2 (Ph-CH_2-***C***H_2-CH_2-N). **IR** (ATR, cm^{-1}: 3026 (=C–H); 2976 and 2897 (–CH); 1708 (–C=C- aromatic); 1096 (C-O), mp. 78.1 °C.

(1,3-Dioxolane-2-yl)-*N*-(3-phenylpropyl)piperidine hydrobromide (51)

Yield 1.84 g (98%). $C_{17}H_{26}O_2N_1Br$ (355.1 g/mol); **^{1}H NMR** ($CDCl_3$, δ = ppm, J = Hz): 11.29 (1 H, br, NH^+), 7.30 – 7.16 (5 H, m, arom.), 4.79 and 4.64 (1 H, d, rotameres, J = 5.6, O-CH-O), 4.08 – 3.99 (4 H, m, O-CH_2-CH_2-O), 3.70 – 3.60 (2 H, m, Ph-CH_2-CH_2-C***H*****$_2$**-N), 3.07 – 2.71 (4 H, m, 2-H, 6-H), 2.68 – 2.16 (7 H, m, 3-H, 4-H, 5-H, Ph-C***H*****$_2$**-CH_2-CH_2-N), 1.76 – 1.69 (2 H, m, Ph-CH_2-C***H*****$_2$**-CH_2-N). **^{13}C NMR** ($CDCl_3$, δ = ppm): 139.4 (phenyl C-1), 128.8, 128.4 (phenyl, C-2, C-3, C-5, C-6), 126.7 (phenyl C-4), 105.3 (O–CH–O), 66.0 (O–$(CH_2)_2$–O), 57.3 (Ph-CH_2-CH_2-***C***H_2-N), 52.6 (C-2, C-6), 38.7 (C-4),

32.9 (Ph-***C***H_2-CH_2-CH_2-N), 24.9 (Ph-CH_2-***C***H_2-***C***H_2-N), 23.9 (C-3, C-5). **IR** (ATR, cm^{-1}):3029 (=C–H), 2926 and 2885 (–CH_2), 1600 (–C=C- arom.), 1045 cm^{-1} (C-O). mp. 132 °C (dec.)

1-1-(3-Phenyl-propyl)-piperidine-4-carbaldehyde oxime (52)

Yield: 1.90 g (55 %), $C_{15}H_{22}N_2O$ (246.4 g/mol); **^{1}H NMR** ($CDCl_3$, δ = ppm, J = Hz): 9.11 (1 H, br, OH), 7.64 – 7.10 (6 H, m, 5 H arom., HC=N), 2.91 – 2. 88 (2 H, m, 2-H_{eq}, 6-H_{eq}), 2.55 (2 H, t, J = 7.8, Ph-CH_2-CH_2-C***H₂***-N), 2.34 – 2.30 (2 H, m, 2-H_{ax}, 6-H_{ax}), 2.14 – 1.53 (9 H, m, 3-H, 4-H, 5-H, Ph-C***H₂***-CH_2-C***H₂***-N). **^{13}C NMR** ($CDCl_3$, δ = ppm): 154.1 (HC=N), 141.9 (C-1, arom.), 128.4, 128.3 (C-2, C-3, C-5, C-6 arom.), 125.6 (C-4 arom.), 58.3 (C-2, C-6), 53.0, Ph-CH_2-CH_2-***C***H_2-N), 33.7 (C-4), 29.0 (C-3, C-5), 28.4, 28.2 (Ph-***C***H_2-***C***H_2-CH_2-N). **IR** (ATR, cm^{-1}): 3050 – 2750 (OH, br), 3021 (=CH), 2937, 2827 (-CH), 1652 (C=N), 1601, 1495 (C=C, arom.), 942 (N-O), 740 and 700 cm^{-1} (out of plane), mp. 111 °C.

4-[(2,6-Dichloro-benzyloxyimino)-methyl]-1-(3-phenyl-propyl)-piperidinium hydrochloride (53)

Yield: 0.51 g (40 %). $C_{22}H_{27}Cl_3N_2O$ (412.5 g/mol); **^{1}H NMR** (d_6-DMSO, δ ppm, J = Hz): 10.28 (1 H, br, NH^+), 7.50 – 7.18 (9 H, HC=N, 8 H arom.), 5.23 (2 H, s, CH_2-O), 3.58 – 3.38 (2 H, m, 2-H_{eq}, 6-H_{eq}), 3.00 – 2.80 (4 H, m, Ph-CH_2-CH_2-C***H₂***-N, 2-H_{ax}, 6-H_{ax}), 2.61 (2 H, t, J = 7.6, Ph-C***H₂***-CH_2-CH_2-N), 2.41 – 2.37 (1 H, m, 4-H), 2.00 – 1.68 (6 H, m, 3-H, 5-H, Ph-CH_2-C***H₂***-CH_2-N). **^{13}C NMR** (d_6-DMSO, δ = ppm): 153.0 (C=N), 140.5 (C-1'), 136.1 (C-2'', C-6''), 132.0 (C-1''), 131.2 (C-4''), 128.6, 128.4, 128.2 (C-2', C-3', C-5', C-6', C-3'', C-5''), 126.1 (C-4'), 69.4 (CH_2-O), 55.6 (Ph-CH_2-CH_2-***C***H_2-N), 50.9 (C-2, C-6), 33.8 (C-4), 32.0 (Ph-***C***H_2-CH_2-CH_2-N), 26.0 (C-3, C-5), 24.8 (Ph-CH_2-***C***H_2-CH_2-N^+). **IR** (ATR, cm^{-1}): 2910 (-CH), 2512 (NH^+) 1715 (C=N), 1599 and 1563 (C=C, arom.), 1021 (C-O), 931 (N-O), 777, 767, 753 and 698 cm^{-1} (out of plane), Mp.: 198 °C (dec).

Analytical Data

Entry		C Calc found	H Calc found	N Calc found
3	$C_{19}H_{19}N_3O_5$	61.8	5.18	11.4
	(369.4 g/mol)	61.6	5.22	11.3
4	$C_{20}H_{21}N_3O_5$	62.6	5.08	7.3
	(369.4 g/mol)	62.7	5.02	7.4
5	$C_{23}H_{27}N_3O_7$	60.4	5.95	9.2
	(457.5 g/mol)	60.6	6.12	9.0
6	$C_{23}H_{25}N_3O_7$	60.7	5.53	9.2
	(455.5 g/mol)	60.5	5.74	9.5
7	$C_{23}H_{25}N_3O_7$	60.7	5.53	9.2
	(455.5 g/mol)	60.9	5.27	9.0
8	$C_{25}H_{24}N_4O_5$	65.2	5.25	12.2
	(460.5 g/mol)	65.5	5.07	12.1
9	$C_{26}H_{25}N_3O_5$	68.0	5.48	9.1
	(459.5 g/mol)	67.8	5.19	9.4
10	$C_{24}H_{23}N_3O_9$	58.0	4.66	8.5
	(497.5 g/mol)	57.8	4.89	8.3
11	$C_{26}H_{27}N_3O_9$,	59.4	5.18	8.0
	525.5 g/mol	59.7	5.09	7.8
12	$C_{28}H_{25}N_3O_9$	61.4	4.60	7.7
	(547.6 g/mol)	61.1	4.33	7.5
13	$C_{30}H_{29}N_3O_9$	62.6	5.08	7.3
	(575.7 g/mol)	62.8	5.29	7.6
14	$C_{28}H_{24}N_3O_9Cl$	57.8	4.16	7.2
	(582.0 g/mol)	57.6	3.98	7.4
15	$C_{29}H_{27}N_3O_{10}$	60.3	4.71	7.3
	(577.5 g/mol)	60.1	4.98	7.1
16	$C_{29}H_{27}N_3O_9$	62.0	4.85	7.5
	(561.6 g/mol)	61.8	4.99	7.7
17	$C_{28}H_{25}N_3O_9$	61.4	4.60	7.7
	(547.5 g/mol)	61.7	4.58	7.6
18	$C_{24}H_{25}NO_5$	70.8	6.18	3.4
	(407.5 g/mol)	70.9	6.34	3.5
33	$C_{15}H_{19}N_3O_2$	65.9	7.01	15.4
	(273.3 g/mol)	65.7	6.98	15.6
34	$C_{18}H_{25}N_3O_2$	68.5	7.99	13.3
	(315.4 g/mol)	68.3	7.69	13.6
35	$C_{19}H_{27}N_3O_2$	69.3	8.26	12.8
	(329.5 g/mol)	69.1	8.46	12.6
36	$C_{21}H_{31}N_3O_2$	70.6	8.74	11.8
	(357.5 g/mol)	70.4	8.58	11.6
37	$C_{18}H_{25}N_3O_3$	65.2	7.60	12.7
	(331.4 g/mol)	65.4	7.44	12.5

38	$C_{24}H_{29}N_3O_2$	73.6	7.47	10.7
	(391.5 g/mol),	73.7	7.66	10.5
39	$C_{23}H_{26}N_4O_4$	65.4	6.20	13.3
	(422.5 g/mol)	65.6	6.04	13.1
40	$C_{25}H_{31}N_3O_2$	74.0	7.70	10.4
	(405.5 g/mol)	73.8	7.54	10.7
41	$C_{26}H_{33}N_3O_2$	74.4	7.93	10.0
	(419.6 g/mol)	74.2	7.99	9.9
44	$C_{24}H_{29}N_3O_2$	73.6	7.47	10.7
	(391.5 g/mol)	73.4	7.74	10.6
45	$C_{31}H_{34}N_4O_4$	70.7	6.51	10.6
	(526.6 g/mol)	70.5	6.69	10.7
47	$C_{20}H_{23}N_3O$	74.7	7.21	13.1
	(321.4 g/mol)	74.4	7.45	13.0
48	$C_{14}H_{20}N_2O$	72.4	8.68	12.1
	(232.3 g/mol))	72.2	8.96	12.0
49	$C_{21}H_{24}N_2OCl_2$	64.5	6.18	7.2
	(391.3 g/mol)	64.7	6.01	7.3
52	$C_{15}H_{22}N_2O$	73.1	9.00	11.4
	(246.4 g/mol)	72.9	8.88	11.7
53	$C_{22}H_{27}Cl_3N_2O$	59.8	6.16	6.3
	(412.5 g/mol)	59.9	6.27	6.5