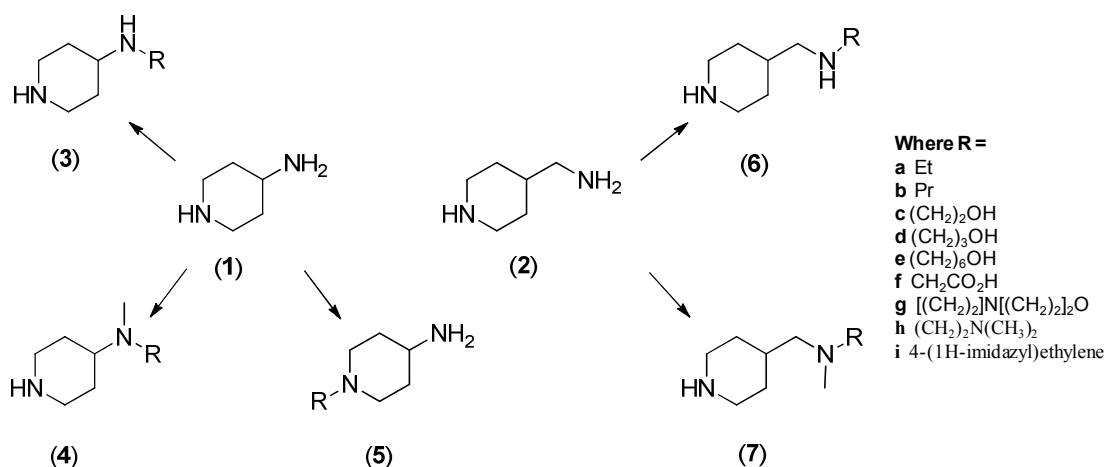


## 1 Supporting information

### 2 S 1. Designer amine synthesis

3 Thirty designer amines in **Figure S1**, as derivatives of 4-aminopiperidine (**1**) or 4-  
4 (aminomethyl)piperidine (**2**), were synthesised via different methods and their chemical  
5 structures identified using  $^1\text{H}$  and  $^{13}\text{C}$  NMR spectroscopy and mass spectroscopy (Burk Av  
6 400). The structure identities of the target amine products were also confirmed by accurate  
7 mass measurements which were carried out using Electro-spray Ionization (ESI) on a Thermo  
8 Q Exactive spectrometer. The chemicals used in synthesis were purchased from various  
9 commercial suppliers including Sigma Aldrich, Strem Chemicals and Oakwood and used  
10 without further purification.

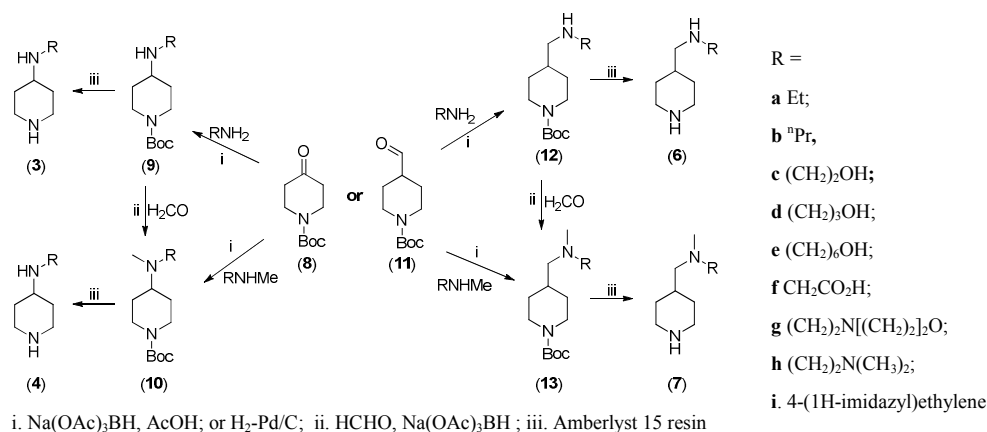


12 **Figure S1.** Designer amines and their subgroups

13 Designer amines of Subgroups (**3**), (**4**), (**6**) and (**7**) were synthesised using reductive  
14 amination followed by Boc-deprotection (**Figure S2**). *tert*-Butyl 4-oxopiperide-carboxylate  
15 (**8**) reacted with primary or secondary amines followed by the reduction using sodium  
16 triacetoxyborohydride ( $\text{Na}(\text{OAc})_3\text{BH}$ )<sup>1</sup> or catalytic hydrogenation<sup>2</sup> in the same reaction pot  
17 gave the corresponding Boc-protected precursors, (**9**) and (**10**). Compound (**10**) was also able  
18 to be made from (**9**) via a methylation with methyl halides<sup>3,4</sup> or via a reductive amination  
19 with formaldehyde<sup>2</sup> if the corresponding secondary amine required in Step i is not readily  
20 available. The same synthetic methods are applicable to the preparation of Compounds (**12**)  
21 and (**13**) from *tert*-butyl 4-formylpiperdine-1-carboxylate (**11**). These synthetic methods  
22 (Steps i and ii in **Figure S2**) are presented in the experimental section (Methods I to IV). To  
23 obtain the target amines (**3**), (**4**), (**6**) and (**7**) in **Figure S2**, the Boc protecting group of  
24 Compounds (**9**), (**10**), (**12**) and (**13**) were removed using Amberlyst 15 ion-exchange resins.<sup>5</sup>

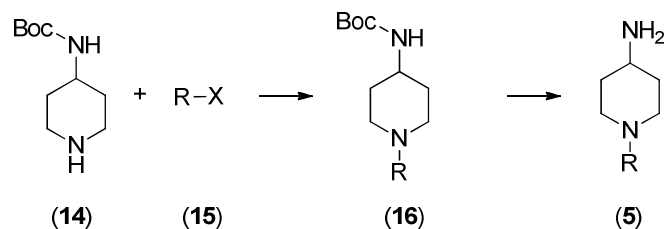
25 Modification was made to this method in the de-Boc process of amino-acid precursors by  
 26 using trimethylamine and water as eluent rather than dimethylamine and methanol to prevent  
 27 unwanted reactions between the eluent and amino acids.

28



29 **Figure S2.** Synthesis of Amines (3), (4), (6) and (7) via reductive amination

30 The amines of subgroup (5) were prepared via two methods and the first one is via  
 31 alkylation of *tert*-butyl piperidin-4-ylcarbamate (14) followed by Boc-deprotection<sup>3</sup>. As  
 32 displayed in **Figure S3**, Compound (14) reacted with alkyl halide (15) (X = Cl or Br) to form  
 33 a hydrohalide salt of the precursor (16). After removal of hydrohalide via an aqueous work-  
 34 up with base, Compound (16) was ready for Boc deprotection to generate Amine (5) using  
 35 ion-exchange resin as described above.

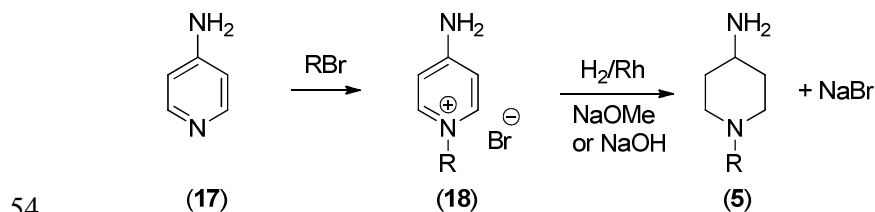


36

37 **Figure S3.** Synthesis of Amine 5 via N-Alkylation Reaction

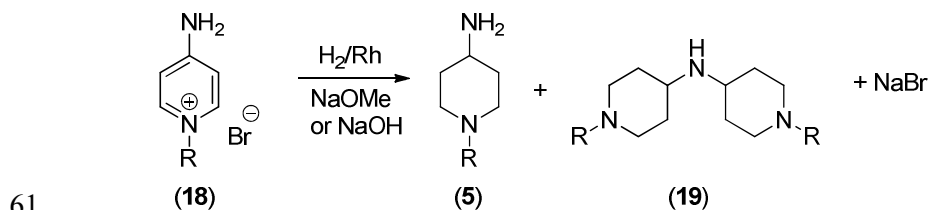
38 An alternative synthetic route is displayed in (**Figure S4**). Quaternization of 4-  
 39 aminopyridine (17) with corresponding alkyl halides gives 4-aminopyridinium salts (18)  
 40 which are able to be reduced by sodium borohydride or via hydrogenation to 1-substituted-4-  
 41 aminopiperidine (5).<sup>6,7,8</sup> Both toluene and isopropanol were reported as sole solvents for the  
 42 preparation of 4-amino-1-alkylpyridium salts, (18) which precipitated upon cooling of the  
 43 reaction mixture at the end of reaction. However, reproducibility of this process using toluene  
 44 as the solvent was found to be problematic for the synthesis at larger scales in the synthesis of

45 Compound **(18c)** ( $R = (\text{CH}_2)_2\text{OH}$ ); often the product formed as a soft lump in the hot reaction  
 46 mixture, encasing a large quantity of starting material, which formed a solid cake when the  
 47 mixture was cooled to room temperature at the end of the reaction, preventing the reaction  
 48 from going to completion. The same reaction using isopropanol as the solvent achieved  
 49 completion and yielded the product as crystals. However, further crystallisation of the mother  
 50 liquor was needed to get a second or even third crop of the product due to the increased  
 51 solubility of the product in isopropanol. It was found that by utilising a mixed solvent of  
 52 isopropanol in toluene (25%, when  $R = \text{}^n\text{Pr}$  and 30%,  $R = (\text{CH}_2)_2\text{OH}$ ) both products were  
 53 obtained as pure solids in excellent yields without further crystallisation.



55 **Figure S4.** Synthesis of Amine (5) via hydrogenation

56 To make Amine (5), the pyridinium salt (18) was reduced via hydrogenation catalysed  
 57 by rhodium on charcoal **Figure S4**. In this hydrogenation, sodium methoxide or sodium  
 58 hydroxide was used to minimize the formation of byproduct (19) (**Figure S5**).<sup>7</sup> The  
 59 hydrogenation proceeded well at a temperature range between 40°C to 60°C while higher  
 60 reaction temperatures caused more byproduct to be formed.



62 **Figure S5.** Product and byproduct in hydrogenation

63 The synthetic methods for each amine subgroup in **Figure S1** are given in the  
 64 experimental section below either as general description of or represented by an example.  
 65 The characterisation of the final amine products by  $^1\text{H}$  and  $^{13}\text{C}$  NMR and accurate mass  
 66 spectroscopy are listed in **Table S2**. The obtained cyclic capacity results of these amines,  
 67 Compounds (1) and (2) and MEA are presented in **Table S1**. The calculated percentage  
 68 improvements in cyclic capacity and energy performance of each amine versus MEA  
 69 (Equations 13 and 14 in the main manuscript text) are also displayed in this table.

70 **Table S1.** Cyclic capacity and energy performance of amines

Compound	Cyclic capacity		% Improvement in cyclic capacity		% Improvement in energy performance relative to PZ
	mol CO <sub>2</sub> / mol N	g CO <sub>2</sub> / g amine	mol CO <sub>2</sub> / mol N	g CO <sub>2</sub> / g amine	
PZ	0.075	0.077	0.00	0.00	0.00
<b>1</b>	0.135	0.120	80.00	56.62	32.92
<b>2</b>	0.100	0.080	33.33	4.41	19.11
<b>3a</b>	0.220	0.151	193.33	97.07	49.69
<b>3c</b>	0.245	0.150	226.67	95.13	52.89
<b>3d</b>	0.170	0.095	126.67	23.39	40.31
<b>3e</b>	0.235	0.103	213.33	34.74	51.53
<b>3g</b>	0.120	0.074	60.00	-3.09	44.58
<b>3h</b>	0.177	0.136	135.56	77.70	55.55
<b>4a</b>	0.215	0.133	186.67	73.60	48.71
<b>4c</b>	0.140	0.078	86.67	1.61	35.65
<b>4d</b>	0.180	0.092	140.00	20.01	43.48
<b>4e</b>	0.220	0.090	193.33	17.88	50.69
<b>5a</b>	0.230	0.158	206.67	106.02	51.41
<b>5b</b>	0.240	0.148	220.00	93.79	52.53
<b>5c</b>	0.225	0.137	200.00	79.20	51.14
<b>5d</b>	0.175	0.097	133.33	27.10	44.01
<b>5e</b>	0.280	0.123	273.33	60.54	55.94
<b>5f</b>	0.105	0.058	40.00	-23.77	21.68
<b>5f-K</b>	0.135	0.061	80.00	-21.01	33.67
<b>5i</b>	0.107	0.073	42.22	-4.43	38.51
<b>6a</b>	0.226	0.140	201.33	82.49	50.76
<b>6c</b>	0.177	0.098	136.00	28.47	44.03
<b>6e</b>	0.195	0.080	100.00	4.49	47.26
<b>6f</b>	0.106	0.054	41.33	-29.27	16.07
<b>6f-K</b>	0.145	0.061	93.33	-20.82	36.80
<b>6g</b>	0.101	0.058	34.22	-23.72	39.49
<b>6h</b>	0.193	0.138	157.78	79.74	57.38
<b>7a</b>	0.262	0.148	249.33	92.56	54.89
<b>7c</b>	0.220	0.112	193.33	46.68	49.70
<b>7f</b>	0.120	0.056	59.33	-26.29	30.37
<b>7f-K</b>	0.190	0.075	153.33	-2.73	46.80

7h	0.147	0.098	96.44	27.33	51.39
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71

72 *Section 2 - Experimental*

73 Method I - syntheses of precursors (9), (10), (12) and (13) via reductive amination using  
 74 Na(OAc)<sub>3</sub>BH (Figure S2, Step i)

75 Sodium triacetoxyborohydride, Na(OAc)<sub>3</sub>BH (Strem Chemicals) (60 mmol) was added  
 76 in portions to a stirring solution of *tert*-Butyl 4-oxopiperide-carboxylate (**8**) or *tert*-butyl 4-  
 77 formylpiperidine-1-carboxylate (**11**) (30 mmol), acetic acid (30 mmole) and corresponding  
 78 amine, RNH<sub>2</sub> or RNHMe, (30 mmole) in dichloromethane (60 mL). The reaction was stirred  
 79 under nitrogen at room temperature for 18 hours. The reaction was quenched by the careful  
 80 addition of H<sub>2</sub>O or 1 M NaOH (60 mL). The mixture was adjusted to basic (>pH 10) by the  
 81 careful addition of solid NaOH and stirred for 15-30 minutes. The organic phase was  
 82 separated and the aqueous phase extracted with dichloromethane (2 x 60 mL). The combined  
 83 organic phase was washed with H<sub>2</sub>O (2 x 60 mL) and dried by K<sub>2</sub>CO<sub>3</sub> or filtration through  
 84 phase separation paper. Removal of the solvent under vacuum gave the products of (**9**), (**10**),  
 85 (**12**) and (**13**) respectively to the used reagents in excellent yields. The products were used for  
 86 Boc-deprotection without further purification.

87 Note: One equivalent of triethylamine (Et<sub>3</sub>N) instead of AcOH is used if amine  
 88 hydrochloride salt is used in the reaction.

89 Method II - Methylation via reductive amination using formaldehyde (Figure S2, Step ii)<sup>2</sup>

90 **1-Boc-4-[ethyl(methyl)amino]piperidine 10b** Aqueous formaldehyde (~37%, 17.7  
 91 mL, ~220 mmol) was added to a stirring solution of 1-Boc-4-ethylaminopiperidine (**9b**) (10g,  
 92 44 mmol), Acetic acid (65 mL, 1.14 mol), and Na(OAc)<sub>3</sub>BH (28 g, 132 mmol) in  
 93 dichloromethane (290 mL). The solution was stirred at room temperature for 18 hours, then  
 94 quenched by the addition of NaOH (1 M, 200 mL) and made basic (>pH 10) by the careful  
 95 addition of solid NaOH. The phases were allowed to separate and the aqueous phase was  
 96 extracted with dichloromethane (2 x 150 mL). The combined organic extracts were washed  
 97 with H<sub>2</sub>O (200 mL) and saturated NaCl (200 mL), filtered through phase separation filter  
 98 paper and evaporated to dryness to yield the desired target as a clear oil (10.3 g, 97%).

99 Method III –Sequential Reductive Amination (Two steps in one pot) (Figure S2, Steps i/ii)

100           **1-Boc-[4-(3-hydroxypropyl)(methyl)amino]piperidine (10d)** Na(OAc)<sub>3</sub>BH (3.2g,  
101 15mmol) was added in portions to a stirring solution of *tert*-Butyl 4-oxopiperide-carboxylate  
102 (**8**) (1.5 g, 7.5 mmol) , acetic acid (0.43 mL, 7.5 mmol) and propanolamine (0.58 mL, 7.5  
103 mmol) in dichloromethane (15 mL). The reaction was stirred under nitrogen at room  
104 temperature over night. After confirming the completeness of step 1 using <sup>1</sup>H NMR analysis,  
105 the reaction was diluted with dichloromethane (85 mL) then additional Na(OAc)<sub>3</sub>BH (4.8 g,  
106 22.5 mmol) and AcOH (10 mL) were added followed by aqueous formaldehyde (~37% in  
107 H<sub>2</sub>O, 3.1 mL). The reaction was stirred under N<sub>2</sub> for 18 hours at room temperature. The  
108 reaction was quenched by the addition of NaOH (1 M, 50 mL). The mixture was adjusted to  
109 basic (>pH 10) by the careful addition of solid NaOH. The solution was allowed to stir for  
110 15-30 minutes, then the organic phase was separated and aqueous phase extracted with DCM  
111 (2 x 30 mL). The combined organic phase was washed with H<sub>2</sub>O (30 mL) and saturated NaCl  
112 (30 mL), dried by filtration through phase separation paper and evaporated to dryness to give  
113 the desired target as a clear oil (2.0g, 98%).

114 General Method IV – reductive amination via hydrogenation (Figure S2, Step i.)

115           **1-Boc-4-[(6-hydroxyhexyl-amino)methyl]piperidine (Amine 12e)** Hexanolamine  
116 (3.52 g, 30 mmol) was added to a solution of 1-Boc-piperidine-4-carboxaldehyde (**11**) (6.4 g,  
117 30 mmol) in EtOH (40 mL) followed by 10% Pd/C (50% in H<sub>2</sub>O, 0.3 g). Hydrogenation  
118 proceeded at 40 psi until gas uptake ceased (~2h). The reaction mixture was filtered through  
119 celite and evaporated to dryness. The residue was dissolved in DCM (50 mL) and washed  
120 with H<sub>2</sub>O to remove residual hexanolamine. The organic phase was filtered through phase  
121 separation paper and evaporated to dryness to yield (**12e**) as a pale yellow oil (8.05 g, 85%).

122           Compounds (**12a**), (**12c**), (**12f**) and (**12h**) were also prepared in excellent yields using  
123 this method.

124           Note: One equivalent of triethylamine is also added if the amine HCl salt was used in  
125 the reaction.

126 General Method V – Alkylation with Alkyl Halides (Figure S3)

127           ***tert*-Butyl (1-propylpiperidin-4-yl)carbamate (16b)** Bromopropane (12.7 mL, 140  
128 mmol) was added to a stirring suspension of 4-(Boc-amino)-piperidine (**14**) (14 g, 70 mmol)  
129 and K<sub>2</sub>CO<sub>3</sub> (77g, 560mmol) in acetonitrile (300 mL). The reaction mixture was heated at  
130 reflux for 5 hours and then cooled to room temperature. K<sub>2</sub>CO<sub>3</sub> was removed by filtration and  
131 the filtrate concentrated under vacuum. The residue was dissolved in dichloromethane (100

132 mL) and water (100 mL) was added. The mixture was stirred and adjusted to >pH 10 with  
133 NaOH. The phases were allowed to separate and the aqueous phase extracted with DCM (2 x  
134 100 mL). The combined organic phase was washed with H<sub>2</sub>O (2 x 100 mL) and sat NaCl  
135 (100 mL), dried by filtration through phase separation filter paper and evaporated to dryness  
136 to yield (**16b**) as a pale yellow solid (13.7g, 80%).

137 Compounds (**16a**), (**16e**), (**16f**) and (**16i**) were also made by this method. Small  
138 quantity of KI was added if the alkylchloride was used in the reaction.

139 General method VI - Boc-Deprotection via ion-exchange resin5

140 Amberlyst 15 resin (~4.7mmol/g, 5eq of resin per N; ie 10:1 for diamines and 15:1 for  
141 tri-amines) was added to the Boc-protected precursor (**9**, **10**, **12**, **13**, or **16**) dissolved in THF  
142 (enough to cover the resin, ~1.3mL/g of resin). The mixture was heated at gentle reflux  
143 overnight without stirring. After confirming all amine was bound to resin (<sup>1</sup>H NMR analysis  
144 of the supernatant), the resin was transferred to a glass column, drained, and washed with  
145 THF (1 bed volume), eluting dropwise.

146 The amine was released from the resin using 2 M MeNH<sub>2</sub>/EtOH (1 eq MeNH<sub>2</sub> to the  
147 resin, diluted from 8 M solution to give a 2 M solution) and further washed with EtOH (1 bed  
148 volume). Evaporation of the combined ethanolic fractions to dryness gave the free amine in  
149 quantitative or near quantitative yields.

150 The resin was regenerated / activated by placing in a glass column and eluting dropwise  
151 with 3 M HCl<sub>(aq)</sub> (≥1 eq with respect to resin active sites), water (1-2 bed volumes), MeOH (1  
152 bed volume), and DCM (1 bed volume). The regenerated / activated resin was dried under a  
153 stream of N<sub>2</sub> or vacuum.

154 NOTE: for amino acids the MeNH<sub>2</sub>/EtOH was replaced with Me<sub>3</sub>N/H<sub>2</sub>O

155 General method VII - Boc-Deprotection via TFA

156 **6-(4-Aminopiperid-1-yl)hexan-1-ol (Amine 3e)** Trifluoroacetic acid (44mL) was  
157 added to 1-Boc-4-hexanolaminopiperidine (**9e**) (22 g, 73 mmol), stirred at room temperature  
158 for 1.5 h then evaporated to dryness. The resulting TFA salt was treated with 20%  
159 HCl/MeOH (220 mL) for 30 minutes then evaporated to dryness.

160 NaOH (10 M, 22 mL) was added to the 4-hexanolaminopiperidine hydrochloride in  
161 H<sub>2</sub>O (10 mL) and cooled in an ice-bath, the solution was warmed to room temperature, stirred  
162 for 1h then evaporated to dryness. The residue was mixed with diethyl ether / isopropanol

163 (2:1, 45mL) and stirred overnight at room temperature. The precipitated sodium chloride was  
164 filtered off and the filtrate evaporated to dryness. Analysis by  $^{23}\text{Na}$  NMR spectroscopy  
165 indicated the continued presence of sodium chloride. The procedure was repeated with  
166 diethyl ether / isopropanol (4:1, 50 mL;  $\text{Na}_2\text{SO}_4$  was also added to remove any residual  $\text{H}_2\text{O}$   
167 and further decrease the solubility of the sodium chloride in the solvent). The process was  
168 repeated until no Na was observed by  $^{23}\text{Na}$  NMR analysis to yield the desired target, salt free  
169 as a golden oil which solidified on standing (10.5g, 72%).

170 General Method VIII – Amine 5 via hydrogenation of pyridinium halide (Figure S4)<sup>6-7-8</sup>

171 **4-Amino-1-(2-hydroxyethyl)pyridinium bromide (18c)** 2-hydroxyethylene bromide  
172 (9.1 mL, 128 mmol) was added to a solution of 4-aminopyridine (**17**) (10 g, 106 mmol) in  
173 toluene (260 mL). The reaction was heated at reflux for 3.5 hours with stirring and then  
174 cooled to room temperature. The oil that formed during reflux solidified upon cooling with  
175 vigorous stirring to form a suspension. The suspension was filtered and the solid washed with  
176 toluene. The product (**18c**) (22.7 g, 98% yield) was obtained as a pale brown solid.

177 **4-Amino-1-(2-hydroxyethyl)piperidine (5c)** Sodium (1.3 g, 56 mmol) was added  
178 slowly to cold MeOH (50 mL) with stirring under nitrogen. The prepared mixture of  
179 NaOMe/MeOH was transferred to an autoclave and the pyridium bromide salt (**18c**) (11.1 g,  
180 51 mmol) obtained from the above reaction added to the reaction mixture followed by 5%  
181 rhodium on charcoal (1.1 g, 10% w/w). The reaction was processed under a hydrogen  
182 atmosphere (140 psi) at 60°C over night. The reaction mixture was filtered through Celite and  
183 washed with MeOH (100 mL).

184 The filtrate was concentrated under vacuum to dryness to confirm complete recovery.  
185 The residue was redissolved in MeOH (150 mL) and poured over Amberlyst 15 resin (106 g,  
186 50 mmol). The mixture was heated at gentle reflux without stirring overnight. After  
187 confirming all amine was bound to resin ( $^1\text{H}$  NMR analysis of the supernatant), the resin was  
188 transferred to a column and washed with MeOH (150 mL). The amine was released from the  
189 resin using 2 M  $\text{MeNH}_2/\text{EtOH}$  (1 eq  $\text{MeNH}_2$  to the resin, diluted from 8 M solution to give a  
190 2 M solution) and further washed with EtOH (1 bed volume). Removal of the solvent of the  
191 combined ethanolic fractions gave 5.04g of clear golden oil (69 %). Analysis of  $^1\text{H}$  and  $^{23}\text{Na}$   
192 NMR showed the desired product (**5**) free from sodium salt.

193 A fractional distillation was also studied and it was potentially better way to achieve  
194 higher yield and more pure product. The product was collected at 122°C/1.0 mbar.

195 **Table S2.** Synthesised amines – preparative methods, yields\* and NMR/MS analyses

Amine	Methods	Yields (%)	Accurate MS	NMR $\delta$ (ppm) (in d <sub>4</sub> -methanol unless addressed)	
				<sup>1</sup> H NMR	<sup>13</sup> C NMR
<b>3a</b>	I VI	97 78	C <sub>7</sub> H <sub>16</sub> N <sub>2</sub> [M+H] <sup>+</sup> Cal. 129.1386 Meas. 129.1387	3.01 (br d, J=12.8Hz, 2H), 2.62 (q, J=7.3Hz, 2H), 2.57-2.49 (m, 3H), 1.86 (m, 2H), 1.22 (ddd, J=24.1, 12.4, 4.0 Hz, 2H), 1.09 (t, J=7.2Hz, 3H).	56.1 (CH), 46.0 (2xCH <sub>2</sub> ), 41.2 (CH <sub>2</sub> ), 33.9 (2xCH <sub>2</sub> ), 14.9 (CH <sub>3</sub> ).
<b>3b</b>	I VI	95 68	C <sub>8</sub> H <sub>18</sub> N <sub>2</sub> [M+H] <sup>+</sup> Cal. 143.1543 Meas. 143.1543	3.01 (br d, J=12.5Hz, 2H), 2.58-2.47 (m, 5H), 1.86 (br d, J=12.8Hz, 2H), 1.49 (sextet, J=7.4Hz, 2H), 1.22(ddd, J=24.0, 12.5, 3.7Hz, 2H), 0.91, (t, J=7.4Hz, 3H).	56.3 (CH), 49.3 (CH <sub>2</sub> ), 46.0 (2xCH <sub>2</sub> ), 33.9 (2xCH <sub>2</sub> ), 23.8 (CH <sub>2</sub> ), 12.1 (CH <sub>3</sub> )
<b>3c</b>	I VI	94 96	C <sub>7</sub> H <sub>16</sub> N <sub>2</sub> O [M+H] <sup>+</sup> Cal. 145.1335 Meas. 145.1335	3.65 (t, J=5.6Hz, 2H), 3.05 (br dt, J=12.9, 3.1Hz, 2H), 2.73 (t, J=5.6Hz, 2H), 2.57 (td, J=12.7, 2.7Hz, 2H), 2.57, 1H overlapped; 1.90 (br d, J=12.8Hz, 2H), 1.27 (ddd, J=23.9, 12.6, 4.2Hz, 2H).	61.7 (CH <sub>2</sub> ), 56.1 (CH), 48.8 (CH <sub>2</sub> ), 45.9 (2xCH <sub>2</sub> ), 33.9 (2xCH <sub>2</sub> )
<b>3d</b>	I VI	93 99	C <sub>8</sub> H <sub>18</sub> N <sub>2</sub> O [M+H] <sup>+</sup> Cal. 159.1492 Meas. 159.1492	3.63 (t, J=6.2Hz, 2H), 3.07-2.98 (m, 2H), 2.70 (t, J=7.3Hz, 2H), 2.60-2.49 (m, 3H), 1.94-1.85 (m, 2H), 1.75-1.66 (m, 2H), 1.31-1.18 (m, 2H).	61.7 (CH <sub>2</sub> ), 56.3 (CH), 46.0 (2xCH <sub>2</sub> ), 44.6(CH <sub>2</sub> ), 33.8(2xCH <sub>2</sub> ), 33.3 (CH <sub>2</sub> )
<b>3e</b>	I VII	97 81	C <sub>11</sub> H <sub>24</sub> N <sub>2</sub> O [M+H] <sup>+</sup> Cal. 201.1961 Meas. 201.1962	3.54 (t, J=6.6Hz, 2H), 3.02 (m, 2H), 2.62-2.49 (m, 5H), 1.80-1.88 (m, 2H), 1.58-1.46 (m, 4H), 1.44-1.32 (m, 4H), 1.24 (ddd, J= 24.0, 12.4, 3.8 Hz, 2H).	62.9 (CH <sub>2</sub> ), 56.2 (CH), 47.2 (CH <sub>2</sub> ), 45.9 (2xCH <sub>2</sub> ), 33.6 (CH <sub>2</sub> ), 33.5 (2x CH <sub>2</sub> ), 30.6 (CH <sub>2</sub> ), 28.3 (CH <sub>2</sub> ), 26.9 (CH <sub>2</sub> )
<b>3f</b>	I VI	90*	C <sub>7</sub> H <sub>15</sub> N <sub>2</sub> O <sub>2</sub> [M+H] <sup>+</sup> Cal.159.1128 Meas. 159.1128	(D <sub>2</sub> O) 3.27 (br d, J=12.8Hz, 2H), 3.11 (s, 2H), 2.83 (br t, J=12.8Hz, 2H), 2.71 (m, 1H), 1.97 (br d, J=13.2Hz, 2H), 1.38 (m, 2H).	178.4 (C=O), 51.8 (CH), 48.8 (CH <sub>2</sub> ), 43.0 (2xCH <sub>2</sub> ), 28.3 (2xCH <sub>2</sub> )
<b>3g</b>	I VI	97*	C <sub>11</sub> H <sub>23</sub> N <sub>3</sub> O [M+H] <sup>+</sup> Cal. 214.1914 Meas. 214.1914	3.68 (br t, J=4.7 Hz, 4H), 3.06-2.99 (m, 2H), 2.73 (t, J=6.6 Hz, 2H), 2.60-5.51 (m, 3H), 2.51-2.43 (m, 6H), 1.92-1.85 (m, 2H), 1.25 (ddd, J= 24.0, 12.4, 4.0 Hz, 2H)	67.8 (CH <sub>2</sub> ), 58.9 (CH <sub>2</sub> ), 56.3 (CH), 54.8 (CH <sub>2</sub> ), 45.9 (2xCH <sub>2</sub> ), 43.3 (CH <sub>2</sub> ), 34.0 (2xCH <sub>2</sub> )
<b>3h</b>	I VI	97 96	C <sub>9</sub> H <sub>21</sub> N <sub>3</sub> [M+H] <sup>+</sup> Cal. 172.1808 Meas. 172.1808	3.09-2.98 (m, 2H), 2.72 (t, J=6.8Hz, 2H), 2.64-2.51 (m, 3H), 2.46 (t, J=6.9Hz, 2H), 2.25 (s, 6H), 1.94-1.86 (m, 2H), 1.26 (ddd, J= 23.9, 12.3, 4.1Hz, 2H)	59.7 (CH <sub>2</sub> ), 56.3 (CH), 45.9 (2xCH <sub>2</sub> ), 45.7 (2xCH <sub>3</sub> ), 44.4 (CH <sub>2</sub> ), 33.9 (2xCH <sub>2</sub> )
<b>3i</b>	I VI	77*	C <sub>10</sub> H <sub>18</sub> N <sub>4</sub> [M+H] <sup>+</sup> Cal. 195.1604 Meas. 195.1605	7.57 (d, 1.2Hz, 1H), 6.83 (br s, 1H), 3.08-2.98 (m, 2H), 2.02-2.82 (m, 2H), 2.80-2.71 (m, 2H), 2.64-2.50 (m, 3H), 1.94-1.84 (m, 2H), 1.24 (ddd J=23.7, 12.4, 4.0Hz, 2H).	136.5 (C), 136.2 (CH), 117.8 (CH), 55.9 (CH), 46.8 (CH <sub>2</sub> ), 45.7 (2xCH <sub>2</sub> ), 33.5 (2xCH <sub>2</sub> ), 27.9 (CH <sub>2</sub> )
<b>4a</b>	I II VI	97 97 80	C <sub>8</sub> H <sub>18</sub> N <sub>2</sub> [M+H] <sup>+</sup> Cal. 143.1543 Meas. 143.1543	7.57 (d, 1.2Hz, 1H), 6.83 (br s, 1H), 3.08-2.98 (m, 2H), 2.02-2.82 (m, 2H), 2.80-2.71 (m, 2H), 2.64-2.50 (m, 3H), 1.94-1.84 (m, 2H), 1.24 (ddd J=23.7, 12.4, 4.0Hz, 2H).	61.6 (CH), 48.1 (CH <sub>2</sub> ), 46.7 (2xCH <sub>2</sub> ), 37.1 (CH <sub>3</sub> ), 29.4 (2xCH <sub>2</sub> ), 12.3 (CH <sub>3</sub> )
<b>4c</b>	I VI	98 99	C <sub>8</sub> H <sub>18</sub> N <sub>2</sub> O [M+H] <sup>+</sup> Cal. 159.1492 Meas. 159.1492	3.60 (t, J=6.3Hz, 2H), 3.07 (br d, J=12.6Hz, 2H), 2.60 (t, J=6.3Hz, 2H), 2.58-2.47 (m, 3H), 2.28 (s, 3H), 1.78 (br d, J=12.7Hz, 2H), 1.42 (ddd, J=24.5, 12.4, 3.9Hz, 2H).	62.6 (CH), 60.6 (CH <sub>2</sub> ), 56.1 (CH <sub>2</sub> ), 46.6 (2xCH <sub>2</sub> ), 38.4 (CH <sub>3</sub> ), 29.4 (2xCH <sub>2</sub> )
<b>4d</b>	I II VI	-- 98 98	C <sub>8</sub> H <sub>20</sub> N <sub>2</sub> O [M+H] <sup>+</sup> Cal. 173.1648 Meas. 173.1648	3.59 (t, J=6.2Hz, 2H), 3.05 (br d, J=12.3Hz, 2H), 2.61-2.47 (m, 5H), 2.25 (s, 3H), 1.77 (br d, J=13.2Hz, 2H), 1.72-1.64 (m, 2H), 1.42 (ddd, J=24.7, 12.5, 4.2 z, 2H).	62.2 (CH), 62.1 (CH <sub>2</sub> ), 52.0 (CH <sub>2</sub> ), 46.7 (2xCH <sub>2</sub> ), 37.8 (CH <sub>3</sub> ), 30.6 (CH <sub>2</sub> ), 29.4 (2xCH <sub>2</sub> )
<b>4e</b>	I II VI	96*	C <sub>12</sub> H <sub>26</sub> N <sub>2</sub> O [M+H] <sup>+</sup> Cal. 215.2118 Meas. 215.2118	3.52 (t, J=6.6Hz, 2H), 3.05 (br d, J=12.5Hz, 2H), 2.56-2.42 (m, 5H), 2.24 (s, 3H), 1.80-1.73 (m, 2H), 1.56-1.26 (m, 10 H).	62.8 (CH <sub>2</sub> ), 62.0 (CH), 54.5 (CH <sub>2</sub> ), 46.7 (2xCH <sub>2</sub> ), 37.9 (CH <sub>3</sub> ), 33.6 (CH <sub>2</sub> ), 29.4 (2xCH <sub>2</sub> ), 28.6 (CH <sub>2</sub> ), 28.1 (CH <sub>2</sub> ), 26.9 (CH <sub>2</sub> )
<b>5a</b>	III VI	67 83	C <sub>7</sub> H <sub>16</sub> N <sub>2</sub> [M+H] <sup>+</sup> Cal. 129.1386 Meas. 129.1387	2.91 (br d, J=12.5 Hz, 2H), 2.59 (m, 1H), 2.39 (q, J=7.3Hz, 2H), 1.99 (td J=12.1, 2.4 Hz, 2H), 1.81 (br d, J=13.4Hz, 2H), 1.38 (m, 2H), 1.07 (t, J=7.3Hz, 3H).	53.2 (CH <sub>2</sub> ), 53.1 (2xCH <sub>2</sub> ), 49.5 (CH), 35.5 (2xCH <sub>2</sub> ), 12.0 (CH <sub>3</sub> )
<b>5b</b>	III/VI or	80/92	C <sub>8</sub> H <sub>18</sub> N <sub>2</sub> [M+H] <sup>+</sup> Cal. 143.1543 Meas. 143.1543	2.89 (br d, J=12Hz, 2H), 2.58 (m, 1H), 2.28 (m, 2H), 2.00 (td, J=12.0, 2.4 Hz, 2H), 1.84-1.76 (m, 2H), 1.55-1.46 (m, 2H), 1.38(ddd, J=24.0, 12.8, 3.6 Hz, 2H), 0.89, (t, J=7.5Hz, 3H).	61.8 (CH <sub>2</sub> ), 53.6 (2xCH <sub>2</sub> ), 49.5 (CH), 35.5 (2xCH <sub>2</sub> ), 20.8 (CH <sub>2</sub> ), 12.3 (CH <sub>3</sub> )
<b>5c</b>	IV/VI	95/69	C <sub>7</sub> H <sub>16</sub> N <sub>2</sub> O	3.67 (t, J= 6.2Hz, 2H), 2.93(br d, J=11.9Hz, 2H),	61.3 (CH <sub>2</sub> ), 60.1 (CH <sub>2</sub> ),

	or		[M+H] <sup>+</sup> <i>Cal. 145.1335</i> Meas. 145.1336	2.66-2.56 (m, 1H), 2.52 (t, J=6.3Hz, 2H), 2.17-2.06 (m, 2H), 1.82 (br d, J=12.8Hz, 2H), 1.49-1.34 (m, 2H).	54.0 (2xCH <sub>2</sub> ), 49.4 (CH), 35.5 (2xCH <sub>2</sub> )
<b>5d</b>	IV VI	97 84	C <sub>8</sub> H <sub>18</sub> N <sub>2</sub> O [M+H] <sup>+</sup> <i>Cal. 159.1492</i> Meas. 159.1492	3.58 (t, J=6.2Hz, 2H), 2.91 (br d, J=12.4Hz, 2H), 2.60 (m, 1H), 2.44 (t, J=7.9Hz, 2H), 2.02 (m, 2H), 1.81 (br d, J=13.0Hz, 2H), 1.71 (m, 2H), 1.37 (m, 2H).	62.0 (CH <sub>2</sub> ), 57.0 (CH <sub>2</sub> ), 53.6 (2xCH <sub>2</sub> ), 49.4 (CH), 35.6 (2xCH <sub>2</sub> ), 30.3 (CH <sub>2</sub> )
<b>5e</b>	III VI	70 100	C <sub>11</sub> H <sub>24</sub> N <sub>2</sub> O [M+H] <sup>+</sup> <i>Cal. 201.1961</i> Meas. 201.1962	3.57 (t, J=6.6Hz, 2H), 2.95 (br d, J=12.3Hz, 2H), 2.66 (m, 1H), 2.37 (m, 2H), 2.06 (td, J=12.3, 2.6, 2H), 1.86 (br d, J=12.6Hz, 2H), 1.61-1.51 (m, 4H), 1.50-1.32 (m, 6H).	62.9 (CH <sub>2</sub> ), 59.7 (CH <sub>2</sub> ), 53.6 (2xCH <sub>2</sub> ), 49.2 (CH), 35.5 (2xCH <sub>2</sub> ), 33.5 (CH <sub>2</sub> ), 28.6 (CH <sub>2</sub> ), 27.7 (CH <sub>2</sub> ), 26.8 (CH <sub>2</sub> )
<b>5f</b>	III VI	98 100	C <sub>7</sub> H <sub>14</sub> N <sub>2</sub> O <sub>2</sub> [M+H] <sup>+</sup> <i>Cal. 159.1128</i> Meas. 159.1128 [M+Na] <sup>+</sup> <i>Cal. 181.0947</i> Meas. 181.0947	(D <sub>2</sub> O) 3.17 (br s, 1H) 3.15-3.05 (m, 3H), 2.54-2.40 (m, 2H), 2.08-1.94 (m, 2H), 1.73-1.56 (m, 2H).	175.8 (C=O), 60.5 (CH <sub>2</sub> ), 51.0 (2xCH <sub>2</sub> ), 47.3 (CH), 29.7 (2xCH <sub>2</sub> )
<b>5i</b>	III VI	81 85	C <sub>10</sub> H <sub>18</sub> N <sub>4</sub> [M+H] <sup>+</sup> <i>Cal. 195.1604</i> Meas. 195.1605	7.55 (d, J=1.2Hz, 1H), 6.81 (br d, J=0.8Hz, 1H), 3.05-2.92 (m, 2H), 2.83-2.74 (m, 2H), 2.69-2.56 (m, 2H), 2.12 (td, 12.2Hz, 2H), 1.89-1.77 (m, 2H), 1.49-1.36 (m, 2H)	136.5 (C), 136.0 (CH), 117.7 (CH), 59.5 (CH <sub>2</sub> ), 53.6 (2xCH <sub>2</sub> ), 49.3 (CH), 35.4 (2xCH <sub>2</sub> ), 25.3 (CH <sub>2</sub> )
<b>6a</b>	IV VI	91 99	C <sub>8</sub> H <sub>18</sub> N <sub>2</sub> [M+H] <sup>+</sup> <i>Cal. 143.1543</i> Meas. 143.1543	2.99 (dt, J=12.3, 3.0Hz, 2H), 2.58 (q, J=7.2Hz, 2H), 2.54 (td, J=12.4, 2.6Hz, 2H), 2.41 (d J=6.8Hz, 2H), 1.70 (m, 2H), 1.60 (m, 1H), 1.16-1.05 (m, 2H), 1.09 (t, J=7.2Hz, 3H).	56.9 (CH <sub>2</sub> ), 46.9 (2xCH <sub>2</sub> ), 45.0 (CH <sub>2</sub> ), 37.2 (CH), 32.1 (2xCH <sub>2</sub> ), 14.7 (CH <sub>3</sub> )
<b>6c</b>	IV VI	87 100	C <sub>8</sub> H <sub>18</sub> N <sub>2</sub> O [M+H] <sup>+</sup> <i>Cal. 159.1492</i> Meas. 159.1492	3.63 (t, J=5.7Hz, 2H), 3.00 (br d, J=12.2Hz, 2H), 2.67 (t, J=5.7Hz, 2H), 2.54 (td, J=12.4, 2.7Hz, 2H), 2.45 (d, J=6.8Hz, 2H), 1.71 (m, 2H), 1.61 (m, 1H), 1.11 (ddd, J=24.2, 12.4, 3.9Hz, 2H).	61.5 (CH <sub>2</sub> ), 56.9 (CH <sub>2</sub> ), 52.5 (CH <sub>2</sub> ), 46.8 (2xCH <sub>2</sub> ), 37.2 (CH), 32.0 (2xCH <sub>2</sub> )
<b>6e</b>	IV V	85 100	C <sub>12</sub> H <sub>26</sub> N <sub>2</sub> O [M+H] <sup>+</sup> <i>Cal. 215.2118</i> Meas. 215.2118	3.58 (t, J=6.7Hz, 2H), 3.05 (br d, J=12.4Hz, 2H), 2.64-2.55 (m, 4H), 2.47 (d, J=6.7Hz, 2H), 1.75 (m, 2H), 1.65 (m, 1H), 1.61-1.52 (m, 4H), 1.47-1.34 (m, 4H), 1.15 (ddd, J=24.4, 12.3, 3.9Hz, 2H).	62.9 (CH <sub>2</sub> ), 57.1 (CH <sub>2</sub> ), 51.0 (CH <sub>2</sub> ), 46.8 (2xCH <sub>2</sub> ), 37.1 (CH), 33.6 (CH <sub>2</sub> ), 32.1 (2xCH <sub>2</sub> ), 30.4 (CH <sub>2</sub> ), 28.3 (CH <sub>2</sub> ), 26.9 (CH <sub>2</sub> )
<b>6f</b>	IV V	88 94	C <sub>8</sub> H <sub>16</sub> N <sub>2</sub> O <sub>2</sub> [M+H] <sup>+</sup> <i>Cal. 173.1285</i> Meas. 173.1284	(D <sub>2</sub> O) 3.25 (br d, J=12.8Hz, 2H), 3.05 (s, 2H), 2.82 (td, J=12.8, 3.0Hz, 2H), 2.40 (d, J=6.8Hz, 2H), 1.87-1.79 (m, 2H), 1.76-1.64 (m, 1H), 1.25 (m, 2H).	178.7 (C=O), 53.4 (CH <sub>2</sub> ), 52.1 (CH <sub>2</sub> ), 43.9 (2xCH <sub>2</sub> ), 33.2 (CH), 26.9 (2xCH <sub>2</sub> )
<b>6g</b>	IV V	97*	C <sub>12</sub> H <sub>24</sub> N <sub>3</sub> O [M+H] <sup>+</sup> <i>Cal. 228.2076</i> Meas. 228.2071	3.73-3.62 (m, 4H), 3.08-2.96 (m, 2H), 2.69 (t, J=6.5Hz, 2H), 2.57 (td, J=12.5, 2.8Hz, 2H), 2.52-2.41 (m, 8H), 1.72 (br d, J=13.3Hz, 2H), 1.68-1.54 (m, 1H), 1.13 (ddd, J= 24.9, 12.5, 3.9Hz, 2H)	67.8 (CH <sub>2</sub> ), 58.7 (CH <sub>2</sub> ), 57.1 (CH <sub>2</sub> ), 54.9 (CH <sub>2</sub> ), 46.82 (CH <sub>2</sub> ), 46.79 (2xCH <sub>2</sub> ), 37.2 (CH), 32.0 (2xCH <sub>2</sub> )
<b>6h</b>	IV V	95*	C <sub>10</sub> H <sub>23</sub> N <sub>3</sub> [M+H] <sup>+</sup> <i>Cal. 186.1970</i> Meas. 186.1965	3.00 (m, 2H), 2.66 (t, J=7.2Hz, 2H), 2.55 (td, J=12.3, 2.2Hz, 2H), 2.47-2.42 (m, 4H), 2.23 (s, 6H), 1.71 (br d, J=13.0Hz, 2H), 1.67-1.54 (m, 1H), 1.11 (m, 2H).	59.5(CH <sub>2</sub> ), 57.2(CH <sub>2</sub> ), 48.0 (CH <sub>2</sub> ), 46.8 (2xCH <sub>2</sub> ), 45.7 (2xCH <sub>2</sub> ), 37.2 (CH), 32.0 (2xCH <sub>2</sub> )
<b>7a</b>	I V	90 97	C <sub>9</sub> H <sub>20</sub> N <sub>2</sub> [M+H] <sup>+</sup> <i>Cal. 157.1699</i> Meas. 157.1699	3.04 (td, J=12.3, 3.0Hz, 2H), 2.60 (dt, J=12.3, 2.7Hz, 2H), 2.45 (q, J=7.3Hz, 2H), 2.23 (s, 3H), 2.22 (2H, overlapped), 1.77 (m, 2H), 1.68(m, 1H), 1.14 (m, 2H), 1.09 (t, J=7.2Hz, 3H).	65.1 (CH <sub>2</sub> ), 52.9 (CH <sub>2</sub> ), 46.9 (2xCH <sub>2</sub> ), 42.7 (CH <sub>3</sub> ), 35.2 (CH), 32.6 (2xCH <sub>2</sub> ), 11.9 (CH <sub>3</sub> )
<b>7c</b>	I V	93*	C <sub>9</sub> H <sub>20</sub> N <sub>2</sub> O [M+H] <sup>+</sup> <i>Cal. 173.1648</i> Meas. 173.1649	(CDCl <sub>3</sub> ) 3.52, 2H, td b, J <sub>1</sub> 5.4 Hz, J <sub>2</sub> 0.8Hz; 3.03, 2H, d b, J <sub>1</sub> 2.1 Hz; 2.55, 2H, t b, J <sub>1</sub> 2.2 Hz; 2.46, 2H, td b, J <sub>1</sub> 5.5 Hz, J <sub>2</sub> 1.1 Hz; 2.19, 3H, s; 2.21-2.17, 2H overlapped; 1.69, 2H, d b, J <sub>1</sub> 2.8 Hz; 1.57, 1H, m; 1.02, 2H, ddd, J <sub>1</sub> 24.4 Hz, J <sub>2</sub> 12.3 Hz, J <sub>3</sub> 3.8 Hz.	64.7 (CH <sub>2</sub> ), 59.4 (CH <sub>2</sub> ), 58.4 (CH <sub>2</sub> ), 46.6 (2xCH <sub>2</sub> ), 42.2 (CH <sub>3</sub> ), 34.6 (CH), 32.1 (2xCH <sub>2</sub> )
<b>7f</b>	I V	78*	C <sub>9</sub> H <sub>18</sub> N <sub>2</sub> O <sub>2</sub> [M+H] <sup>+</sup> <i>Cal. 187.1441</i> Meas. 187.1441 [M+Na] <sup>+</sup> <i>Cal. 209.1260</i> Meas. 209.1261	(D <sub>2</sub> O) 3.45-3.35 (m, 2H), 3.13 (br s, 2H), 3.03-2.91 (m, 2H), 2.53-2.45 (m, 2H) 2.36 (br s, 3H), 2.06-1.95 (m, 2H), 1.95-1.83 (m, 1H) 1.46-1.30 (m, 2H)	177.8 (C=O), 61.8 (CH <sub>2</sub> ), 60.8 (CH <sub>2</sub> ), 43.9 (2xCH <sub>2</sub> ), 42.3 (CH <sub>3</sub> ), 31.1 (CH), 27.3 (2xCH <sub>2</sub> )
<b>7h</b>	I V	88 98	C <sub>11</sub> H <sub>25</sub> N <sub>3</sub> [M+H] <sup>+</sup> <i>Cal. 200.2121</i> Meas. 200.2122	3.05-2.95 (m, 2H), 2.55 (dt, J=12.4, 2.5Hz, 2H), 2.51-2.40 (m, 4H), 2.25 (s, 6H), 2.21 (s, 3H), 2.19 (d overlapped, J=7.2Hz, 2H), 1.74 (br d, J=13.3Hz, 2H), 1.70-1.55 (m, 1H), 1.08 (ddd, J=24.7, 12.1, 3.9Hz, 2H)	66.2 (CH <sub>2</sub> ), 57.8 (CH <sub>2</sub> ), 56.9 (CH <sub>2</sub> ), 46.9 (2xCH <sub>2</sub> ), 45.8 (2xCH <sub>2</sub> ), 43.5 (CH <sub>3</sub> ), 35.4 (CH), 32.5 (2xCH <sub>2</sub> )

196 \*Refer to **Error! Reference source not found.** for Amine Subgroups (3) to (7); R = a. Et; b. <sup>n</sup>Pr; c. (CH<sub>2</sub>)<sub>2</sub>OH;  
197 d. (CH<sub>2</sub>)<sub>3</sub>OH; e. (CH<sub>2</sub>)<sub>6</sub>OH; f. CH<sub>2</sub>CO<sub>2</sub>H; g. (CH<sub>2</sub>)<sub>2</sub>N[(CH<sub>2</sub>)<sub>2</sub>]<sub>2</sub>O; h. (CH<sub>2</sub>)<sub>2</sub>N(CH<sub>3</sub>)<sub>2</sub>; i. 4-(1H-imidazolyl)ethylene

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