

## **Mannich synthesis of acetylenic amino alcohols in aqueous ionic liquids**

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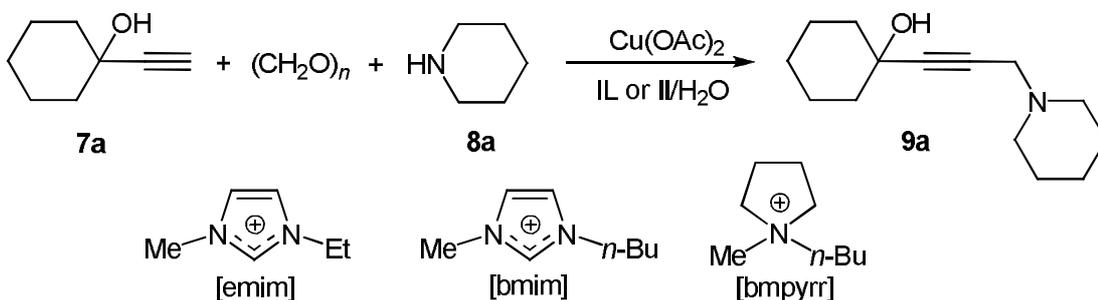
### **General Remarks**

The  $^1\text{H}$  NMR spectra were recorded with a Bruker AM-300 (300.13 MHz) spectrometer in  $\text{CDCl}_3$ , chemical shifts are given relative to  $\text{Me}_4\text{Si}$ . The IR spectra were recorded in KBr pellets on a Specord M-82. Microanalysis was carried out on a Perkin-Elmer 2400. The reactions were monitored by TLC (Silicagel or aluminium oxide plates from Merck KGaA; eluent: hexane, hexane/ethyl acetate, visualization by  $\text{I}_2$  or UV). Ionic liquids were supplied by Merck KGaA, Germany. Specific optical rotations  $[\alpha]_{\text{D}}^{t, \text{C}}$  were measured with a Jasco DIP-360 polarimeter at 589 nm.

### **Typical procedure**

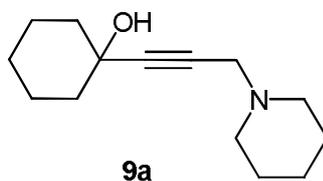
A mixture of hydroxyalkylacetylene **7** (1.0 mmol), secondary amine **8** (1.2 mmol), paraformaldehyde (0.10 g, 3.0 mmol),  $\text{Cu}(\text{OAc})_2$  (0.05 g, 0.3 mmol), IL (3.0 mmol) and corresponding amount of water was stirred under the conditions specified in Tables 1 and 2. The reaction mixture was extracted with  $\text{Et}_2\text{O}$  (3 x 5 ml). The combined extracts were passed through a silica gel or neutral (Brockman)  $\text{Al}_2\text{O}_3$  pad, the solvent was evaporated *in vacuo* (15 Torr) and the residue was crystallized or purified by column chromatography on silica gel (Acros, 40–60 mm, eluent petrol ether -  $\text{Et}_2\text{O}$  –  $\text{EtOAc}$ ). Fresh starting compounds **7**, **8** and  $(\text{CH}_2\text{O})_n$  were added to the recycled catalytic system which remained in the vessel after extraction of the products. The reaction was performed again according to the conditions specified in the Table 2.

**Table 1S** Conditions for interaction between compounds **7a**, **8a** and CH<sub>2</sub>O in ILs and in [emim]HSO<sub>4</sub>–water solvent systems.

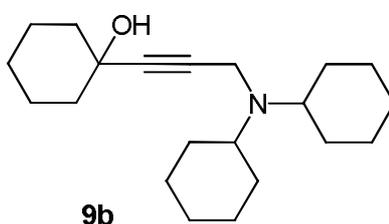


Entry	IL	T, °C	τ, h	Yield of <b>9a</b> (%)
1	[emim]BF <sub>4</sub> <sup>-</sup>	20	5	70
2	[emim]BF <sub>4</sub> <sup>-</sup>	30	2.5	70
3	[bmim]BF <sub>4</sub> <sup>-</sup>	30	3.5	75
4	[bmpirr]CF <sub>3</sub> SO <sub>3</sub> <sup>-</sup>	30	2	72
5	[bmpirr](CF <sub>3</sub> SO <sub>2</sub> ) <sub>2</sub> N <sup>-</sup>	30	2	72
6	[bmim]PF <sub>6</sub> <sup>-</sup>	30	2	70
7	[bmim]CF <sub>3</sub> SO <sub>3</sub> <sup>-</sup>	30	1.5	80
8	[emim]CF <sub>3</sub> SO <sub>3</sub> <sup>-</sup>	30	1.5	80
9	[emim]HSO <sub>4</sub> <sup>-</sup>	50	5	65
10	[emim]HSO <sub>4</sub> <sup>-</sup> – H <sub>2</sub> O (3:1 w/w)	40	3	74
11	[emim]HSO <sub>4</sub> <sup>-</sup> – H <sub>2</sub> O (2:1 w/w)	40	3	80
12	[emim]HSO <sub>4</sub> <sup>-</sup> – H <sub>2</sub> O (1:1 w/w)	50	4	73

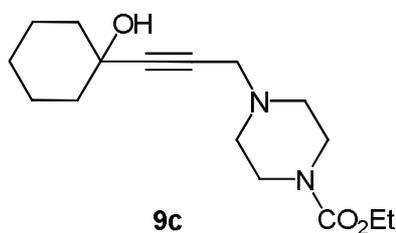
## Characterization of compounds 9a-u



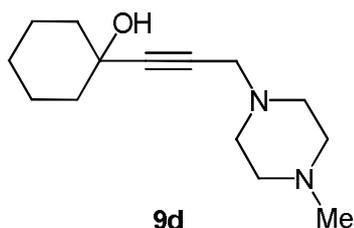
**1-[3-(Piperidin-1-yl)prop-1-ynyl]cyclohexanol (9a).** Pale-yellow oil, 0.19 g (85%),  $^1\text{H NMR } \delta$ : 3.32 (s, 2H,  $\equiv\text{CCH}_2$ ); 2.40–2.60 (m, 4 H, N- $\text{CH}_2$ -piperidine); 1.40–2.00 (m, 17 H, C- $\text{CH}_2$ -cyclohexane, piperidine, OH).



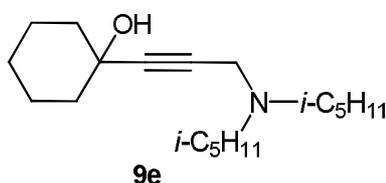
**1-[3-(Dicyclohexylamino)prop-1-ynyl]cyclohexanol (9b).** Oil, 0.27 g (85%),  $^1\text{H NMR } (J/\text{Hz})$   $\delta$ : 3.54 (s, 2H,  $\equiv\text{CCH}_2$ ); 2.78 (dt, 2 H, CH, 10.5, 3.1); 1.00–2.00 (m, 31 H,  $\text{CH}_2$ -cyclohexanes, OH). Found (%): C, 79.63; H 10.94; N 4.21. Calc. for  $\text{C}_{21}\text{H}_{35}\text{NO}$  (%): C 79.44; H 11.11; N 4.41.



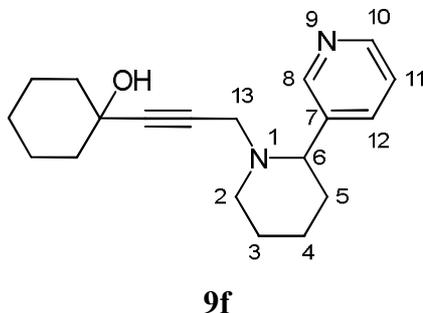
**Ethyl 4-[3-(1-hydroxycyclohexyl)prop-2-ynyl]piperazine-1-carboxylate (9c).** Oil, 0.24 g (80%), IR-spectrum,  $\nu$ ,  $\text{cm}^{-1}$ : 3305, 1720;  $^1\text{H NMR } (J/\text{Hz})$   $\delta$ : 4.12 (q, 2 H,  $\text{CH}_2\text{O}$ , 7.1); 3.51 and 2.50 (each t, 4 H, piperazine, 4.9); 3.36 (s, 2 H,  $\equiv\text{CCH}_2$ ); 2.27 (br. s, 1 H, OH); 1.40–1.95 (m, 10 H, cyclohexane); 1.25 (t, 3 H,  $\text{CH}_3$ , 7.1). Found (%): C, 65.28; H, 8.85; N, 10.02. Calc. for  $\text{C}_{16}\text{H}_{26}\text{N}_2\text{O}_3$  (%): C, 65.28; H, 8.90; N, 9.52.



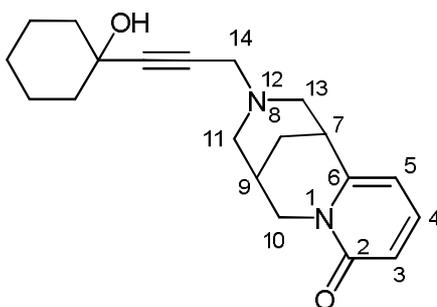
**1-[3-(4-Methylpiperazin-1-yl)prop-1-ynyl]cyclohexanol (9d).** Pale-yellow oil, 0.20 g (83%),  $^1\text{H NMR } \delta$ : 3.30 (s, 2 H,  $\equiv\text{CCH}_2$ ); 3.03 (br. s, 1 H, OH) 2.40–2.65 (m, 8 H, piperazine), 2.25 (s, 3 H,  $\text{CH}_3$ ); 1.10–1.90 (m, 10 H, cyclohexane). Found (%): C, 71.28; H, 10.15; N, 11.97. Calc. for  $\text{C}_{14}\text{H}_{24}\text{N}_2\text{O}$  (%): C, 71.14; H, 10.24; N, 11.85.



**1-(3-Diisopentylaminoprop-1-ynyl)cyclohexanol (9e).** Oil, 0.24 g (82%),  $^1\text{H NMR } (J/\text{Hz}) \delta$ : 3.45 (s, 2 H,  $\equiv\text{CCH}_2$ ); 2.50–2.42 (m, 4 H,  $\text{NCH}_2$ ); 2.18 (d, 2 H, CH, 7.3); 2.02 (br. s, 1 H, OH); 1.85–1.95 (m, 4 H, 2  $\text{CH}_2$ ); 1.20–1.75 (m, 10 H, cyclohexane); 0.90 (d, 12 H,  $\text{CH}_3$ , 6.8). Found (%): C, 77.63; H, 11.94; N, 4.91. Calc. for  $\text{C}_{19}\text{H}_{35}\text{NO}$  (%): C, 77.75; H, 12.02; N, 4.77.

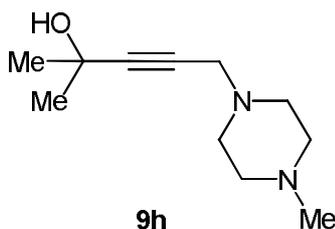


**1-{3-[2-(Pyridin-3-yl)piperidin-1-yl]prop-1-ynyl}cyclohexanol (9f).** Viscous oil, 0.21 g (87%),  $[\alpha]_{\text{D}}^{23} -198^\circ$  (c 1.0,  $\text{CHCl}_3$ ) [ref.<sup>1</sup>  $[\alpha]_{\text{D}}^{23} -187^\circ$  (c 0.49,  $\text{CHCl}_3$ )],  $^1\text{H NMR } (J/\text{Hz}) \delta$ : 8.60 (d, 1 H,  $\text{H}^8$  pyridine, 1.6); 8.50 (dd, 1 H,  $\text{H}^{10}$  pyridine, 4.7, 1.2); 7.72 (d, 1H,  $\text{H}^{12}$  pyridine, 7.9); 7.28 (t, 1 H,  $\text{H}^{11}$  pyridine, 6.4); 3.35 (dd, 1 H,  $\text{H}^5$  piperidine, 11.2, 2.8); 3.22 and 3.12 (both d, 2 H,  $\equiv\text{CCH}_2$ , 17.3); 2.95 (d, 1H,  $\text{H}^5$  piperidine, 11.2); 2.60 (dt, 1 H,  $\text{H}^6$  piperidine, 11.2, 3.6); 1.00–2.00 (m, 17 H,  $\text{CH}_2$ , cyclohexane, piperidine, OH)



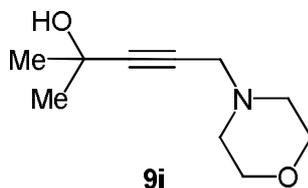
**9g**

**N-[3-(1-Hydroxycyclohexyl)prop-2-yn-1-yl]cytisine (9g).** Colorless crystals, mp 78–79 °C (from petrol ether), 0.20 g (85%),  $[\alpha]_D^{25} -124^\circ$  (c 0.62, CHCl<sub>3</sub>), <sup>1</sup>H NMR (*J*/Hz) δ: 7.25 (br. s, 1 H, H<sup>4</sup> cytisine); 6.45 (d, 1 H, H<sup>3</sup> cytisine, 8.6); 5.98 (d, 1 H, H<sup>5</sup> cytisine, 7.6); 4.05 (d, 1H, H<sup>10</sup> cytisine, 15.4); 3.9 (m, 1 H, H<sup>10</sup> cytisine); 3.22 (br. s, 2 H, ≡CCH<sub>2</sub>); 2.98 (br. s, 1 H, H<sup>9</sup> cytisine); 2.80 (t, 2 H, H<sup>11</sup> cytisine, 9.9); 2.62 (d, 2 H, H<sup>13</sup> cytisine, 11.7); 2.48 (br. s, 1 H, H<sup>7</sup> cytisine); 2.05 (br. s, 1 H, OH); 1.9 (d, 2H, H<sup>8</sup> cytisine, 13.1); 1.80 -1.1(m, 12 H, CH<sub>2</sub> cyclohexane). Found (%): C, 73.28; H, 8.12; N, 8.35. Calc. for C<sub>20</sub>H<sub>26</sub> N<sub>2</sub>O<sub>2</sub> (%): C, 73.59; H, 8.03; N, 8.58.



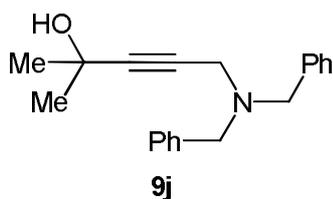
**9h**

**2-Methyl-5-(4-methylpiperazin-1-yl)pent-3-yn-2-ol (9h).** Pale-yellow oil, 0.17 g (86%), IR-spectrum,  $\nu$ , cm<sup>-1</sup>: 2200, 3280; <sup>1</sup>H NMR δ: 3.71 (br. s, 1 H, OH); 3.25 (s, 2 H, ≡CCH<sub>2</sub>); 2.30-2.65 (m, 8 H, piperazine); 2.22 (s, 3 H, NCH<sub>3</sub>); 1.44 (s, 6 H, C-CH<sub>3</sub>). Found (%): C, 66.98; H, 10.56; N, 14.65. Calc. for C<sub>11</sub>H<sub>20</sub> N<sub>2</sub>O (%): C 67.30; H 10.27; N 14.27.

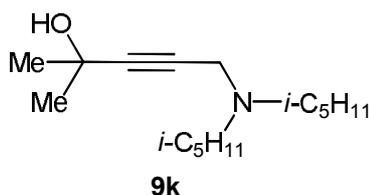


**9i**

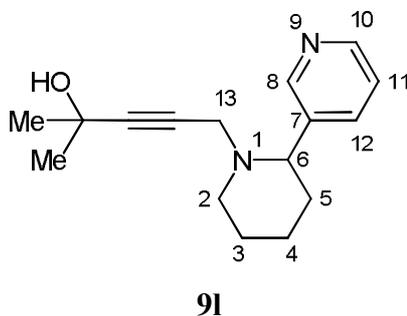
**2-Methyl-5-morpholinopent-3-yn-2-ol (9i).** Pale-yellow oil, 0.15 g (84%), IR-spectrum,  $\nu$ , cm<sup>-1</sup>: 2200, 3280; <sup>1</sup>H NMR (*J*/Hz) δ: 3.74 (t, 4 H, OCH<sub>2</sub>-morpholine, 7.0); 3.30 (s, 2 H, ≡CCH<sub>2</sub>); 2.55 (t, 4 H, NCH<sub>2</sub>-morpholine, 3.0); 2.17 (br. s, 1 H, OH); 1.53 (s, 6 H, CH<sub>3</sub>). Found (%): C, 64.98; H, 9.44; N, 7.55. Calc. for C<sub>10</sub>H<sub>17</sub>NO<sub>2</sub> (%): C, 65.54; H, 9.35; N, 7.64.



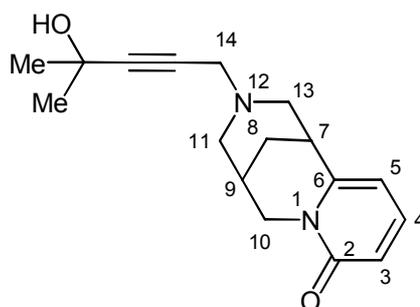
**5-Dibenzylamino-2-methylpent-3-yn-2-ol (9j).** Viscous oil, 0.51 g (90%), IR-spectrum,  $\nu$ ,  $\text{cm}^{-1}$ : 2200, 3280;  $^1\text{H NMR}$  ( $J/\text{Hz}$ )  $\delta$ : 7.17-7.50 (m, 10 H, Ph); 3.70 (s, 4 H,  $\text{CH}_2\text{Ph}$ ); 3.28 (s, 2 H,  $\equiv\text{CCH}_2$ ); 1.93 (br. s, 1 H, OH); 1.60 (s, 6 H, Me). Found (%): C, 81.48; H, 8.12; N, 4.89. Calc. for  $\text{C}_{20}\text{H}_{23}\text{NO}$  (%): C, 81.87; H, 7.90; N, 4.77.



**5-Diisopentylamino-2-methylpent-3-yn-2-ol (9k).** Pale-yellow oil, 0.18 g (72%), IR-spectrum,  $\nu$ ,  $\text{cm}^{-1}$ : 2200, 3280;  $^1\text{H NMR}$  ( $J/\text{Hz}$ )  $\delta$ : 3.32 (s, 2H,  $\equiv\text{CCH}_2$ ); 2.16 (d, 4 H,  $\text{NCH}_2$ , 7.0); 1.95 (br. s, 1 H, OH); 1.55-1.78 (m, 2 H, CH); 1.53 (s, 6 H, Me); 1.27 (s, 4 H,  $\text{CH}_2$ ); 0.87 (d, 12 H, Me, 6.0). Found (%): C, 75.95; H, 12.50; N, 5.48. Calc. for  $\text{C}_{16}\text{H}_{31}\text{NO}$  (%): C, 75.83; H, 12.33; N, 5.53.

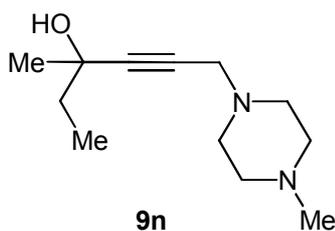


**2-Methyl-5-[2-(pyridin-3-yl)piperidin-1-yl]pent-3-yn-2-ol (9l).** Viscous oil, 0.11 g (73%),  $[\alpha]_{\text{D}}^{26}$   $-172^\circ$  (c 0.97,  $\text{CHCl}_3$ ) [Ref.<sup>1</sup>  $[\alpha]_{\text{D}}^{23}$   $-195^\circ$  (c 0.43,  $\text{CHCl}_3$ )], IR-spectrum,  $\nu$ ,  $\text{cm}^{-1}$ : 1715, 2205, 3280;  $^1\text{H NMR}$  ( $J/\text{Hz}$ )  $\delta$ : 8.60 (s, 1 H,  $\text{H}^8$  pyridine); 8.49 (d, 1 H,  $\text{H}^{10}$  pyridine, 1.7); 7.70 (d, 1 H,  $\text{H}^{12}$  pyridine, 7.7); 7.25 (m, 1 H,  $\text{H}^{11}$  pyridine,); 3.75 (br. s, 1 H, OH); 3.3 (dd, 1 H,  $\text{H}^5$  piperidine, 11.2, 2.4); 3.15 and 3.05 (both d, 2 H,  $\equiv\text{CCH}_2$ , 17.2); 2.95 (m, 1 H,  $\text{H}^5$  piperidine); 2.52 (dt, 1 H,  $\text{H}^6$  piperidine, 11.2, 2.4); 1.56-1.90 (m, 4 H,  $\text{CH}_2$  piperidine); 1.55 (s, 6 H, Me); 1.20-1.48 (m, 2 H,  $\text{CH}_2$  piperidine).



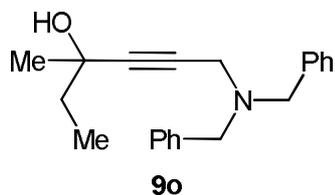
**9m**

***N*-(4-Hydroxy-4-methylpent-2-yn-1-yl)cytisine (9m)**. Colorless crystals, mp 146-147 °C (from petrol ether/EtOAc ~1:1), 0.14 g (80%),  $[\alpha]_D^{26}$  -155° (c 0.51, CHCl<sub>3</sub>), IR-spectrum,  $\nu$ , cm<sup>-1</sup>: 1715, 2205, 3280; <sup>1</sup>H NMR (*J*/Hz)  $\delta$ : 7.25 (t, 1 H, H<sup>4</sup> cytizine, 7.6); 6.45 (d, 1 H, H<sup>3</sup> cytizine, 8.5); 5.98 (d, 1 H H<sup>5</sup> cytizine, 6.6); 4.03 (d, 1 H, H<sup>10</sup> cytizine, 15.4); 3.9 (dd, 1 H, H<sup>10</sup> cytizine, 15.4, 6.6); 3.20 (d, 2 H,  $\equiv$ CCH<sub>2</sub>, 6.9); 2.98 (br. s, 1 H, H<sup>9</sup> cytizine); 2.88-2.70 (m, 2 H, H<sup>11</sup> cytizine); 2.59 (t, 2 H, H<sup>13</sup> cytizine, 9.0); 2.47 (s, 1 H, H<sup>7</sup> cytizine); 1.95 (d, 2 H, H<sup>8</sup> cytizine, 13.0); 1.65 (br. s, 1 H, OH); 1.50 (s, 6 H, Me) Found (%): C, 71.21; H, 7.76; N, 9.77. Calc. for C<sub>17</sub>H<sub>22</sub>N<sub>2</sub>O<sub>2</sub> (%): C, 71.30; H, 7.74; N, 9.78.



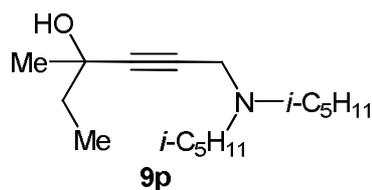
**9n**

**3-Methyl-6-(4-methylpiperazin-1-yl)hex-4-yn-3-ol (9n)**. Pale-yellow oil, 0.19 g (90%), IR-spectrum,  $\nu$ , cm<sup>-1</sup>: 2200, 3280; <sup>1</sup>H NMR (*J*/Hz)  $\delta$ : 3.28 (s, 2 H,  $\equiv$ CCH<sub>2</sub>); 2.95 (br. s, 1 H, OH); 2.35-2.65 (m, 8 H, NCH<sub>2</sub> piperazine); 2.25 (s, 3 H, NCH<sub>3</sub>); 1.65 (dq, 2 H,  $\underline{\text{C}}\text{H}_2\text{CH}_3$ , 7.4, 3.8); 1.42 (s, 3 H, Me); 0.98 (t, 3 H,  $\text{CH}_2\underline{\text{C}}\text{H}_3$ , 7.4). Found (%): C, 68.55; H, 10.50; N, 13.56. Calc. for C<sub>12</sub>H<sub>22</sub>N<sub>2</sub>O (%) : C, 68.53; H, 10.54; N, 13.32.

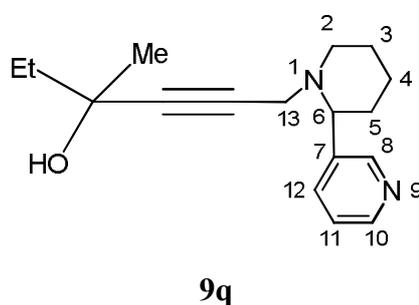


**9o**

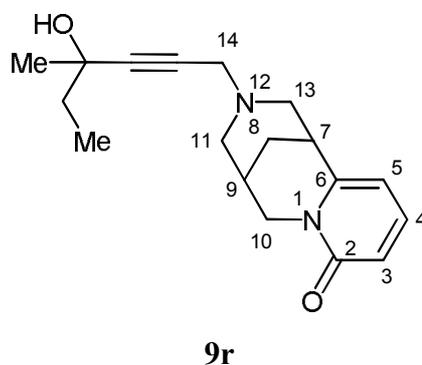
**6-Dibenzylamino-3-methylhex-4-yn-3-ol (9o)**. Viscous oil, 0.22 g (73%), IR-spectrum,  $\nu$ , cm<sup>-1</sup>: 2200, 3280; <sup>1</sup>H NMR (*J*/Hz)  $\delta$ : 7.17-7.50 (m, 10 H, Ph); 3.70 (s, 4 H,  $\underline{\text{C}}\text{H}_2\text{Ph}$ ); 3.30 (s, 2 H,  $\equiv$ CCH<sub>2</sub>); 2.0 (br. s, 1 H, OH); 1.60-1.88 (m, 2 H,  $\underline{\text{C}}\text{H}_2\text{CH}_3$ ); 1.55 (s, 3 H, Me); 1.12 (t, 3 H,  $\text{CH}_2\underline{\text{C}}\text{H}_3$ , 7.5). Found (%): C, 81.98; H, 8.31; N, 4.57. Calc. for C<sub>21</sub>H<sub>25</sub>NO (%) : C, 82.04; H, 8.20; N, 4.56.



**6-Diisopentylamino-3-methylhex-4-yn-3-ol (9p).** Pale-yellow oil, 0.18 g (87%), IR-spectrum,  $\nu$ ,  $\text{cm}^{-1}$ : 2200, 3280;  $^1\text{H NMR}$  ( $J/\text{Hz}$ )  $\delta$ : 3.35 (s, 2 H,  $\equiv\text{CCH}_2$ ); 2.17 (d, 4 H,  $\text{NCH}_2$ , 7.3); 1.90 (br. s, 1 H, OH); 1.58-1.75 (m, 6 H, CH,  $\text{CH}_2$ ); 1.47 (s, 3 H,  $\text{CH}_3$ ); 1.27-1.40 (m, 2 H,  $\text{CH}_2\text{CH}_3$ ); 1.05 (t, 3H,  $\text{CH}_2\text{CH}_3$ , 7.5); 0.89 (d, 12 H,  $\text{CH}_3$ , 6.6). Found (%): C, 76.25; H, 12.50; N, 5.48. Calc. for  $\text{C}_{17}\text{H}_{33}\text{NO}$  (%): C, 76.33; H, 12.44; N, 5.24.

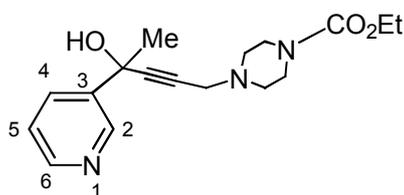


**3-Methyl-6-[2-(pyridin-3-yl)piperidin-1-yl]hex-4-yn-3-ol (9q).** Viscous oil, 0.22 g (80%),  $[\alpha]_{\text{D}}^{26}$   $-217^\circ$  (c 0.52,  $\text{CHCl}_3$ ) [Ref.<sup>1</sup>  $[\alpha]_{\text{D}}^{26}$   $-233^\circ$  (c 0.56,  $\text{CHCl}_3$ )], IR-spectrum,  $\nu$ ,  $\text{cm}^{-1}$ : 1715, 2205, 3280;  $^1\text{H NMR}$  ( $J/\text{Hz}$ )  $\delta$ : 8.60 (s, 1 H,  $\text{H}^8$  pyridine); 8.50 (d, 1 H,  $\text{H}^{10}$  pyridine, 1.7); 7.7 (d, 1 H,  $\text{H}^{12}$  pyridine, 7.7); 7.25 (m, 1 H,  $\text{H}^{11}$  pyridine,); 3.33 (dd, 1 H,  $\text{H}^5$  piperidine, 11.2, 2.4); 3.15 and 3.05 (both d, 2 H,  $\equiv\text{CCH}_2\text{N}$ , 17.2); 2.95 (d, 1 H,  $\text{H}^5$  piperidine, 11.2); 2.56 (dt, 1 H,  $\text{H}^6$  piperidine, 11.2, 2.4); 2.2 (br. s, 1 H, OH); 1.55-1.90 (m, 6 H,  $\text{CH}_2$  piperidine); 1.50 (s, 3 H,  $\text{CH}_3$ ); 1.27-1.40 (m, 2 H,  $\text{CH}_2\text{CH}_3$ ); 1.05 (t, 3H,  $\text{CH}_2\text{CH}_3$ , 7.5).



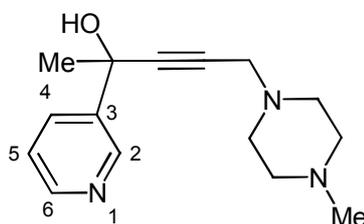
**N-(4-Hydroxy-4-methylhex-2-yn-1-yl)cytisine (9r).** Viscous oil, 0.25 g (83%),  $[\alpha]_{\text{D}}^{26}$   $-182^\circ$  (c 0.53,  $\text{CHCl}_3$ ), IR-spectrum,  $\nu$ ,  $\text{cm}^{-1}$ : 1715, 2205, 3280;  $^1\text{H NMR}$  ( $J/\text{Hz}$ )  $\delta$ : 7.25 (t, 1 H,  $\text{H}^4$  cytisine, 7.6); 6.42 (d, 1 H,  $\text{H}^3$  cytisine, 8.7); 5.98 (d, 1 H,  $\text{H}^5$  cytisine, 6.7); 4.03 (d, 1 H,  $\text{H}^{10}$

cytisine, 15.4); 3.90 (dd, 1 H, H<sup>10</sup> cytisine, 15.4, 6.6); 3.21 (d, 2 H,  $\equiv\text{CCH}_2\text{N}$ , 4.2); 2.97 (br. s, 1 H, H<sup>9</sup> cytisine); 2.8 (t, 2 H, H<sup>11</sup> cytisine, 11.6); 2.59 (m, 2 H, H<sup>13</sup> cytisine); 2.45 (s, 1 H, H<sup>7</sup> cytisine); 2.10 (br. s, 1 H, OH); 1.88 (d, 2 H, H<sup>8</sup> cytisine, 13.0); 1.80-1.60 (m, 2 H,  $\text{CH}_2\text{CH}_3$ ); 1.45 (s, 3H,  $\text{CH}_3$ ); 1.02 (t, 3H,  $\text{CH}_2\text{CH}_3$ , 7.4) Found (%): C, 71.67; H, 7.87; N, 9.26. Calc. for  $\text{C}_{18}\text{H}_{24}\text{N}_2\text{O}_2$  (%): C, 71.97; H, 8.05; N, 9.33.



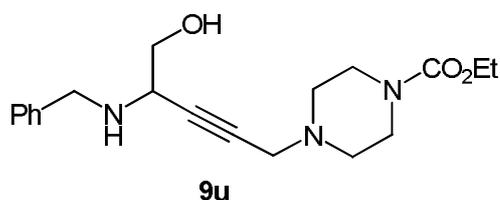
**9s**

**Ethyl 4-[4-hydroxy-4-(pyridin-3-yl)pent-2-ynyl]piperazine-1-carboxylate (9s).** Viscous oil, 0.24 g (76%), IR-spectrum,  $\nu$ ,  $\text{cm}^{-1}$ : 2200, 3280;  $^1\text{H}$  NMR ( $J/\text{Hz}$ )  $\delta$ : 8.9 and 8.5(both br. s, 2 H, H<sup>2</sup> and H<sup>6</sup> pyridine); 7.95 (d, 1 H, H<sup>4</sup> pyridine, 7.9); 7.25 (d, 1 H, H<sup>5</sup> pyridine, 5.0); 4.12 (q, 2 H,  $\text{CH}_2\text{O}$ , 7.1); 3.55 (br. s, 1 H, OH); 3.5 and 2.48 (both m, 8 H, piperazine); 3.35 (s, 2 H,  $\equiv\text{CCH}_2\text{N}$ ); 1.78 (s, 3 H,  $\text{CCH}_3$ ); 1.25 (t, 3 H,  $\text{CH}_2\text{CH}_3$ , 7.1). Found (%): C, 64.45; H, 7.29; N, 13.56. Calc. for  $\text{C}_{17}\text{H}_{23}\text{N}_3\text{O}_3$  (%): C, 64.33; H, 7.30; N, 13.24.



**9t**

**5-(4-Methylpiperazin-1-yl)-2-(pyridin-3-yl)pent-3-yn-2-ol (9t),** Viscous oil, 0.19 g (73%), IR-spectrum,  $\nu$ ,  $\text{cm}^{-1}$ : 2200, 3280;  $^1\text{H}$  NMR ( $J/\text{Hz}$ )  $\delta$ : 8.9 (d, 1 H, H<sup>2</sup> pyridine, 1.9); 8.48 (d, 1 H, H<sup>6</sup> pyridine, 2.9); 7.95 (d, 1 H, H<sup>4</sup> pyridine, 7.9); 7.25 (d, 1 H, H<sup>5</sup> pyridine, 5.0); 3.55 (br. s, 1H, OH); 3.40 (s, 2 H,  $\equiv\text{CCH}_2$ ); 2.28-2.75 (m, 8 H,  $\text{CH}_2$  piperazine); 2.25 (s, 3 H,  $\text{NCH}_3$ ); 1.75 (s, 3 H,  $\text{CCH}_3$ ). Found (%): C, 69.75; H, 8.19; N, 16.56. Calc. for  $\text{C}_{15}\text{H}_{21}\text{N}_3\text{O}$  (%): C, 69.47; H, 8.16; N, 16.20.



**9u**

**Ethyl 4-(4-benzylamino-5-hydroxypent-2-ynyl)piperazine-1-carboxylate (9u).** Pale-yellow oil, 0.24 g (69%), IR-spectrum,  $\nu$ ,  $\text{cm}^{-1}$ : 2200, 3280;  $^1\text{H}$  NMR ( $J/\text{Hz}$ )  $\delta$ : 7.20-7.41 (m, 5 H, Ph); 4.36 (dd, 1 H, CH, 11.9, 4.0); 4.12 (m, 4 H,  $\text{CH}_2\text{O}$ ); 3.75-3.90 (m, 2 H,  $\text{CH}_2\text{Ph}$ ); 3.35-3.60 (m, 6 H,  $\equiv\text{CCH}_2$ ,  $\text{CH}_2$  piperazine); 3.30 (s, 1 H, NH) 2.90 (br. s, 1 H, OH); 2.35-2.60 (m, 4 H,  $\text{CH}_2$  piperazine); 1.25 (t, 3 H,  $\text{CH}_2\text{CH}_3$ , 7.0). Found (%): C, 65.85; H, 8.09; N, 12.06. Calc. for  $\text{C}_{19}\text{H}_{27}\text{N}_3\text{O}_3$  (%): C, 66.06; H, 7.88; N, 12.16.

## References

1. M. V. Mavrov and S. G. Zlotin, *Izv. Akad. Nauk, Ser. Khim.*, 2007, 1576 (*Russ. Chem. Bull., Int. Ed.*, 2007, **56**, 1637).