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Synthesis of Substituted N-Alkylamines in Aqueous Media

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ABSTRACT

Synthesis of N-substituted aminopentanes based on the reaction of the amines with 1-brompentanes (*n*-and *iso*-structure) and amino (bis-amino) hydroxy compounds via opening reaction of epoxides with amines environmentally friendly practices in water medium has been developed. Structure of obtained compounds by elemental analysis and IR-, ^{1}H and ^{13}C NMR-spectroscopy were confirmed.

Keywords: N-Alkylamines; Ionic Liquids; Amino Alcohols; Antibacterial Properties

1. Introduction

Modern direction of chemistry and chemical technology includes the development of new, environmentally safe chemical processes. Currently, the synthesis of nitro compounds containing different functional groups environmentally friendly methods in "green" solvents such as ionic liquids or water has attracted special attention of researchers [1-5]. Water use has several advantages such as simplicity of implementation, low cost, high efficiency in many organic reactions involving water soluble substrates, fire safety. Improvement general methods of synthesis based on the available raw materials in aqueous medium are very relevant [6-8]. Substituted diamines were used for the synthesis of azacrown ethers [9], and polymers for special purposes [10], stable carbines [11], silylenes [12] and other stable ions. They are used as ligands in asymmetric synthesis of valuable synthetic and natural products [13] and also for the preparation of complexes with metals such as magnesium, copper, silver, palladium and platinum. The antitum or properties of physiologically active complexes of platinum (II) with diamines have been studied in detail and are widely used in medical practice [14].

2. Experimental

IR spectra of the compounds were recorded on a UR-20 spectrometer in the 4000 - 400 cm^{-1}. ^{1}H and ^{13}C NMR recorded on a Bruker-300 (300 MHz), solvent $CDCI_3$ and D_2O, chemical shifts are given relative to TMS. Mass-spectra were obtained on a mass spectrometer VG-7070E (ionizing voltage 70 eV). Chromatographic analysis of reaction mixtures and determination of purity of the synthesized compounds was performed on a chromatograph LXM MD-8, a glass column (2000 × 3 mm) (10%-Apiezon on Chromosorb G), carrier gas-helium (40 cm^3/min), katarometer, column temperature −150˚C, the evaporator −200˚C.

N-Pentylamines(III_{a-j}), Common methods of synthesis.

To a solution of 5 mmol of amines (I_{a-e}) in 5 - 7 ml of water was added 1 mmol 1-brom-pentane ($II_{a,b}$) and stirred at a given temperature (50˚C - 90˚C) for 6 - 9 h. The mixture was saturated by 10 g dry powder NaOH. The organic layer was separated, the aqueous layer extracted with ether. The organic layers were combined, dried over Na_2CO_3. After distillation of the solvent, the residue was distilled in a vacuum.

β-Aminoalcohols, Bis-aminopropane (VI_{a-c}, VII_{a-c}), General method of synthesis.

To a solution of 1.1 - 5 mmol amines (I_{a-c}) in 5 - 7 ml of water was added 1 mmol of epoxide (II or III) and stirred at a given temperature (50˚C - 90˚C) for 9 h. The mixture was saturated with 10 g of dry NaOH. The organic layer was separated, the aqueous layer extracted with ether. The organic layers combine, and dried. After distillation of the solvent, the residue was distilled in a vacuum.

N-Penthyldiethylamin(III_a), IR (ν, cm^{-1}): 2910 (CH_3), 2840 (CH_2), 1230 (CN). ^{1}H NMR (300 MHz, D_2O) δ: 0.9 - 1.2 d.d (9H, CH_3), 1.4 - 1.6 m (6H, CH_2), 2.45 m (2H, NCH_2), 2.6 q (4H, CH_2N). ^{13}C NMR (300 MHz, D_2O) δ: 12 (CH_3), 14 (CH_3), 22 (CH_2), 27 (CH_2), 39 (CH_2), 48 (CH_2N), 56 (NCH_2). Found, %: C 75.82, H 14.51; N 9.50. C_9H_{21}-N. Calculated, %: C 75.54, H 14.67; N 9.78.

N-Pentylpiperidine (III_b). Obtained from 17 g (0.2 mol)

piperidine (1 b) and 6.0 g (0.04 mol) 1-brompentane (IIa). Yield 4.79 (78%), bp.65˚C in (2 mm Hg), n_D^{20} 1.4221, d_4^{20} 0.8419. IR(ν, cm^{-1}): 2900 (CH_3), 2830 (CH_2), 1230 (CN). ^{1}H NMR (300 MHz, D_2O) δ: 1.04 mp (CH, CH_3), 1.3 - 1.7 (12H, CH_2), 2.3 m (2H, NCH_2), 2.4 s (4H, CH_2 Pip.). ^{13}C NMR (300 MHz, D_2O) δ: 14.4 (CH_3), 22.8 (CH_2), 24.9 (CH_3), 26.0 (CH_2), 26.9 (CH_2 pip.), 30.0 (CH_2 pip.), 54.8 (CH_2N pip.), 59.3 (NCH_2 aliph.). Found, %: C 77.82, H 13.62; N 9.13. $C_{10}H_{21}N$. Calculated, %: C 77.42, H 13.55; N 9.03.Yield 11 g (77%), bp. 41˚C - 42˚C (20 mm·Hg), n_D^{20} 1.4109, d_4^{20} 0.7779.

N-Pentylmorpholine (III_c), 0.8957. IR (ν, cm^{-1}): 2910 (CH_3), 2850 (CH_2), 1230 (C-N). ^{1}H NMR (300 MHz, D_2O) δ: 1.05 m (3H, CH_3), 1.45 - 1.65 m (6H, CH_2), 2.4 m (2H, NCH_2), 2.5 m (4H, CH_2N), 3.65 - 3.75 m (4H, OCH_2). ^{13}C NMR (300 MHz, D_2O) δ: 14 (CH_3), 23 (CH_2), 26 (CH_2), 30 (CH_2), 46 (NCH_2), 54 (CH_2N), 59 (CH_2N morph.), 66 (OCH_2 morph.), 67 (OCH_2 morph.). Found, %: C 68.75, H 12.97; N 8.92. $C_9H_{19}NO$. Calculated, %: C 68.81, H 12.09; N 8.91.Yield 5 g (62%), bp.60˚C (2 mm·Hg), n_D^{20} 1.4111, d_4^{20}.

N-Pentylethanolamine (III_d), IR (ν, cm^{-1}): 3475 (OH), 3400 (NH), 2920 (CH_3), 2820 (CH_2), 1225 (C-N). ^{1}H NMR (300 MHz, D_2O) δ: 0.87 t (3H, CH_3), 1.25 m (4H, CH_2), 1.45 m (2H, CH_2), 2.5 и 2.65 t (4H, CH_2N), 3.5 - 3.6 t. t (3H, NH, NCH_2), 4.75 s (3H, CH_2OH). ^{13}C NMR (300 MHz, D_2O) δ: 13.8 (CH_3), 22.4 (CH_2), 29.0 (CH_2), 29.5 (CH_2), 49.1 (NHC), 50.7 (CHN), 60.0 (C-OH). Mass spectrum (ES), m/z (I, %): 131 [M] + (37) 100 (100), 74 (100), 56 (100). Found, %: C 65.02, H 13.01; N 10.73. $C_7H_{17}NO$. Calculated, %: C 64.12, H 12.97; N 10.68.Yield 2.98 g (76%), bp. 83˚C - 85˚C (2 mm·Hg), n_D^{20} 1.4382, d_4^{20} 0.8712.

N-Pentylbenzylamine (III_e), IR (ν, cm^{-1}): 2910 (CH_3), 2850 (CH_2), 1220 (CN). ^{1}H NMR (300 MHz, D_2O) δ: 0.95 m (3H, CH_3), 1.35 q (2H, CH_2), 1.45 - 1.6 m (7H, NH, CH_2), 2.63 m (2H, NCH_2), 3.8 s (2H, CH_2Ph), 7.15 - 7.4 (4H, H ar). ^{13}C NMR (300 MHz, $CDCl_3$) δ: 54.25 (CH_2Ph), 126.82, 128.12, 128.37, 128.89 (C_{Ar}). Found, %: C 81.51, H 10.61; N 7.99. $C_{12}H_{19}N$. Calculated, %: C 81.37, H 10.73; N 7.90.Yield 2.97 g (85%), b.p. 112 - 114 (6 mm·Hg), n_D^{20} 1.5073, d_4^{20} 0.9088.

N-(3-methylbutyl)diethylamine (III_f), IR (ν, cm^{-1}): 2940 (CH_3), 2860 (CH_2), 1227 (C-N). ^{1}H NMR (300 MHz, D_2O) δ: 1.07 d (6H, CH_3), 1.15 m (6H, CH_3), 1.47 (2H, CH_2), 1.79 s (1H, CH), 2.5 q and 2.65 m (6H, CH_2N). ^{13}C NMR (300 MHz, D_2O) δ: 14 (CH_3), 17 (CH_3), 23 (CH_3), 26 (CH_3), 27 (CH_2), 36 (CH), 46 (CH_2), 47 (CH_2), 51 (NCH_2). Found, %: C 75.63, H 14.48; N 9.62. $C_9H_{21}N$. Calculated, %: C 75.54, N 14.67; N 9.78.Yield 8.57 g (60%), bp. 139˚C, n_D^{20} 1.4109, d_4^{20} - 0.7779.

N-(3-methylbutyl)piperidine (III_g), IR (ν, cm^{-1}): 2920 (CH_3), 2860 (CH_2), 1230 (C-N). ^{1}H NMR (300 MHz, D_2O) δ: 1 d (6H, CH_3), 1.45 s (1H, CH), 1.5 - 1.8 m (6H, CH_2 pip. CH_2 alif.), 2.34 m (2H, NCH_2), 2.4 m (6H, CH_2 pip.). ^{13}C NMR (300 MHz, D_2O) δ: 11.8 (CH_3), 18.0 (CH_3), 25.5 (CH_2), 24.5 (CH), 26 (CH_2), 27 (CH_2 pip.), 35 (CH), 54.4 (CH_2N pip.), 55.5 (CH_2N pip.), 57.7 (NCH_2 alif.). Found, %: C 77.73, H 13.45; N 9.10. $C_{10}H_{21}N$. Calculated, %: C 77.42, N 13.55; N 9.03.Yield 8.13 g (81%), bp60˚C (2 mm·Hg), n_D^{20} 1.4378, d_4^{20} - 0.8392.

N-(3-methylbutyl)morpholine (III_h), IR (ν, cm^{-1}): 2900 (CH_3), 2850 (CH_2), 1230 (C-N). ^{1}H NMR (300 MHz, D_2O) δ: 1.05d (6H, CH_3), 1.5 q. (2H, CH_2), 1.8 s (1H, CH), 2.4 m, 2.5 m (6H, CH_2N morph.), 3.17 m (4H, OCH_2 morph.). ^{13}C NMR (300 MHz, D_2O) δ: 12 (CH_3), 17.7 (CH_3), 23.3 (CH), 26.6 (CH_2), 35.5 (NCH_2), 53 (NCH_2mor-ph.), 54 (CH_2N morph.), 57 (CH_2O morph.), 67 (CH_2O morph.). Found, %: C 69.01, H 12.34; N9.02. $C_9H_{19}NO$. Calculated: C 68.81, H 12.09; N 8.91.Yield 4.42 g (71%), bp.70˚C (10 mm·Hg), n_D^{20} 1.4381, d_4^{20} - 0.8935.

N-(3-methylbutyl)ethanolamine (III_i), IR (ν, cm^{-1}): 3440 (OH), 2910 (CH_3), 2860 (CH_2), 1225 (CN). ^{1}H NMR (300 MHz, D_2O) δ: 0.9 d (6H, CH_3), 1.3 m (2H, CH_2), 1.5 sep (1H, CH), 2.4 - 2.65 m (3H, CH_2NH), 3.5 t (2H, NCH_2), 4.7 s (3H, CH_2OH). ^{13}C NMR (300 MHz, D_2O) δ: 22.55 (CH_3), 22.47 (CH_3), 26.4 (CH), 38.22 (CH_2), 50.95 (CH_2N), 59.94 (CH_2OH). Found, %: C 64.09, H 4.13; N 11.65. $C_7H_{17}NO$. Calculated, %: C 64.12, H 12.97; N 12.68.Yield 3.84 g (74%), bp. 77˚C - 78˚C (2 mm·Hg), n_D^{20} 1.4371, d_4^{20} 0.8772.

N-(3-methylbutyl)benzylamine (III_k), IR (ν, cm^{-1}): 2920 (CH_3), 2840 (CH_2), 1225 (C-N). ^{1}H NMR (300 MHz, $CDCI_3$) δ: 0.95 t (6H, CH_3), 1.4 kv (2H, CH_2), 1.7 sep (1H, CH), 2.7 tr. (2H, N-CH_2), 3.38 s (2H, $PhCH_2$), 7.2 - 7.5 m (5H, H Ar). ^{13}C NMR (300 MHz, D_2O) δ: 17.7 (CH_3), 22.7 (CH_3), 22.6 (CH_2), 39.27 (CH), 47.7 (N-CH_2), 54.25 ($PhCH_2$), 126.82, 128.12, 128.37, 128.89 (C Ar). Found, %: C 81.62, H 10.59; N 7.81. $C_{12}H_{19}N$. Calculated, %: C 81.37, H 10.73; N 7.90.Yield 4.53 g (82%), bp. 78˚C - 79˚C (2 mm·Hg), n_D^{20} 1.4891, d_4^{20} - 0.8972.

3-(N, N-diethylamino)propan-2-ol (VII_a), IR (ν, cm^{-1}): 3342 (OH), 2970 (CH_3), 2875 (C-N), 1067 (C-O). ^{1}H NMR (300 MHz, $CDCI_3$) δ: 0.9 t (3H, CH_3), 1.0 d (6H, $2CH_3$), 2.1 t (2H, NCH_2), 2.25 - 2.5 m. (4H, $2CH_2N$), 3.6 sep. (1H, CH), 3.7 s.(wide) (1H, OH). ^{13}C NMR (300 MHz, $CDCI_3$) δ: 20.0 (CH_3), 20.3 (CH_3), 21.4 (CH_3), 24.2 (CH_2), 49.5 (NCH_2), 55.8 (C-OH). Found, %: C 64.03, H 16.82; N 13.75. C_7H_{17} NO. Calculated, %: C 64.13, H 17.00; N 14.01.Yield 11.5 g (80%), bp. 64˚C - 65˚C (15 mm·Hg), n_D^{20}1.4210

3-Piperidinopropan-2-ol (VII_b), IR (ν, cm^{-1}): 3352 (OH), 2934 (CH_3), 2855 (CN), 1072 (C-O). ^{1}H NMR (300 MHz, $CDCI_3$) δ: 1.0 d (3H, CH_3), 1.55 - 1.65 m (6H,

CH_2 pip.), 2.8 - 2.9 m (4HCH_2N), 3.0 d.d (2H, NCH_2), 3.5 sep (1H, -CH), 3.7 s.(waid), (1H, OH). ^{13}C NMR (300 MHz,) $CDCl_3$ δ: 24 (CH_3), 24.5 (C pip.), 24.7 (C pip.), 26.6 (C, pip.), 54.1 (NCH_2), 56.8 (C-OH). Found, %: C 67.08, H 11.9; N 9.69. $C_8H_{17}NO$. Calculated, %: C 67.18, H 11.88; N 9.78.Yield 7.13 g (96%), bp. 75˚C -76˚C (20 mm·Hg) n_D^{20} 1.4775 .

3-Morpholinopropan-2-ol (VII$_c$), IR (ν, cm^{-1}): 3441 (OH), 2965 (CH_3), 2854 (CN), 1063 (C-O). ^{1}H NMR (300 MHz,) $CDCl_3$, δ:1.0 d (3H, CH_3), 2.17 d.d (2H, NCH_2), 2.4 - 2.5 m (4H, CH_2N morph.), 3.57 m (4H, CH_2O), 3.7 sep. (1H, CH), 3.8 s.(wiat) (1H, OH). ^{13}C NMR (300 MHz, $CDCl_3$) δ: 22.3 (CH_3), 53 (CH_2N morph.), 56 (NCH_2), 56.6 (C-OH), 66 (OCH_2 morph.). Found, %: C 56.96, H 10.14; N 9.55. $C_7H_{15}O_2N$. Calculated, %: C 57.96, H 10.34; N 9.65.Yield 14.2 g (98%), bp. 70˚C -71˚C (3 mm·Hg), n_D^{20} 1.4590 .

3-Benzilaminopropan-2-ol (VII$_d$), IR (ν, cm^{-1}): 3250 (OH), 2980 (CH_3), 2830 (CN), 1058 (C-O). ^{1}H NMR (300 MHz, $CDCl_3$) δ: 1.17 d (3H, CH_3), 2.5 - 2.6 t.d (2H, NCH_2), 3.32-3.36 s.(wiat) (2H, NHOH), 3.78 d (2H, $PhCH_2$), 3.86 sep.(1H, CH), 7.28 - 7.29 m (5H, *n*-C_6H_5). ^{13}CNMR (300 MHz, $CDCl_3$) δ: 22.2 (C^1), 53.3 m (C^3), 56.6 m (C^2), 65.5 ($RhCH_2$), 126, 127, 140 (CAr). Found, %: C 72.67, H 9.15; N 8.54. $C_{10}H_{15}ON$. Calculated, %: C 72.75, H 9.08; N 8.48.Yield 9.9 g (60%), bp. 126˚C -127˚C (2 mm·Hg), n_D^{20} 1.5270 .

Bis-1,3-(N,N-diethylamino)propan-2-ol (VIII$_a$), IR (ν, cm^{-1}): 3415 (OH), 2940 (CH_3), 2805 (CN), 1115 (C-O). ^{1}H NMR (300 MHz, D_2O) δ: 0.95 m (12H, 4CH_3), 2.34 - 2.52 m (12H, 6NCH_2), 3.28 s (1H, -OH), 3.5 sep. (1H, OCH). ^{13}C NMR (300 MHz, D_2O) δ: 10 (CH_3), 47.1 m (C3), 57.05 m (NCH_2), 66.49 (C2). Found, %: C 65.42, H 12.97; N 13.93. $C_{11}H_{26}N_2O$. Calculated, %: C 65.37, H 12.86; N 13.85.Yield 9.1 g (93%), bp. 122˚C (10 mm·Hg.) n_D^{20} 1.4571 , d_4^{20} 0.9101 .

Bis-1,3-piperidinopropan-2-ol (VIII$_b$), IR (ν, cm^{-1}): 3410 (OH), 2980 (CH_3), 2800 (CN), 1125 (C-O). ^{1}H NMR (300 MHz, $CDCl_3$,δ): 1.28 - 1.53 m (12H, CH_2N pip. NCH_2aliph.), 2.18 s (OH), 3.75 sept (OCH). ^{13}C NMR (300 MHz, D_2O) δ: 24.5 (CH_2 pip.), 26.6 (CH_2 pip.), 54.4 (CH_2N pip.), 63.33 (N-CH_2 alf.), 64.44 (OCH). Found, %: C 66.13, H 11.62; N 12.05. $C_{13}H_{26}N_2O$. Calculated, %: C 69.03, H 11.49; N 12.38.Yield 12 g (90%), bp. 135˚C - 136˚C (3 mm·Hg.) n_D^{20} 1.4955 , d_4^{20} 1.1137 .

Bis-1,3-morpholinopropan-2-ol (VIII$_c$), IR (ν, cm^{-1}): 3422 (OH), 2940 (CH_3), 2805 (CN), 1110 (C-O). ^{1}H NMR (300 MHz, D_2O) δ: 2.17 d (1H, OH), 2.2 - 2.5 m (8H, CH_2,NCH_2cycl), 3.5 t (4H, OCH_2cycl), 3.7 s (OCH). ^{13}C NMR (300 MHz, D_2O) δ: 53 (NCH_2), 62 (CH_2N cycl.), 63 (OCH), 66 (OCH_2). Found, %: C 57.30, H 9.38; N 12.29. $C_{11}H_{22}N_2O_3$. Calculated, %: C 57.42, H 9.56; N 12.17.Yield 11.6 g (87%), bp. 142˚C - 144˚C (2 mm·Hg.) n_D^{20} 1.4358 , d_4^{20} 0.9818 .

Bis-1,3-(N,N-diethylamino)propane (IX$_a$), IR (ν, cm^{-1}): 2980 (CH_3), 1275, 865 (CN). ^{1}H NMR (300 MHz, D_2O) δ: 1.1t (12H, CH_3), 1.6 q. (2H, CH_2), 2.46 - 2.62 sq. (12H, CH_2NCH_2). ^{13}C NMR (300 MHz, $CDCl_3$) δ: 11.4 (CH_3), 25 (CH_2), 47 (CH_2N), 52 (NCH_2). Found, %: C 70.73, 70.79; H 14.26, 14.20; N 15.21, 15.19. $C_{11}H_{26}N_2$. Calculated, %: C 70.97, H 13.96; N 15.05.Yield 11.7 g (63%), bp. 85˚C (20 mm·Hg), n_D^{20} 1.4295, d_4^{20} 0.8392.

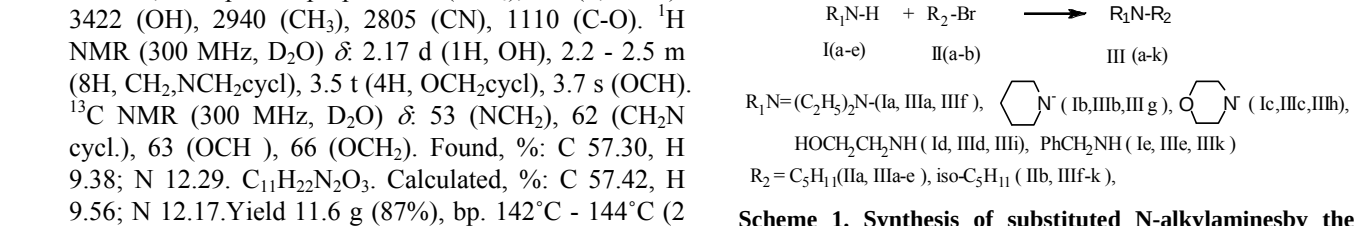
Bis-1,3-piperidinopropan (IX$_b$), IR (ν, cm^{-1}): 1278, 850 (C-N). ^{1}H NMR (300 MHz, D_2O) δ: 1.43 - 1.54 m (14H, CH_2), 2.33 - 2.43 m (12H, CH_2NCH_2). ^{13}C NMR (300 MHz, D_2O) δ: 22.0, 23.0, 26.0 (CH_2, pip. CH_2 alif.), 54 (CH_2N pip.), 57 (NCH_2 aliph.). Found, %: C 74.49, 74.51; H 12.43, 12.49; N 13.15, 13.21. $C_{13}H_{26}N_2$. Calculated, %: C 74.29, H 13.37; N 13.33.Yield 8.13 g (66%), bp.116˚C (2 mm·Hg). n_D^{20} 1.4773, d_4^{20} 0.9354,

Bis-1,3-morpholinopropane (IX$_c$), IR (ν, cm^{-1}): 1235, 850 (C-N). ^{1}H NMR (300 MHz, D_2O) δ: 1.43 - 1.54 and 1.56 - 1.7 m (14H, CH_2), 2.33 - 2.43 m (12H, CH_2 morph., NCH_2 alif.). ^{13}C NMR (300 MHz, D_2O) δ: 24.0 (CH_2 alif.), 54.0, 56.0 (CH_2; NCH_2 morph.), 66 (CH_2O morph.). Found,%: C 61.65, 61.58, H 10.13, 10.20; N 13.15, 13.13. $C_{11}H_{22}N_2O_2$. Calculated, %: C 61.69, H 10.27; N 13.08.Yield 8.12 g (60%), bp. 125˚C (1 mm·Hg), n_D^{20} 1.4781, d_4^{20} 1.0367.

3. Results and Discussion

We have directed our efforts on the region-selective synthesis of amino- and bis-amino alcohols, which may have antibacterial and anticorrosion properties. Interactions of a number of initial amines (I_{a-e}) with brom-pentanes (II_{a-b}) result in N-alkylamines (III_{a-k}) (**Scheme 1**).

The synthesis of target products (III_{a-m}) was carried out inaqueous medium at 50˚C - 90˚C for 6 - 9 h. The yields of target pro-ducts were in the range 60% - 98%. Synthesis of alkyl amines (III_a, III_b, III_f, III_g, IX_a, IX_b) was performed at 50˚C for 8 h at a molar ratio of initial components (amines: pentylbromide or dibromopropane) equal to 5:1. The reaction of monoetha-nolamine (I_d) and morpholine (I_c) with pentylbromides ($II_{a,b}$) goes at a relatively high temperature of 60˚C and long duration (9 h) at optimum component ratio of 5:1. The reaction between benzylamine (I_e) and pentylbromides ($II_{a,b}$) is better to carry out at the even higher temperature (90˚C) for 9 h and the same ratio of reactants. Another possible ap-

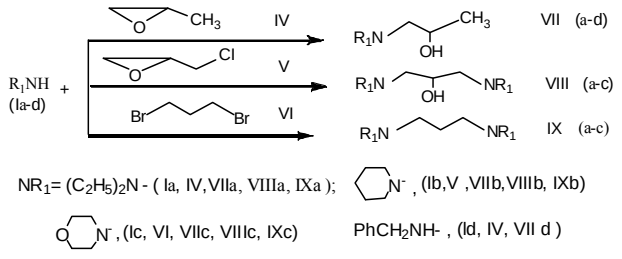


Scheme 1. Synthesis of substituted N-alkylaminesby the alkylation with brompentanes.

proach has been realized by us in obtaining aminoalcohols VII$_{(a-d)}$, bis-aminopropane-2-ols (VIII$_{a-c}$) and bis-aminopropanes (IX$_{a-c}$). We carried out regioselective oxirane ring opening of propylene oxide (IV), epichlorohydrin (V) and 1.3-dibromopropan (VI) as a result of interaction with various amines in aqueous medium according to **Scheme 2**.

The interaction of propylene oxide (IV) and epichlorohydrin (V) with diethylamine (I$_a$) was carried out with stirring the mixture of reagents in the water by heating at 50˚C for 9 hours. The optimum ratio of initial components in this case was as follows: diethylamine/propylene oxide = 1.1:1; diethylamine/epichlorohydrin = 5:1. The reaction of diethylamine with propylene oxide formed secondary amino alcohol (VII$_a$), while the interacttion with epichloro-hydrin leads to the formation of bis-amino alcohol (VIII$_a$), with the yields 80% and 98%, respectively. The reactions of piperidine (I$_b$), morpholine (I$_c$) and benzylamine (I$_e$) with epoxy compounds were carried out at the higher temperature (90˚C) for 9 h. The optimal relations between the components of amines (I$_b$, I$_c$ and I$_e$) and propylene oxide (IV) were 1.1-1, and in the case of epichlo-rohydrin 5:1. Yields of the products with in the limits of 60% - 90% were achieved. Earlier aminoalcohols (VII$_{a-d}$ and VIII$_{a-c}$) were obtained in organic solvents in the presence of catalysts such as salts, metal triflates as complexing agents and others with the yields within 75% - 85% [15-24].

Aminolysis of epoxides could precede regionselectively under (a) or against (b) Krasusky rule [25]. The value of δ protons CH (C^2) group in ^{1}H NMR spectrum of compound (VII$_a$) is in the range of 3.60 ppm, indicating a shift of the signals in a weak field. This result shows that the OH group is located at the carbon atom C^2. Pro-ton signals of the methyl group at the atom C^1 are also shifted toward weaker fields under the influence of the electronegative oxygen atom in the possession of the neighboring atom (C^2) (1.35 ppm). Similarly, proton signals of CH groups of compounds (VII$_{b-d}$) and CH$_2$ groups of compounds (VIII$_{a-c}$) are shifted downfield in comparison with the reference materials. Good correlation with published data for compounds of similar structure [14,15,17,19] also shows in favor of the structure.



Scheme 2. Regioselectiveoxirane ring opening with amines and synthesis aminoalkohols and diamines.

Chromatographic analysis showed the presence of only one regioisomer for obtained compounds. Thus, the openings of the epoxy fragments in compounds (IV, V) with amines (I$_{a-e}$) is in accordance with Krasusky rule and follow the path(a) with the formation of secondary alcohols derivatives region selectively.

Original amines (I$_{a-d}$) are good or partially soluble in water, with the possible formation of the corresponding unstable hydroxides $[RR_1NH_2]^+OH^-$. It is possible and the formation of quaternary ammonium salts $[RR_1NH_2]^+Br^-$ as a result of interaction between amines (I$_{a-d}$) and brompentanes (II$_{a,b}$) or 1.3 dibromopropane (II$_c$). Obtained hydroxides and quaternary ammonium salts are readily soluble in water and not on-lyplay the role of phase transfer catalysts in the reaction of the starting amines (I$_{a-e}$) with brompentanes (II$_{a,b}$) and also could perform catalysis for opening oxiranesin aqueous media. Epichlorohydrin and 1.3 dibromo-propane also form quaternary am-monium salts next type $\{[R_2NHR]^+\text{-}Cl^-\}$, that are phase transfer catalysts. The opening of epoxide ring for propylene oxide and epichlorohydrin under the action of these PTC-catalysts proceeds on well-known scheme [5] for the S_N2 mechanism with the formation of amino and bisaminopropane derivatives.

The obtained hydroxyamino- and bis-amino-compounds are promising for use as an anti-bacterial and antirust agent for oil production.

4. Conclusion

An operationally simple and environmentally benign protocol for the ring opening of epoxides with aliphatic amines has been developed. The reactions proceeded smoothly under mild conditions in water to afford *a*-amino alcohols in high yields with excellent regioselectivities. Also substituted amines were also obtained in environmentally acceptable conditions in the water by the al-kylation with brompentanes.

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