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INTERACTION OF QUATERNARY SALTS OF 1,2-AMINO ALCOHOLS WITH ORGANOHALOGEN COMPOUNDS IN THE SYSTEM OF 50% AQUEOUS ALKALI AND BENZENE

Abstract: In the work the reactions of quaternary salts of 1,2-aminoalcohols with organohalogen compounds in a four-phase system, in the presence of a concentrated solution of aqueous alkali and benzene were studied. It was defined that in this case, bipolar 2-trialkylammonioethoxides are generated, which actively interact with organohalogen compounds and lead to the formation of the corresponding quaternary salts of 1,2-aminoethers.

Key words: quaternary salts, 1,2-amino alcohols, quaternary salts of 1,2-amino alcohols, 2-trialkylammonioethoxides, two-phase systems, four-phase systems, aqueous solutions of alkalis.

Language: English

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Introduction

UDC 547.435. 1`21`32`33

The reaction of quaternary salts of 1,2-amino alcohols with concentrated aqueous solutions of alkalis, leading to the formation of 2-trialkylammonioethoxides [1], opens up new directions and possibilities for the synthesis of many organic compounds. 2-Trialkylammonioethoxides are essentially neutral bipolar species, they are a combination of a four-coordinated ammonium and a negatively charged ethoxide group in one individual molecule, and the feature of one of them depends on the presence of the other, i.e. they are mutually stabilized. It is likely that in 2-trialkylammonioethoxides, the stabilization of charged centers is carried out mainly intermolecularly, since intramolecular stabilization in this case can be carried out with a very unfavorable eclipsed (clear) conformation.
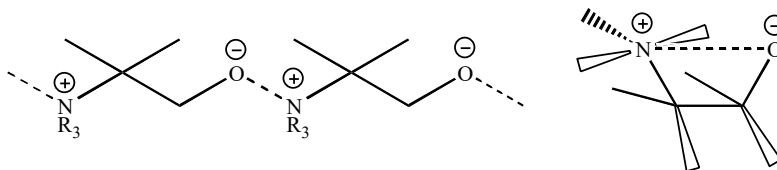
Based on these structural and electronic features of 2-trialkylammonioethoxides, their use as good nucleophiles in nucleophilic substitution reactions becomes obvious. Therefore, in this work, we studied the processes associated with the generation of 2-trialkylammonioethoxides from the corresponding quaternary salts of 1,2-amino alcohols and their interaction with electrophiles such as benzyl, allyl, and alkyl halides. In order to reveal the nucleophilicity of 2-trialkyammonioethoxides, the subject of our research was the study of the reaction of 2-(4-benzylmorpholinio)ethoxide and 4-benzyl-4-(2-hydroxyethyl)morpholinium chloride with benzyl chloride. We should note that the method for obtaining 2-(4-benzylmorpholinio)ethoxide from 4-benzyl-4-(2-hydroxyethyl)morpholinium chloride is described in our work [1].

It was found that 2-(4-benzylmorpholinio)ethoxide (104) actively reacts with benzyl chloride in benzene at 10-20°C and leads to the formation of 4-benzyl-4-(2-benzyloxyethyl)morpholinium chloride with a yield of 93.7 %
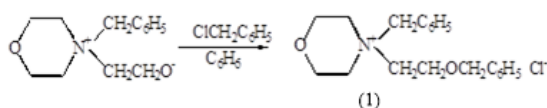
The reaction proceeds in a four-phase system and is completely suppressed in the presence of protic solvents, for example, water and alcohols.

It was found out that 4-benzyl-4-(2-hydroxyethyl)morpholinium chloride, which does not interact with benzyl chloride under normal conditions and when heated in benzene, but in the presence of a 50-55% aqueous solution of potassium hydroxide as a result of the generation of 2-(4-benzylmorolinio) ethoxide actively reacts with it at 15-20°C, with strong stirring, and forms compound (1) with a yield of 96.2%.
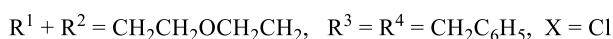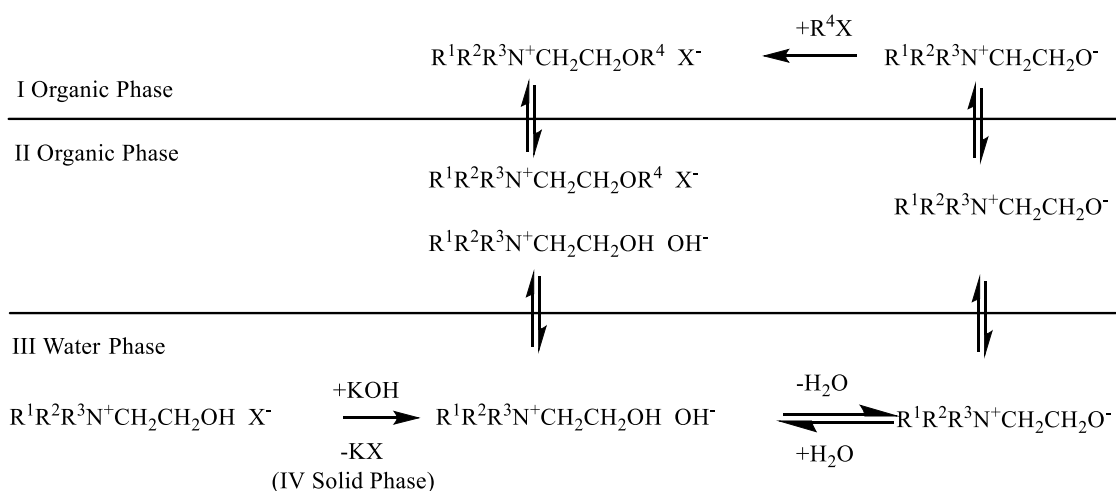
(1)
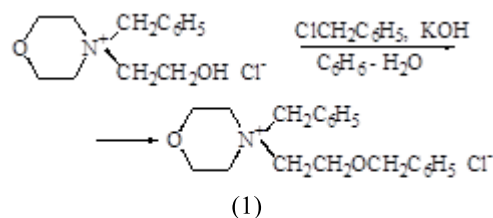
An important feature of this reaction is that it proceeds in a four-phase system immiscible with each other. In this case, the first organic phase contains benzene and benzyl chloride, and the second organic phase contains 2-(4-benziummorpholinio)ethoxide, the product of reaction (1) and, at the initial moments of the reaction, the initial quaternary salt and its hydroxide. The third inorganic phase mainly consists of aqueous solutions of alkali metal hydroxide and its halide, and the fourth solid phase contains the alkali metal halide. With strong stirring, the initial quaternary salt of 1,2-amino alcohol from the second organic phase, passing into an aqueous alkaline medium, turns successively into a hydroxide, then into a bipolar ion. The latter is salted out from the solution, accumulates in the second organic phase and is simultaneously generated into a highly efficient dehydrated benzene phase, where, due to the absence of the solvent solvation effect, it reacts with benzyl chloride, forming the reaction product (1), which further also accumulates in the second organic phase. The specified sequence of transformations is illustrated by the following scheme.

$$R^1R^2R^3N^+CH_2CH_2OR^4 \ X^- \xleftarrow{\ +R^4X\ } R^1R^2R^3N^+CH_2CH_2O^-$$

I Organic Phase

II Organic Phase

$$R^1R^2R^3N^+CH_2CH_2OR^4 \ X^-$$

$$R^1R^2R^3N^+CH_2CH_2O^-$$

$$R^1R^2R^3N^+CH_2CH_2OH \ OH^-$$

III Water Phase

$$R^1R^2R^3N^+CH_2CH_2OH \ X^- \xrightarrow[-KX]{+KOH} R^1R^2R^3N^+CH_2CH_2OH \ OH^- \underset{+H_2O}{\overset{-H_2O}{\rightleftarrows}} R^1R^2R^3N^+CH_2CH_2O^-$$

(IV Solid Phase)

$$R^1 + R^2 = CH_2CH_2OCH_2CH_2, \quad R^3 = R^4 = CH_2C_6H_5, \quad X = Cl$$

In order to establish the generality of the nature of the above reaction, we studied the interaction of some quaternary salts of 1,2-amino alcohols of various structures with organohalogen compounds. It turned out that under the conditions described above, trialkyl(2-hydroxyethyl)ammonium halides actively react with benzyl-, allyl-, and alkyl bromides and form the corresponding quaternary salts of 1,2-aminoesters (2-8) in high yields.

$$R^1R^2R^3N^-CH_2CH_2OH \ X^- \xrightarrow[C_6H_6\text{-}H_2O]{RX, \ KOH} R^1R^2R^3N^-CH_2CH_2OR \ X^-$$

(2-8)
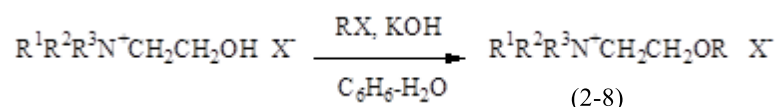
(2) $R^1 = R^2 = R^3 = C_2H_5$, $R^4 = CH_2C_6H_5$, $X = Br$. (3) $R^1 = R^2 = C_4H_9$, $R^3 = R^4 = CH_2C_6H_5$, $X = Cl$. (4) $R^1 + R^2 = -(CH_2)_4$, $R^3 = CH_2CH=CH_2$, $R^4 = CH_2C_6H_5$, $X = Cl$. (5) $R^1 = R^2 = R^3 = C_2H_5$, $R^4 = CH_2CH=CH_2$, $X = Br$. (6) $R^1 = R^2 = R^3 = R^4 = C_2H_5$, $X = Br$. (7) $R^1 = R^2 = R^4 = C_2H_5$, $R^3 = CH_2C_6H_5$, $X = Br$. (8) $R^1 = R^2 = -(CH_2)_4$, $R^3 = CH_2CH=CH_2$, $R^4 = C_2H_5$, $X = Br$.

We have found out that this reaction is more general and extends to quaternary salts of bis- and tris(2-hydroxyethyl)amines. It has been established that bis-(2-hydroxyethyl)diethylammonium bromide, similarly to trialkyl(2-hydroxyethyl)ammonium halides, in the system of 50-55% aqueous alkali and benzene at 10-20 ° C actively interacts with a twofold excess of benzyl bromide and, as a result, successive benzylation of hydroxyl groups gives bis(2-benzyloxyethyl)diethylammonium bromide (9) in quantitative yield

(9)
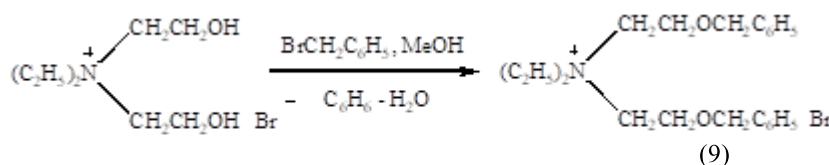
O-benzylation of three hydroxyl groups proceeds similarly in benzyltris(2-hydroxyethyl)ammonium chloride with a threefold excess of benzyl chloride
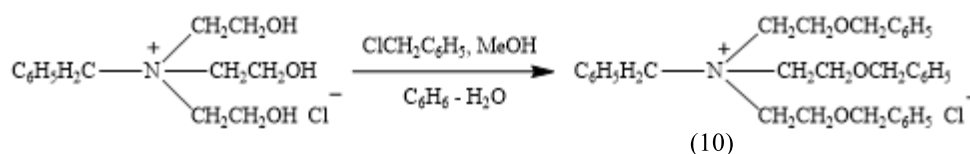
(10)

Clarivate Analytics *indexed*

The structure of the synthesized compounds (1-10) was established by physicochemical methods of analysis, including H-NMR spectroscopy.

Pic. 1. H-NMR spectrum of 4-benzyl-4-(2-benzyloxyethyl)morpholinium chloride (1). Solvent CD_3OD. In the region of weak fields, four singlets are observed, which are due to protons of benzyl radicals located at various N and O heteroatoms. In this case, the signals of the $C_6H_5CH_2N^+$ fragment appear at 7.45 (C_6H_5) and 4.76 (CH_2) ppm. , and the signals of the $C_6H_5CH_2O$ fragment at 7.28 (C_6H_5) and 4.56 (CH_2) ppm respectively. The proton signals of OCH_2 and CH_2N^+ groups located in the heterocycle are found at 3.95 (m) and 3.49 (t) ppm. Multiplet at 3.95 ppm due to the overlap of the signal of the methylene group of the $OCH_2C_6H_5$ radical. And the signal of the CH_2 group directly bound to the quaternary nitrogen atoms in the $N+-CH_2CH_2O$ fragment appears at 3.69 ppm. in the form of a triplet.

Pic. 2. H-NMR spectrum of (2-benzyloxyethyl)triethylammonium bromide (2). Solvent D_2O. Proton signals in C_6H_5, $Ar-CH_2-O$ and OCH_2C groups are found in the characteristic low field region at 7.68, 4.8, 4.1 ppm. respectively. The difference in chemical shifts directly bonded by oxygen in the $Ar-CH_2-O$ and $O-CH_2-C$ groups is due to the significant influence of the unsaturated substituent in the first group. The signals of methylene protons directly bound to the quaternary nitrogen atom appear in the region of a slightly stronger field, i.e. in the region of 3.55 ppm The multiplicity of the signal is due to the fact that one methyl group is under the influence of the $-J$ -effect of oxygen in the $N+-CH_2-C-O$ group. In the characteristic region of stronger fields at 1.48 ppm in the form of a triplet, the signals of methyl groups of ethyl radicals bound to the nitrogen atom appear. When integrated, the ratio of protons in the groups corresponded to the calculated one.

Pic. 3. H-NMR spectrum of benzyl-(2-benzylocoethyl)dibutylammonium chloride (3). Solvent CD_3OD. As can be seen, the signals of the protons of the C_6H_5 groups in the fragments $C_6H_5CH_2N^+$ and $C_6H_5CH_2O$ are found at 7.44, 7.28 ppm. respectively. And the signals at 4.57 (s), 4.53 (s), 3.9 (t), 3.46 (t) and 3.15 (t) ppm respectively correspond to the protons of $Ar-CH2-N^+$, $Ar-CH_2-O$, $C-CH_2-O$, N^+-CH_2-C-O and N^+-CH_2-C groups. The proton signals of the C_3H_7-C fragment in the $(C_4H_9)_2N+$ radical appear in the corresponding regions of strong fields.

Pic. 4. H-NMR spectrum of 1-allyl-1-(2-benzyloxyethyl)piperidinium chloride (4). Solvent $CD_3OD + D_2O$. Singlet signals due to the protons of the $C_6H_5CH_2O$ group are found at 7.26 (C_6H_5) and 4.51 (CH_2) ppm. respectively. A multiplet of three olefinic hydrogens of the allyl group is detected in a low field at 6.26-5.39 ppm, and the signal of its methylene group appears as a doublet at 4.06 ppm.

The proton signals of the $N+CH_2$, CCH_2C methylene groups in the heterocycle and $N+CH_2$, OCH_2 groups in the $N+CH_2CH_2O$ fragment are found at 3.39, 1.74, 3.59, 3.84 ppm. respectively.

Pic. 5. H-NMR spectrum of (2-alkyloxyethyl)triethylammonium bromide (5). Solvent D_2O. As can be seen, the proton signals in the
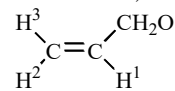
allyl group
$$\underset{H^2}{\overset{H^3}{}}C=C\underset{H^1}{\overset{CH_2O}{}}$$
 have the following chemical shifts: 6.65-5.90 (H^1), 5.71 (H^3), 5.55 (H^2) and 4.36 (CH_2) ppm. respectively. Triplet at 4.20 ppm corresponds to the signal of the OCH_2 group in the $N+CH_2CH_2O$ fragment. Clear triplet at 1.6 ppm corresponds to the methyl group of three ethyl groups located at the quaternary nitrogen atom, and the multiplet at 3.71 ppm due to overlapping signals of methylene protons of ethyl radicals and the N^+CH_2 group of the $N^+CH_2CH_2O$ fragment.

Pic. 6. H-NMR spectrum of (2-ethoxyethyl)triethylammonium bromide (6). Solvent D_2O. As it should be expected, the multiplet at 1.59 ppm due to the position of methyl group triplets in the OCH_2CH_3 and $N^+(CH_2CH_3)_3$ groups. In this case, the signals of the methylene groups directly associated with the O and N heteroatoms appear as a multiplet at 4.15 and 3.68 ppm. respectively.

Pic. 7. H-NMR spectrum of benzyl(2-ethoxyethyl)diethylammonium bromide (7). Solvent D_2O. As can be seen from pic. 7 similar to the H-NMR spectrum of compound (6) at 1.59 ppm. a multiplet is observed, which is the result of the superimposition of the signals of CH_3 groups of ethyl radicals located at different heteroatoms. And the signals of C_6H_5, $ArCH_2N+$, CCH_2N+ groups appear in the corresponding regions of the spectrum, namely at 7.78 (s), 4.71 (s) and 3.56 (t) ppm. respectively. The ammonium group, which has the $-J$ -effect, causes a shift of electrons in the chain and weakens the electron field around the H nuclei in the CH_2O group of the $N^+CH_2CH_2O$ fragment. For this reason, the signal of this group appears at 4.16 ppm, and the signal of the methylene group of the ethyl radical, also bound to oxygen, is found at 3.9 ppm.

Pic. 8. H-NMR spectrum of 1-allyl-1-(2-ethoxyethyl)piperidinium bromide (8), Solvent D_2O. The signals of olefinic protons of the allyl group $C-CH=CH_2$ appear in the low-field region at 5.95-6.69 ppm. The proton signals of $N^+-CH_2-C=C$ and N^+-C-CH_2-O groups appear at 4.45 and 4.29 ppm. respectively. Multiplet at 3.86 ppm due to the superimposition of the signals of the methylene protons of the ethoxy group and the signals of the protons of the CH_2 groups located in the piperidinium ring at the nitrogen atom, as well as the signal of the protons of the N^+-CH_2-C-O group. Multiplet at 2.2 ppm corresponds to the signals of the protons of the methylene groups located in the heterocycle in the β- and γ-positions with respect to the nitrogen atom.

Clear triplet at 1.58 ppm due to the signal of the protons of the methyl group of the radical O-CH$_2$-CH$_3$.

Pic. 9. H-NMR spectrum of bis(2-benzyloxyethyl)diethylammonium bromide (9). Solvent CD3OD. Compound (9) has the following signals in the H-NMR spectrum. (δ-scale, ppm), CH$_3$C 1.26 (t), N+CH$_2$ 3.38 (m), OCH$_2$C 3.76 (t), ArCH$_2$O 4.36 (s). C$_6$H$_5$ 7.14 (s).
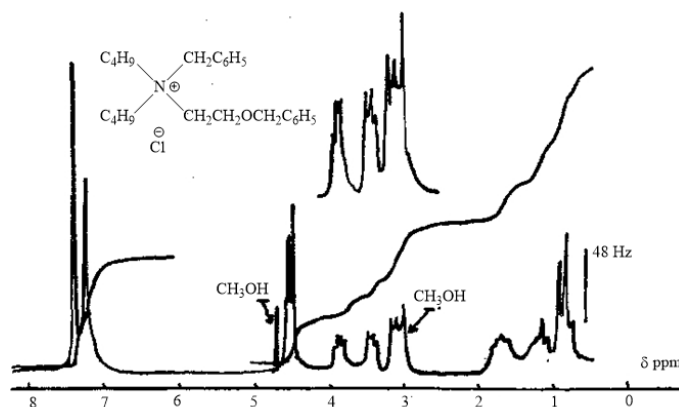
Pic. 10. H-NMR spectrum of benzyltris(2-benzyloxyethyl)ammonium chloride (10). Solvent CD$_3$OD. Compound (10) has the following signals in the H-NMR spectrum (δ-scale, ppm) N$^+$C-C$_6$H$_5$ 7.27 (s), O-C-C$_6$H$_5$ 7.19 (s), N$^+$-CH$_2$-Ar 4,65 (s), OCH$_2$Ar 4.35 (s), O-CH$_2$C 3.78 (t), N$^+$CH$_2$C 3.42 (t).
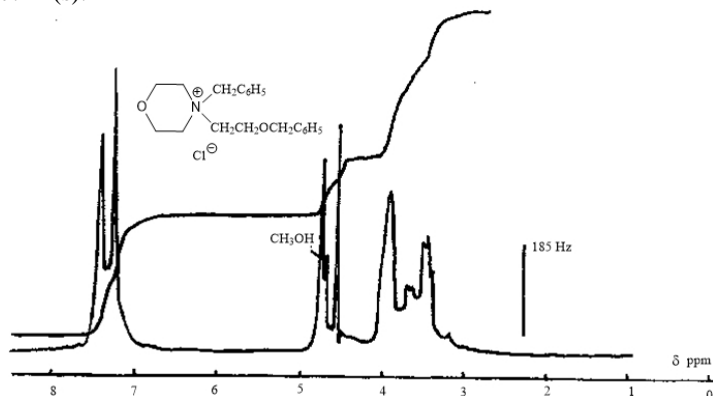
Pic.1. H-NMR spectrum of 4-benzyl-4-(2-benzyloxyethyl)morpholinium chloride (1)
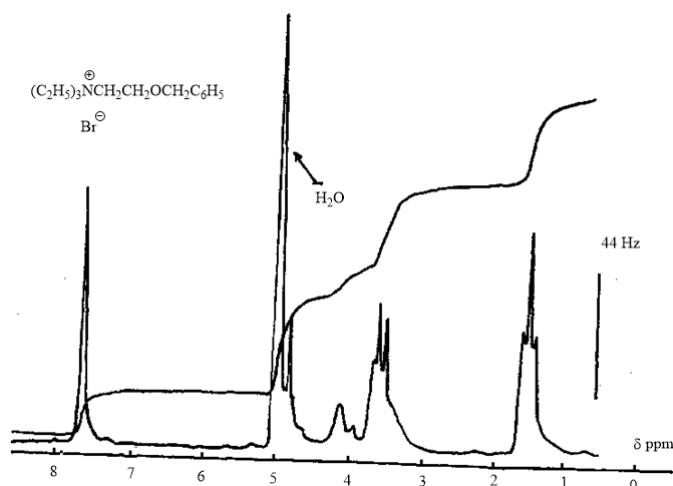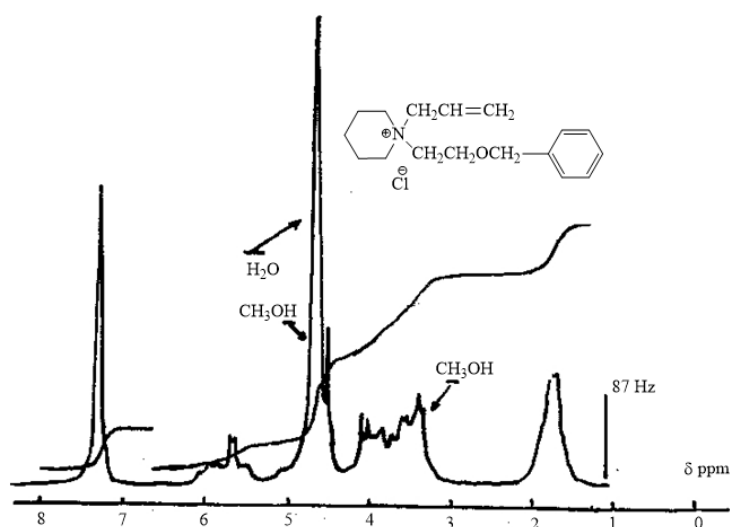

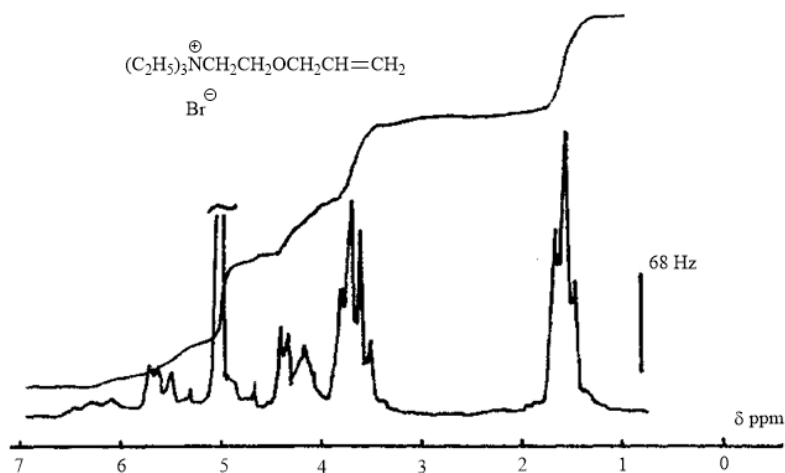**Pic.2. H-NMR spectrum of (2-benzyloxyethyl)triethylammonium bromide (2)**

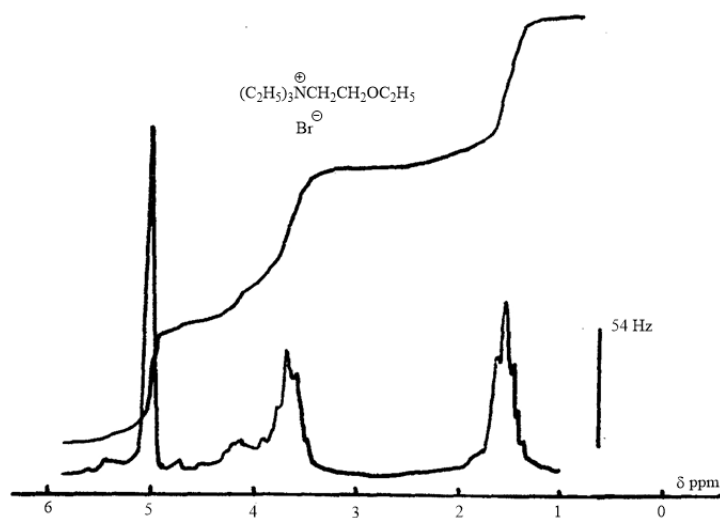**Pic.3. H-NMR spectrum of benzyl(2-benzyloxyethyl)dibutylammonium chloride (3)**

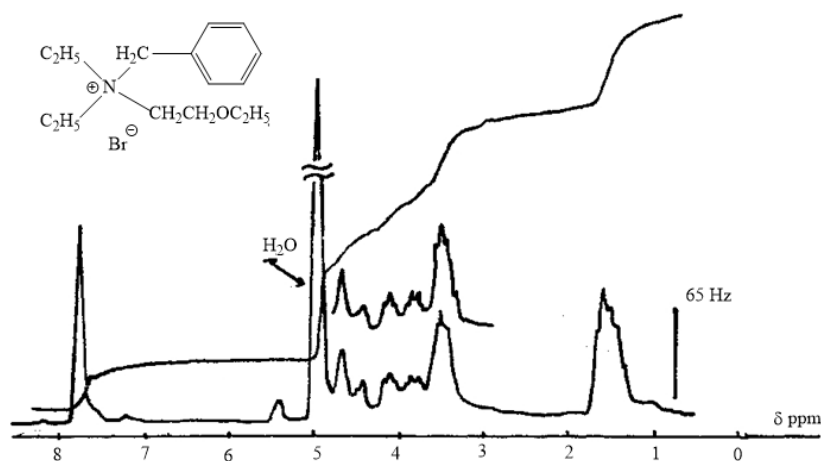**Pic.4. H-NMR spectrum of 1-allyl-1-(2-benzyloxyethyl)piperidinium chloride (4)**

Pic.5. H-NMR spectrum of (2-allyloxyethyl)triethylammonium bromide (5)

Pic.6. H-NMR spectrum of (2-ethoxyethyl)triethylammonium bromide (6)

Impact Factor:

ISRA (India) = **6.317**	**SIS** (USA) = **0.912**	**ICV** (Poland) = **6.630**
ISI (Dubai, UAE) = **1.582**	**РИНЦ** (Russia) = **3.939**	**PIF** (India) = **1.940**
GIF (Australia) = **0.564**	**ESJI** (KZ) = **8.771**	**IBI** (India) = **4.260**
JIF = **1.500**	**SJIF** (Morocco) = **7.184**	**OAJI** (USA) = **0.350**

Pic.7. H-NMR spectrum of benzyl(2-ethoxyethyl)diethylammonium bromide (7)
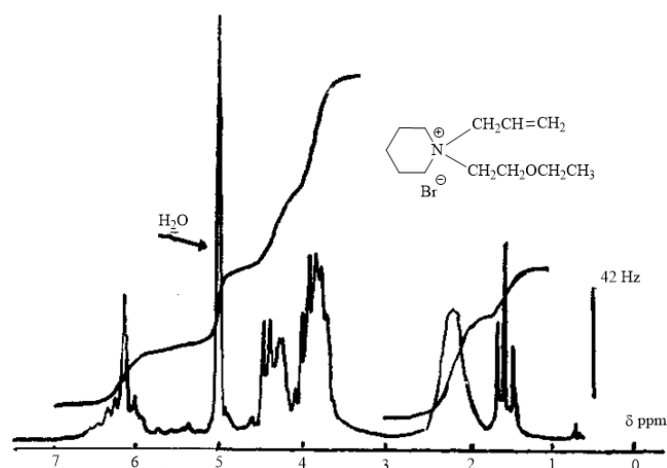
Pic.8. H-NMR spectrum of 1-allyl-1-(2-ethoxyethyl)piperidinium bromide (8)
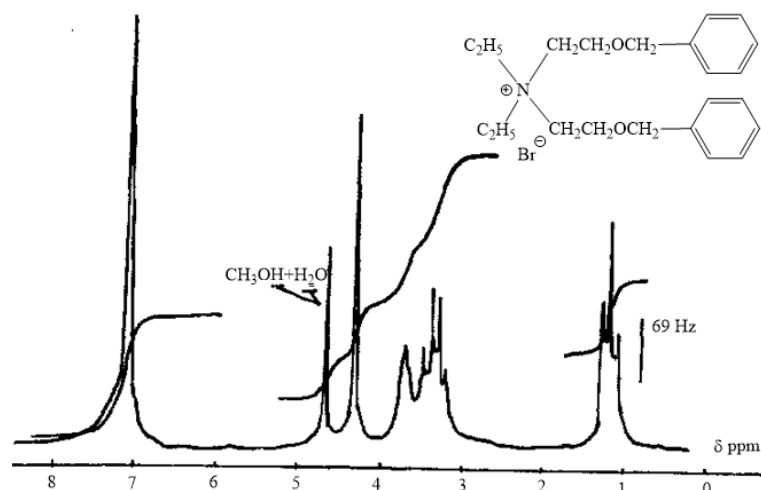
Pic.9. H-NMR spectrum of bis(2-benzyloxyethyl)diethylamine bromide (9)

Pic.10. H-NMR spectrum of benzyltris(2-benzyloxyethyl)ammonium chloride (10)
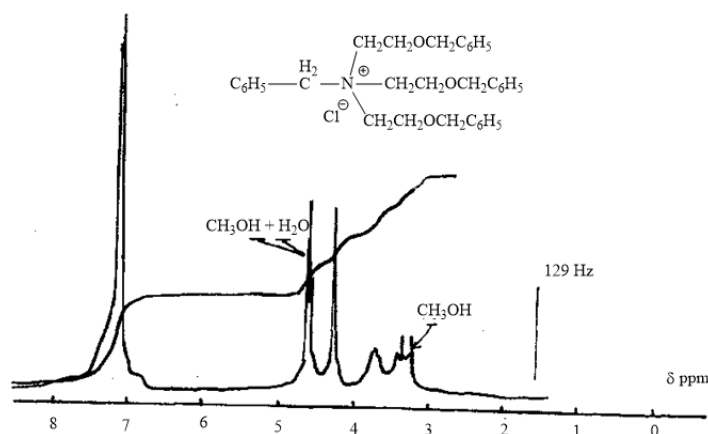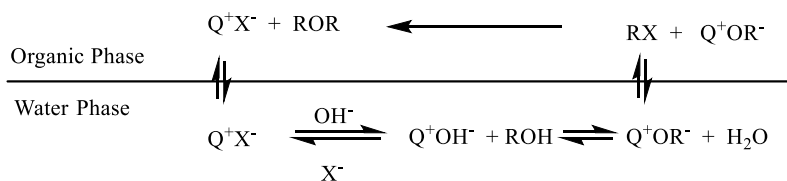
Thus, by studying the reactions of quaternary salts of 1,2-amino alcohols with organohalides in a four-phase system, under exceptionally mild conditions, i.e. in the presence of concentrated aqueous solutions of alkalis and an aprotic solvent at 10-20°C, we have revealed their important property, leading to the formation of quaternary salts of 1,2-aminoesters. It should be noted that the above study as a method of trapping nucleophilic particles by electrophiles confirms the results of the study that were obtained in our work [1], where it was shown that quaternary salts of 1,2-amino alcohols under the action of a strong base at low water vapor pressure over the reaction mixture at 0-20°C they form 2-trialkylammonioethoxides, which are bipolar compounds.

Besides it, the formation of 2-trialkylammonioethoxides from quaternary derivatives of 1,2-aminoalcohols, as well as their interaction with electrophiles, to some extent resembles the reaction of O-alkylation of the hydroxyl group in alcohols with alkyl halides, which proceeds under conditions of interfacial catalysis [2,3,4-10]. Let us consider a typical example of such catalysis. It has been established that in a two-phase system of 50% aqueous alkali and benzene in the presence of phase transfer catalysts, the reaction of O-alkylation of alcohols is accelerated and proceeds even at 0-20°C. When used as an interfacial catalyst - tetraalkylammonium halide Q^+X^- in the aqueous phase, ions are first exchanged between Q^+X^- and alkali to form Q^+OH^-, the latter then forms Q^+OR^- with alcohol. The last reaction takes place in the aqueous phase or at the phase boundary. The substitution between Q^+OR^- and RX takes place in the organic phase. The newly formed original catalyst Q^+X^- passes into the aqueous phase and the process is repeated. Thus, the role of the onium ion Q^+ consists in the formation of an ion pair with the anion QR^- and in the transfer of the ion pair to the organic phase, followed by the transfer of the halogen anion X^- to the aqueous phase.

$$Q^+X^- + ROR \longleftarrow \qquad RX + Q^+OR^-$$

Organic Phase

Water Phase

$$Q^+X^- \underset{X^-}{\overset{OH^-}{\rightleftarrows}} Q^+OH^- + ROH \rightleftharpoons Q^+OR^- + H_2O$$

It shows that, despite some similarities, the interaction of quaternary derivatives of 1,2-amino alcohols with alkali and the subsequent reaction of bipolar particles with electrophiles is a special process, i.e. in contrast to the O-alkylation of alcohols under the conditions of an interfacial process, in this case, not an ion pair is generated in the medium, but a bipolar molecule in which the negative charge is fixed on the oxygen atom, and the positive one on the nitrogen atom. In this respect, such a molecule also differs from zwitter ions, for example, from betaines,

in which charge localization is impossible due to the reaction proceeding according to the scheme [11]

$$H_3N^+CH_2COO^- \rightleftharpoons H_2NCH_2COOH$$
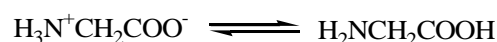
On the other hand, during the interaction of 2-trialkylammonioethoxide with an electrophile in the organic phase, the addition reaction of two molecules occurs, and in the reaction of the Q^+OR^- ion pair with RX under the conditions of the interfacial process, an exchange reaction occurs, and, in the first case, the obtained product does not participate in the further
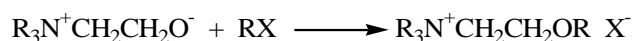
process. Thus, generalizing the results of our studies and known data on bimolecular substitution reactions [12, 13], the reaction of 2-trialkylammonioethoxides with electrophiles can be classified as a new type of nucleophilic substitution, proceeding between a bipolar nucleophile and a neutral substrate

$$R_3N^+CH_2CH_2O^- \ + \ RX \ \longrightarrow \ R_3N^+CH_2CH_2OR \ X^-$$

Obtaining quaternary salts of 1,2-aminoesters by the interaction of quaternary derivatives of 1,2-aminoalcohols with organohalogen compounds (Experimental part)

1. Synthesis of 4-benzyl-4-(2-benzyloxyityl) morpholinium chloride (1) from 2-(4-benzylmorpholinio)ethoxide. In a three-necked cylindrical flask equipped with a stirrer, a separating funnel and a bottom tap for draining the reaction mass, to a mixture of 22.1 g (0.1 mol) of 2-(4-benzylmorpholinio)ethoxide and 25 ml of dry benzene, while stirring, 12.65 g (0.11 mol) of benzyl chloride were added dropwise. The temperature of the reaction mixture is maintained with a water bath at 10–20°C. After two hours of stirring, benzene is separated from the reaction mixture, the oily residue is dissolved in 20 ml of propyl alcohol and filtered. Then propyl alcohol is distilled off from the solution, the residue is recrystallized from acetone and compound (109) is obtained in an amount of 32.6 g (93.8%) (see table).

2. Synthesis of 4-benzyl-4-(2-benzyloxyethyl) morpholinium chloride (1) from 4-benzyl-4-(2-hydroxyethyl) morpholinium chloride. In the above installation, to 40-50 g of a 50-55% aqueous solution of potassium hydroxide or sodium hydroxide, 50 ml of benzene, 25.75 g (0.1 mol) of 4-benzyl-4- (2-hydroxyethyl) are sequentially added morpholinium chloride and 13.92 g (0.11 mol) of benzyl chloride. The reaction mixture was intensively stirred for 2 hours. The temperature of the reaction mixture is maintained with a water bath at 10-15°C. At the end of the reaction, the stirrer is turned off. When left to stand, the reaction mixture separates into four phases: the upper phase consists of benzene, the second phase consists of 4-benzyl-4-(2-benzyloxyethyl) morpholinium chloride. The third phase, in addition to water and alkali, also contains an alkali metal halide. In the lower fourth phase is an alkali metal halide. The lower fourth and third phases are drained. 25 ml of water is added to the mixture remaining in the flask. The aqueous solution is separated from the benzene solution, transferred to a separating funnel and extracted again with 20 ml of benzene and acidified with hydrochloric acid until neutral. The water is then distilled off under reduced pressure until a viscous mass is formed. To the residue was added 20 ml of propanol and the insoluble part was separated. Then propanol is distilled off from the solution and compound (1) is obtained in the quantity of 34.12 g (98.2%).

Compounds (3, 4) are similarly obtained (see table).

3. Synthesis of (2-benzyloxyethyl) triethylammonium bromide (2). In the above setup, to a mixture of 40 ml of 50% sodium hydroxide, 50 ml of benzene, 22.6 g (0.1 mol) of (2-hydroxyethyl) triethylammonium bromide and 13.92 g (0.11 mol) of benzyl bromide are added successively. The reaction mixture is intensively stirred at 10-15°C for 2 hours. At the end of the reaction the stirrer is stopped and the reaction mixture is left for foliation. Then the lower two phases are drained. To the mixture remaining in the flask, 25 ml of water is added. Then the aqueous solution is separated from the benzene solution, transferred to a separating funnel and extracted with 20 ml of benzene. After that, the aqueous solution is acidified with hydrobromic acid until neutral, and water is distilled off from the solution under reduced pressure at 60-70 °C. Quaternary salt of 1,2-aminoester (2) is isolated from the residue by a similar method described in 2 methods in the amount of 30.6 g (96.84%).

Compounds (5-8) were obtained similarly (see table).

4. Synthesis of bis(2-benzyloxyethyl) diethylammonium bromide (9). In the above installation, to a mixture of 60 g of 50% sodium hydroxide, 50 ml of benzene, 24.2 g (0.1 mol) of bis (2-hydroxyethyl) diethylammonium bromide and 37.62 g (0.22 mol) of benzyl bromide are successively added. The reaction mixture is vigorously stirred at 15-20°C for 2-3 hours. At the end of the reaction, the stirrer is stopped and the reaction mixture is left for foliation. Then the lower two phases are decanted. The mixture remaining in the flask is neutralized with hydrobromic acid until neutral, transferred to a distillation flask, and benzene is distilled off. Then 40 ml of propanol is added to the residue and the insoluble part in propanol is separated. Then propanol is separated by evaporation and compound (9) is obtained in the amount of 39.3 g (93.1%) in the form of a viscous mass (see table).

5. Synthesis of benzyltris(2-benzyloxyethyl) ammonium chloride (10). In the described installation, to a mixture of 50 ml of benzene, 80 g of a 50% aqueous solution of potassium hydroxide, 27.55 g (0.1 mol) of benzyl tris (2-hydroxyethyl) ammonium chloride, at 15-20 ° C with vigorous stirring, (0.32 mol) benzyl chloride is added dropwise. The feed rate is adjusted so that the temperature of the reaction mixture does not exceed 30°C. After the addition of benzyl chloride, the reaction mixture was stirred for

another 3-4 hours and processed as in method 4. Compound (10) was obtained in the quantity of 51.3 g (94%) (see table).

Table 1. Results of the interaction of quaternary salts of 1,2-amino alcohols with alkyl-, allyl- and benzyl halides in the system of 50-55% aqueous KOH (or NaOH) and benzene

№	Name of the compound. Brutto formula	Jield, in, в %	Melting temp., in °C or physical form at 20 °C	Elementary analysis, in % Found/calcualted			
				C	H	N	Hal
1	2	3	4	5	6	7	8
1	4-Benzyl-4(2-benzyloxyethyl)morpholinium chloride C$_{20}$H$_{26}$O$_2$NCl	96,2	148-150	69,31 69,06	7,77 7,48	4,21 4,03	4,16 4,03
2	(2-Benzyloxyethyl)triethylammonium bromide C$_{15}$H$_{26}$ONBr	96,8	96-98	56,71 56,96	8,44 8,23	4,70 4,43	25,50 25,32
3	Benzyl-4(2-benzyloxyethyl)dibutylammonium chloride C$_{24}$H$_{36}$ONCl	94,7	110-112	73,76 73,94	9,53 9,24	3,37 3,59	9,26 9,11
4	4-Allyl-1-(2-benzyloxyethyl)piperidinium chloride C$_{17}$H$_{26}$ONCl	89,3	масла	69,31 69,04	8,97 8,80	4,56 4,74	12,28 12,01
5	2-Allyloxyethyl)triethylammonium bromide C$_{11}$H$_{24}$ONBr	95,3	66-68	49,47 49,62	9,02 9,02	5,26 5,26	30,08 30,08
6	(2-Ethoxyethyl)triethylammonium bromide C$_{10}$H$_{24}$ONBr	94,5	72-74	47,00 47,24	9,62 9,62	5,33 5,51	31,21 31,50
7	Benzyl(2-ethoxyethyl)diethylammonium bromide C$_{15}$H$_{26}$ONBr	97,3	масла	56,76 56,96	8,30 8,23	4,21 4,43	25,05 25,32
8	1-Allyl-1-(2-ethoxyethyl)piperidinium bromide C$_{12}$H$_{24}$ONBr	97,4	масла	51,58 51,80	8,43 8,63	5,32 5,04	28,59 28,78
9	Bis(2-benzyloxyethyl)diethylammonium bromide C$_{22}$H$_{32}$ONBr	93,1	масла	62,31 62,56	7,81 7,58	3,43 3,32	18,74 18,96
10	Benzyltris(2-benzyloxyethyl)ammonium chloride C$_{34}$H$_{40}$ONCl	94,0	масла	74,58 74,79	7,21 7,33	2,69 2,57	6,33 6,51

Conclusions

It was found for the first time that in the four-phase system "solid phase - aqueous phase - organic phase - organic phase" in the reaction of quaternary salts of 1,2-amino alcohols with organohalogen compounds, the corresponding quaternary salts of 1,2-amino ethers are formed as a result of the generation of 2-trialkylammonioethoxides. Alkylation of the OH group in quaternary compounds of 1,2-amino alcohols occurs at room temperature in the presence of 50% alkali and benzene, without the addition of a phase transfer catalyst.

It was defined that the regularities typical for the reaction of quaternary salts of 1,2-amino alcohols are characteristic of quaternary salts of bis-, tris(2-hydroxyethyl)amines under the same conditions.

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