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SYNTHESIS OF AMINOCOMPOUNDS AND OBTAINED ON THEIR BASE OF SOME BIOLOGICALLY ACTIVE COMPOUNDS

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Резюме: Ушбу мақолада ацетилен спиртлари ва фенилацетилендан Манних реакцияси асосида аминоспиртлар ва аминобирикмаларнинг ҳосил бўлиши ва синтезланган аминобирикмаларнинг галогенли ҳосилаларининг биологик активлиги ўрганилди. Ацетилен спиртлари А.Е.Фаворский реакцияси билан синтезланди ва фенилацетилен эса стиролдан олинди. Аминоспиртлар ҳосил бўлиш унумига турли омиллар (температура, катализатор, вақт ва эритувчи табиати) таъсири ўрганилди. Ацетилен аминоспиртлари ҳосил бўлиш меҳа-низмининг назарий таҳлили ифодаланди. Синтезланган аминоспиртларнинг физик –кимёвий катталиклари аниқланди ва ҳосил бўлиш унуми топилди. Аминоспиртларнинг кимёвий тузилиши ИК –ва ПМР –спектрлари билан тасдиқланди. Аминобирикмаларни хлорлаш ва бромлаш асосида синтезлан-ган бирикмаларнинг биологик активлиги ўрганилди.

Калит сўзлар : катализатор, Манних реакцияси, (N-оксиметил)амин, конден -сация реакцияси, ИК-спектр, валент тебраниш, деформацион тебраниш, стимулятор, антимикробли активлик.

Аннотация. В статье изучены образование аминоспиртов и аминосоединений на основе реакции Манниха из ацетиленовых спиртов и фенилацетилена и биологическая активность галогенированных производных синтезированных аминосоединений. Ацетиленовые спирты синтезированы по реакции А.Е. Фаворского, а фенилацетилен получен из стирола. Изучено влияние различ -ных факторов (температуры, при разные катализаторов, времени и природы растворителя) на выход аминоспиртов. Дан теоретический анализ механизма образования ацетиленаминспиртов. Определены физико-химические свойст- ва синтезированных аминоспиртов и был найден их выход.



Химическая структура аминспиртов подтверждена ИК- и ПМР-спектрами. Изучена биологическая активность соединений, синтезированных хлорированием и бромированием аминсоединений.

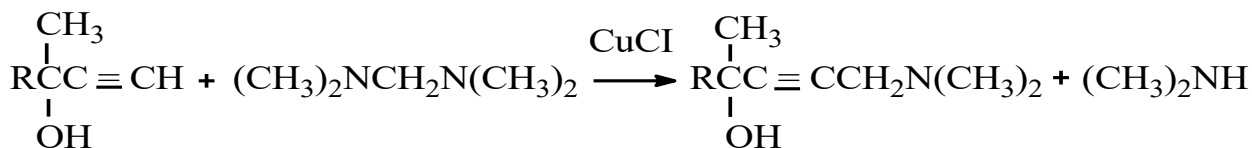
Ключевые слова: катализатор, реакция Манниха, N-оксиметиламин, реакция конденсации, ИК-спектр, валентные колебания, деформационные колебания, стимулятор, антимикробная активность

Annotation. In the article formation of aminoalcohols and aminocompounds by Mannich reaction from acetylenic alcohols and phenylacetylene and also biological activity of halogenated derivatives of the synthesized aminocompounds have been investigated. Acetylenic alcohols were synthesized by the reaction A.E. Favorsky and phenylacetylene was obtained from styrene. The influence of various factors (temperature, catalyst, time and nature of solvents) on the yield of aminoalcohols was studied. A theoretical analysis of the mechanism of formation of acetylenic aminoalcohols is given. The physico-chemical properties of the synthesized aminoalcohols and their yields were determined. The chemical structure of aminoalcohols has been confirmed by IR and PMR spectrums. The biological activity of compounds synthesized by chlorination and bromination of aminocompounds has been investigated.

Key words: catalyst, Mannich reaction, N-hydroxymethylamine, condensation reaction, IR spectrum, valent vibrations, deformational vibrations, stimulant, antimicrobe activity.

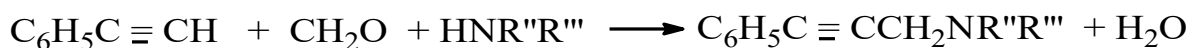
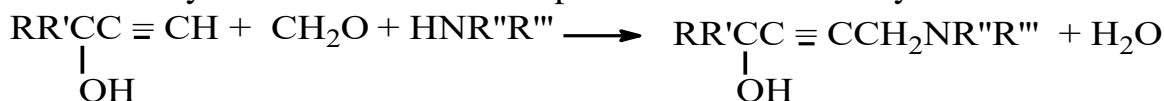
Introduction. Mannich reaction has allowed to synthesise physiologically active compounds and aminoalcohols [1] which are used in industry as adsorbents at purification of gases; compounds strengthening process of vulcanization of synthetic and natural rubbers; inhibitors of metals corrosion. also they are used for formation of coverings on metallic surfaces and increasing of corrosion stability of different metals [2,3]. Aminoalcohols obtained on the base of acetylene, phenylacetylene and acetylene alcohols are very important compounds because on their base pesticides, medical preparates, bactericides, stimulants and inhibitors are obtained [4-7]. Many chemists are interested in the synthesis of compounds containing different functional groups in their molecules and investigation of their different properties. Aminoalcohols containing in their composition triple bond have theoretical and practical importance. Aim of this investigation is synthesis of aminoalcohols and aminocompounds on the base of tertiary acetylenic alcohols and phenylacetylene and investigation of physico-chemical properties of obtained compounds and obtain on their base biologically active substances. Acetylenic alcohols have been synthesized by reaction of A.E. Favorsky [8] and phenylacetylene was obtained by bromination of styrene [9]. Synthesis of aminoalcohols by Mannich reaction from acetylenic alcohols and phenylacetylene.

Aminoalcohols are synthesized by two methods: breaking of diamines and the Mannich reaction. Yields of aminoalcohols obtained by breaking of diamines were equalled 84-96% [10]. Reaction was carried out at 80 °C and normal pressure during 3-5 hours without using solvent. Scheme of obtained compounds can be presented as following :



where : R = -C₂H₅ ; - C₄H₉ ; - C₆H₁₃

Acetylenic alcohols and phenylacetylene have possessed by enough acidic properties owing to presence of mobile hydrogen atom at triple bond. Ions metals such as Cu⁺, Cu²⁺ and Ag⁺ can substitute hydrogen atom. Intermediate metal-organic compounds have transformed in aminoalcohols by Mannich reaction with paraformaldehyde and secondary amines. In this reaction n-dioxane was used as solvent and salts Cu₂Cl₂ and Cu(CH₃COO)₂ were used as catalysts. This reaction for obtaine acetylene derivatives can be presented schematically as fol-lows:



where : R = R' = -CH₃ ; R = - CH₃, R' = - C₂H₅ ; R = - H, R' = - C₃H₇

R'' = R''' = - CH₃ ; R'' = R''' = -C₂H₅ ; R'' = R''' = - C₄H₉ ; R'' = R''' = - C₅H₁₀

It was determined that yield of aminoalcohols has depended on following factors: a) temperature. At temperature 35-45 °C rate of reaction was low but at 45-85 °C yield of aminoalcohols was equaled 50-55% and at 85-100 °C it's yield was equled 66-80%. From fig. 1 it is shown that yield of aminoalcohol has increased with increasing molecular mass of secondary amine. At using hetero-cyclic amines such as piperidine and morpholine yield of aminoalcohols was equaled 50-64%.

Table 1

Dependence on yield of reaction from temperature

| Temperature, °C | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 120 |
|--|---------------------|----|----|----|----|----|----|-----|-----|
| Name of substance | Yield of reaction,% | | | | | | | | |
| 5-N-diethyl - amino-2-methyl pentin-3-ol-2 | - | 23 | 30 | 40 | 50 | 59 | 62 | 65 | 60 |
| 5-N-dibutyl amino-2-methyl pentin-3-ol -2 | 18 | 27 | 38 | 45 | 55 | 63 | 70 | 73 | 70 |
| 5-N-pyperidil-2-methylpentin-3-ol-2 | - | - | 25 | 33 | 40 | 49 | 54 | 60 | 54 |

1. (CH₃)₂COHC ≡ CCH₂N(C₂H₅)₂ (5-N-diethylamino-2-methylpentin-3-ol-2)

2. (CH₃)₂COHC ≡ CCH₂N(C₄H₉)₂ (5-N-dibutylamino-2-methylpentin-3-ol-2)

3. (CH₃)₂COHC ≡ CCH₂NC₅H₁₀ (5- N-pyperidil -2-methylpentin-3-ol-2)

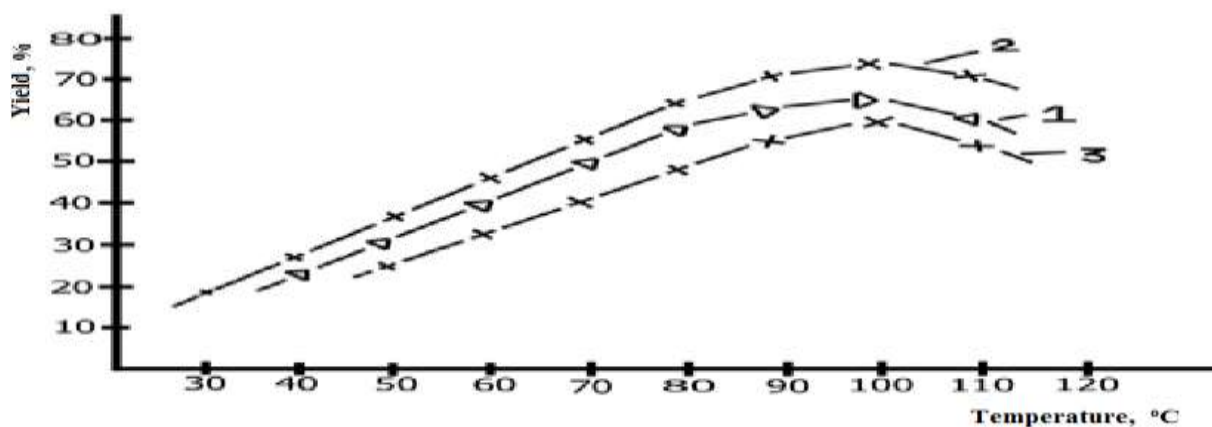


Fig.1. Dependence of aminoalcohols yield from temperature

b) nature of catalysts. Influence of nature of catalysts on yield of acetylenic aminoalcohols was investigated. Results, obtained in presence of withoutoxygen and oxygen salts of d-metal namely of Cu^+ and Cu^{2+} used as catalysts are presented in table 2 .

Table 2

Dependence on aminoalcohols yield from nature of catalysts

| Composin of catalyst | CuI | CuBr | CuBr ₂ | CuCl ₂ | CuCl | Cu(CH ₃ COO) ₂ | CuSO ₄ |
|---|-----------------------|------|-------------------|-------------------|------|--------------------------------------|-------------------|
| Name of substances | Yield of reaction , % | | | | | | |
| 1).6-N-diethylamino-3-methylhexine-4-ol-2 | 34,6 | 47,8 | 58,4 | 67,2 | 80,6 | 79,2 | 70,3 |
| 2). 6-N-dibutylamino -3-methylhexine-4-ol-2 | 33,8 | 34,9 | 40,4 | 45,3 | 52,9 | 63,6 | 56,4 |
| 3). 6-N-piperidyl-3-methylhexine-4-ol-2 | 35,7 | 36,7 | 51,5 | 58,7 | 67 | 66,8 | 57,3 |
| 4).3-N-diethylamino-1-phenylpropine - 1. | 46,3 | 50,8 | 59,9 | 64,8 | 61,1 | 62,1 | 63,4 |

Salts containing in their composition ions Cu^+ , Cu^{2+} and Ag^+ have increased yield of reaction. In presence of salts containing in their composition such ions as Br^- and I^- yield of products was low, but in presence of such salts as Cu_2Cl_2 and $\text{Cu}(\text{CH}_3\text{COO})_2$ aminoalcohols have been obtained with high yields.

c) duration of reaction. Yield of aminoalcohols also has depended on duration of reaction. For example, yield of 5-N-dibutylamino-2-methylpentine-3-ol-2 was equaled 30; 41 and 65 % at time 2; 4 and 8 hours. Data by dependence on yield of some synthesized compounds from duration reaction are presented in table 3 and fig. 2.

Table 3

Dependence products yield on duration of reaction

| Name of substance | 5-N-dibutylamino-2-methylpentine-3-ol-2 (2) | 5-N-diethylamino-2-methylpentin-3-ol-2 (1) | 5-N-pyperidyl-2-methylpentine-3-ol-2 (3) |
|-------------------|---|--|--|
| Time, h. | Yield, % | | |
| 2 | 34 | 30 | 22 |
| 3 | 40 | 35 | 29 |
| 4 | 47 | 41 | 33 |
| 5 | 53 | 44 | 40 |
| 6 | 60 | 52 | 41 |
| 7 | 68 | 59 | 52 |
| 8 | 75 | 65 | 59 |
| 10 | 70 | 63 | 50 |

1. $(\text{CH}_3)_2\text{COHC} \equiv \text{CCH}_2\text{N}(\text{C}_2\text{H}_5)_2$ (5-N-diethylamino-2-methylpentin-3-ol-2)
2. $(\text{CH}_3)_2\text{COHC} \equiv \text{CCH}_2\text{N}(\text{C}_4\text{H}_9)_2$ (5-N-dibutylamino-2-methylpentin-3-ol-2)
3. $(\text{CH}_3)_2\text{COHC} \equiv \text{CCH}_2\text{NC}_5\text{H}_{10}$ (5-N-pyperidil-2-methylpentin-3-ol-2)

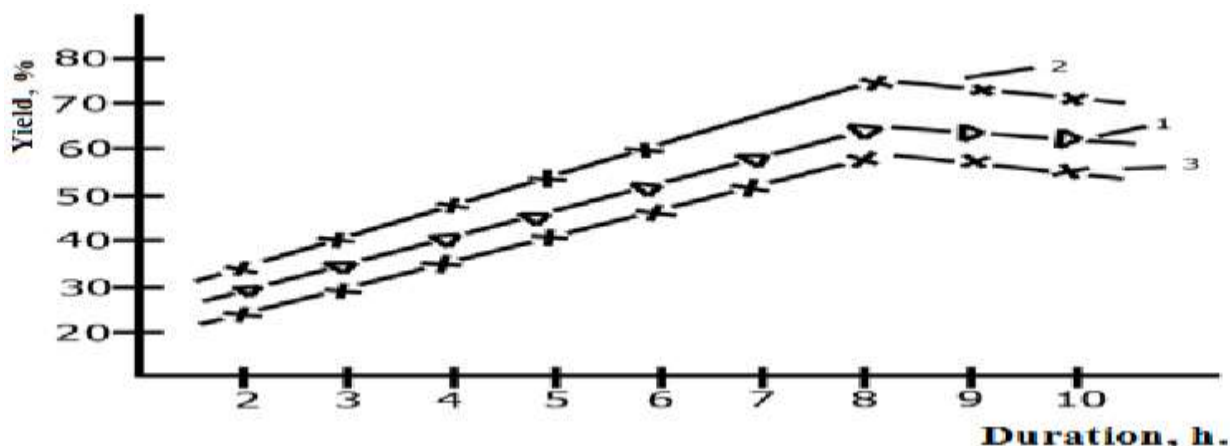


Fig. 2. Dependence on yield of aminoalcohols from reaction time.

g) Nature of solvent. It was shown that yield of aminoalcohols has depended on nature of solvent: in polar solvents such as dioxane ($t_b = 101,1$) yields of aminoalcohols was high (83% and more) and in polar solvents such as benzene and hexane aminoalcohols were obtained with lower yields. Dependence on aminoalcohols yields from nature of solvents is presented in table 4.

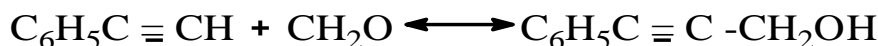
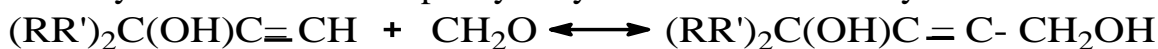
Table 4

Dependence on the aminoalcohol yield from nature of the solvents.

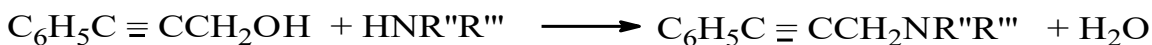
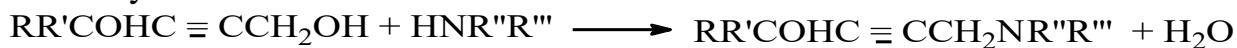
| Name of substance | | Solvent ; yield (%) | | |
|-------------------|--|---------------------|---------|---------|
| № | | Hexane | Benzene | Dioxane |
| 1 | 7-N-diethylamino-5-hydroxy-4-hexene-1-ol | 40,6 | 45,3 | 49-52 |
| 2 | 5-N-piperidyl-2-methylhexyl-3-ol-2 | 48,1 | 56,4 | 58-67 |
| 3 | 6-N-dibutylamino-3-methylhexyn-4-ol-3 | 44,9 | 47,7 | 52,9 |
| 4 | 3-N-piperidyl-1-phenylpropyn-1 | 64,3 | 72,5 | 71-83 |

Mechanism of Mannich reaction didn't determined, but there are two scientific propositions about its mechanism: 1) reaction of aminomethylation of acetylenic

alcohols and phenylacetylene. This process consists from two stages : a) interaction of acetylenic alcohols and phenylacetylene with formaldehyde :



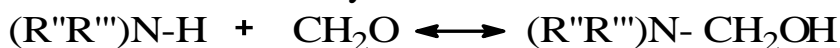
b) Formation of aminoalcohols by condensation of forming intermediates with secondary amines :



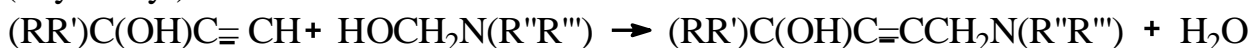
where : $R = R' = -CH_3$; $R = -CH_3$, $R' = -C_2H_5$; $R = -H$, $R = -C_3H_7$

$R'' = R''' = -CH_3$; $R'' = R''' = -C_2H_5$; $R'' = R''' = -C_4H_9$; $R'' = R''' = -C_5H_{10}$

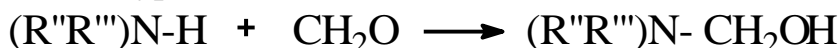
Second preposition. a) formation of N-(oxymethyl) by interaction of secondary amines with formaldehyde :



b) condensation through hydrogen atom at triple bond with intermediate N-(oxymethyl) alcohol:



According to first preposition dimethylethynylcarbinol has reacted with paraformaldehyde in presence of Cu(I) salt in dioxane as solvent. In this case acetylenides didn't react with paraform and reaction of aminomethylation has based on second hypothesis:



Secondary amines have reacted with formaldehyde with formation of N-(oxymethyl)-amine :

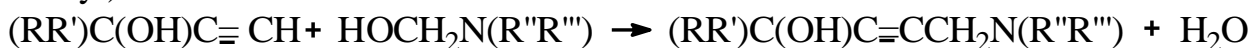


Table 5

Physico-chemical properties of synthesized acetylenic aminoalcohols

| No | Structure formule and name of substance | Yield, % | Temperature of boiling, °C (mm. of Hg st.) | n_D^{20} | d_4^{20} g/sm ³ |
|----|---|----------|--|------------|------------------------------|
| 1 | $(CH_3)_2NCH_2C\equiv CCOH(CH_3)_2$ 5-N-dimethylamino-2-methylpentyn-3-ol-2 | 60 | 92,7 | 1,4570 | 0,9093 |
| 2 | $(CH_3)_2NCH_2C\equiv CCOH(CH_3)C_2H_5$ 6-N-dimethylamino-3-methylhexyn-4-ol-3 | 62,0 | 101/7 | 1,4590 | 0,9067 |
| 3 | $(C_2H_5)_2NCH_2C\equiv CCOH(CH_3)_2$ 5-N-diethylamino-2-methylpeptin-3-ol-2 | 67,4 | 92/4 | 1,4614 | 0,9011 |
| 4 | $(C_4H_9)_2NCH_2C\equiv CCOH(CH_3)_2$ 5-N-dibutylamino-2-methylpentyne-3-ol-2 | 75,0 | 144-145/17 | 1,4860 | 0,9176 |
| 5 | $C_5H_{10}NCH_2C\equiv CCOH(CH_3)_2$ 5-N-piperidyl-2-methylpentyne-3-ol-2 | 50-60 | 112/3 | 1,4895 | - |

| | | | | | |
|----|--|-------|------------|--------|--------|
| 6 | $C_5H_{10}NCH_2C \equiv CCOH(CH_3)C_2H_5$ 6-N-piperidyl-3-methylhexyne-4-ol-3 | 58-67 | 124/3 | 1,4918 | - |
| 7 | $(CH_3)_2NCH_2C \equiv C-C_6H_5$ 3-N-dimethylamino-1-phenylpropyne-1 | 61,9 | 115/8 | 1,4441 | 0,9147 |
| 8 | $(C_2H_5)_2NCH_2C \equiv C-C_6H_5$ 3-N-diethylamino-1-phenylpropyne-1 | 61,1 | 140-141/10 | 1,4321 | 0,9849 |
| 9 | $(C_4H_9)_2NCH_2C \equiv C-C_6H_5$ 3-N-dibutylamino-1-phenylpropyne-1 | 54,5 | 174/15 | 1,4040 | 0,9019 |
| 10 | $C_5H_{10}NCH_2C \equiv C-C_6H_5$ 3-N-piperidyl-1-phenyl-propyne-1 | 71-83 | 123/3 | 1,5620 | - |

IR- spectrums of synthesized compounds have been obtained on UR-20 in thin layer of KBr. Valent vibrations of methyl and methylene groups in IR spectrum of 5-N-diethylamino-2-methylpentyne -3- ol-2 (Fig. 3) have been observed at $2900 - 2700 \text{ cm}^{-1}$; valent vibrations of CO group at $1800 - 1700 \text{ cm}^{-1}$. Absorption of valent vibrations of $-C \equiv C-$ group were observed in range $2200 - 2100 \text{ cm}^{-1}$; absorption of deformation vibrations of $-C \equiv C-$ group were observed at 3315 cm^{-1} .

Wide band in range $3450-3000 \text{ cm}^{-1}$ is attributed to valent vibrations of OH-group: deformation vibrations of methylene group were observed at 1400 cm^{-1} . It is necessary to note that absorption at 1400 cm^{-1} can be attributed to deformation vibrations $-CH_2-N=$ group.

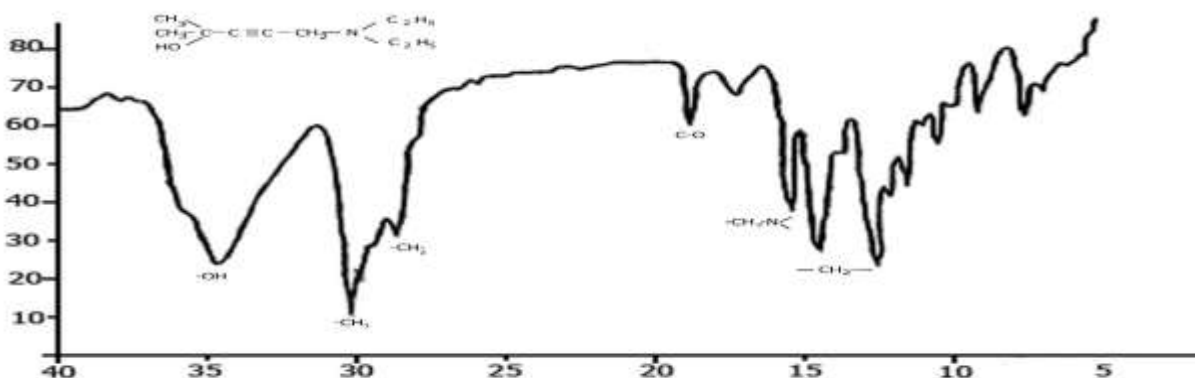
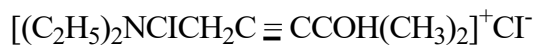


Fig.3. IR – spectrum of 5-N-diethylamino-2- methylpentyne -3-ol-2
Spectrums PMR (1H and ^{13}C) of obtained compounds were obtained on the Varian -400. PMR spectrums of acetylenic alcohols and phenylacetylene were : in aminoalcohols there are lines which can be attributed to TMS $(CH_3)_4Si$ NMR of acetylenic alcohols and phenylacetylene were obtained in pure type: spectrums of aminoalcohols and aminocompounds were obtained at using $CDCl_3$. In PMR spectrum of 5-N- diethyl-2-methylpentyne -3-ol-2 signals of methyl group were observed at 0,9-1,0 m.d.(9H) ; signal of protone at OH- group was observed at 3,20 m.d. with chemical displacement (1 H); signals of protons of methylene group were observed at 1,5-1,7 m.d. (2 H).

Synthesis of herbicides and biostimulators from aminoalcohols.

Aminoalcohols for obtaining biologically active compounds were undergone to chlorination; such reaction of 5-N-diethylamino-2-methylpentene-3-ol-2 was carried out in flask by volume 50 ml under action of light in polar solvent (CCl_4) during 5-6 h. at temperature 60-70 °C; stream of gaseous chlorine obtained under action of acid HCl on KMnO_4 was directed in solution of aminoalcohol in CCl_4 . Formation of trans-dichlorine products was observed what was proved by gas-chromatographical method. At low temperature molecules of chlorine have been connected to aminoalcohol in form N-halogenide:



and at high temperature in form $(\text{C}_2\text{H}_5)\text{NCH}_2\text{CCl}=\text{CClCOH}(\text{CH}_3)_2$. Chemical structure of synthesized halogencontaining compounds was proved by IR and PMR- ^1H spectrums. Valent vibrations of methyl and methylene groups in IR-spectrum of 3,4-dichlor-5-N-diethylamino-2-methylpentene-3-ol-2 were observed in range 2900 – 700 cm^{-1} ; valent vibrations of CO-group- in range 1800 -1700 cm^{-1} ; valent vibrations of C=C-group were observed in range 1645- 1600 cm^{-1} ; wide band in range 3450-3000 cm^{-1} has been attributed to OH-group. Also there are absorption attributed to deformation vibrations of methylene group in range 1400 cm^{-1} . It is necessary to note that absorption at 1440 cm^{-1} was attributed to group – $\text{CH}_2\text{-N}=\text{}$ and absorption in range 600 – 800 cm^{-1} - to group C-Cl.

Threeplated signal corresponding to methyl group was observed in PMR ^1H spectrum of obtained 3,4-dichlor-5-N-diethylamino-2-methylpentene-3-ol-2 in range 0,9 – 1,0 m.d.(9H). Signal of proton of OH-group was observed at 3,20 m.d. with chemical displacement. Chemical structure of synthesized trans-1,2-dichlor-3-N-piperidyl-1-phenylpropene-1 has been confirmed by IR-spectroscopically (fig.4.) and mass-spectroscopically (fig.5).

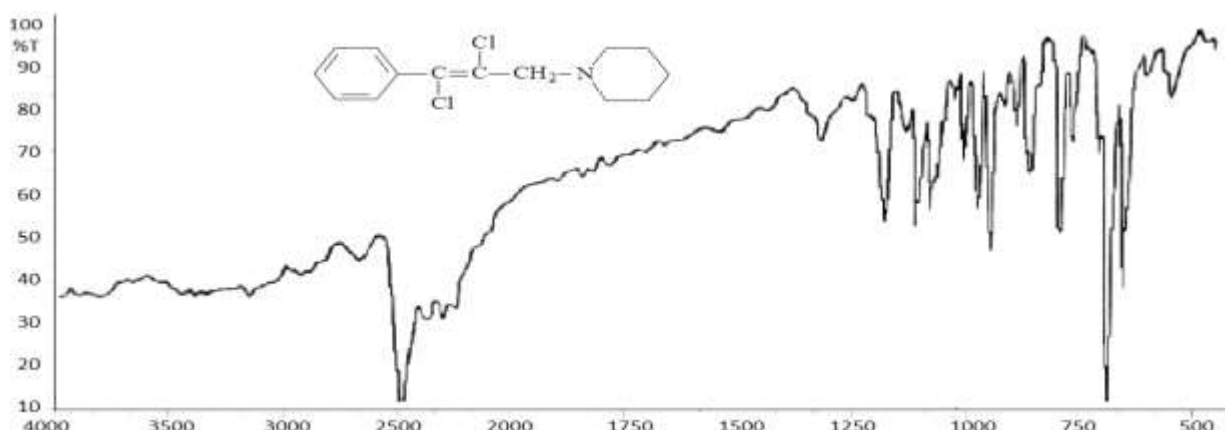


Fig.4. IR- spectrum of trans-1,2-dichlor-3-N-piperidyl-1-phenylpropene-1

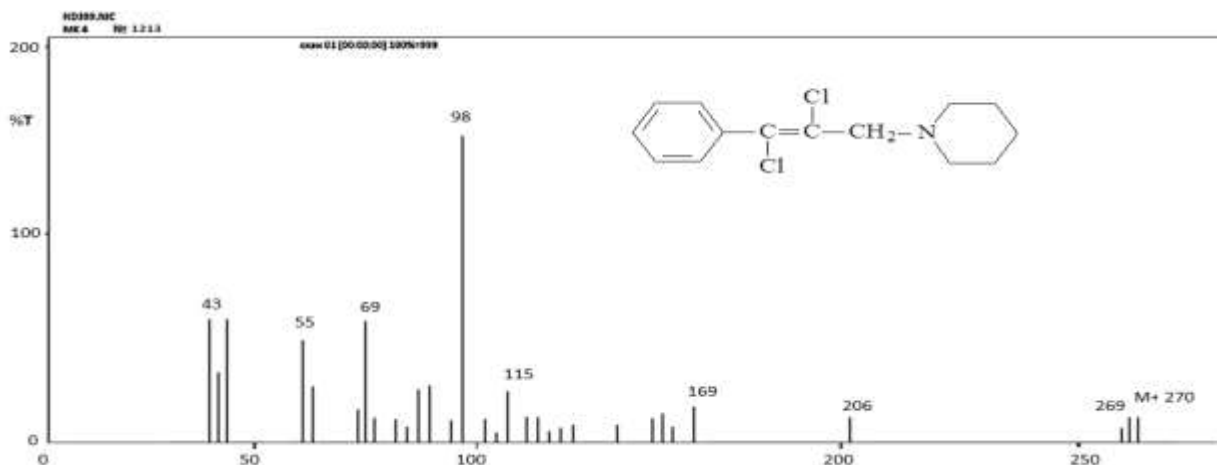


Fig.5. Mass – spectrum of trans – 1,2 – dichlor-3-N- piperidyl-1-phenylpropen -1
Table 6

Synthesized chlorinecontaining compounds.

| № | Name of compounds and their structural formulas | Yield of reaction, % | Temperature of boiling, °C(mm.of Hg st.) and temperature of melting, °C. |
|---|--|----------------------|---|
| 1 | 3,4-dichlorine-5-N-diethylamino-2-methylpentyn-3 -ol-2 $(C_2H_5)_2NCH_2CCl = CCICOH(CH_3)_2$ | 82,7 | 85/10 |
| 2 | 4,5-dichlorine- 6 –N-piperidyl -3-methylhezen -4- ol-3 $C_5H_{10}NCH_2CCl = CCICOH(CH_3)C_2H_5$ | 87,9 | 95/ 10 |
| 3 | trans -1.2 –dibromine-3-N-dimethylamino -1-phenylpropen-1 $(CH_3)_2NCH_2CBr = CBrC_6H_5$ | 66 -71 | 74- 75 |
| 4 | trans -1.2 –dichlorine -3 –N-piperidyl-1-phenylpropen-1 $C_5H_{10}NCH_2CCl = CCIC_6H_5$ | 70 -80 | 39 -40 |

Biological activity of obtained compounds was studied and at this laboratory tests have shown that 4,5-dichlorine- 6–N-piperidyl -3-methylhezen -4- ol-3 has possessed by herbicidal properties; 6-N-piperidyl-3-methylhexyn-4-ol-3 and 3,4-dichlorine-5-N-diethylamino-2-methylpentyn-3 -ol-2 have possessed by biostimulatory properties what have provided by growth of cotton roots and also improvement of germination of cotton seeds. In result cotton harvest, physico-mechanical properties and dimensions of cotton fibers were increased. For dihalogen containing compounds on the base of phenylacetylene such as trans -1.2 –dibromine-3-N-dimethylamino -1- phenylpropen-1 and trans -1.2 –dichlorine -3 –N-piperidyl-1-phenylpropen-1 antimicrobial activity was determined. It was shown that these compounds can be used in fight with stafilococcal infection, paratyphoses A and B, abdominal tubercles and some other diseases.

Conclusions. 1. In reactions of synthesis of aminoalcohols on the base of acetylenic alcohols and phenylacetylene yield of products has depended on nature of solvents, catalysts, temperature and duration of reaction.



2. Yield of aminocompounds obtained from phenylacetylene by Mannich reaction was higher in comparison with aminoalcohols, obtained from acetylenic alcohols.
3. Acetylenic aminoalcohols and phenylamines are yellow transparent liquides soluble in water.
4. Obtained aminocompounds are biologically active and they can be used in medicine and agroindustry.

Recommendations : 1. It is necessary to investigate obtained o-, m- and p- methyl - phenylacetylenes ; to synthesise from them aminocompounds by Mannich reaction and to determine biological activity of the obtained aminocompounds;

2. it is necessary to use aminoalcohols and aminocompounds obtained on the base of acetylenic alcohols and phenylacetylene as inhibitors for decreasing of metals corrosion ;

3. it is necessary to investigate syntheses of monoamines by decomposition of aminoalcohols and aminocompounds, to determine conditions of conversion of monoamines in aminoacides and to investigate obtaining halogen - derivatives of aminocids.

References:

- [1]. Neiland O.Ya. Organic chemistry, -M., Higher school, 1990, - 750 p.
- [2]. Semenov T.A., and Leites I.L. Purification of process gases, -M., 1977.- P. 488
- [3]. Ogorodnikova S.K. Handbook of petrochemist, Vol. 2 -L.,1978 .--592 -P. 4.
- [4]. Herbicidal activity of derivatives of acetylenic alcohols Sirlibaev T.S., Kurbanov A.I., Turgunov E., Kultaev K.K., Koblov R.K., Khikmatov A. Agrochemistry. 1985. - No.11, -P. 105-107
- [5]. Biological activity of some acetylenic aminoalcohols and halogen-containing products based on them Kurbanov A.K., Sirlibaev T.S., Turgunov E., Kultaev K.K., Kovlov R.K, Tarikov S. Agrochemistry, 1986 , - No. 4 -P. 86 -89.
- [6]. Sirlibaev T.S., Kultaev K.K., Kurbanov A.I. Investigation of the antimicrobel activity of some acetylenic compounds and products obtained on their base. Dep. in Uz NIINTI. - 1989. - № 957 - Uz 89. - 8 p.
- [7]. Kurbanov A.I. Syntheses based on secondary, tertiary acetylenic alcohols and pyridylacetylenes, possible fields of application of the obtained compounds: dis ... doc. Chem. Sciences. -T., 1998. -FROM. 270 -275.
- [8]. Kultaev K.K., Turgunov E. An obtaine of singleatomic uncertain alcohols on the base of acethylene and phenyl acethylene and their bromination. Actual problems of modern science, education and training, Urgenhc, 2020, -No. 4.- P. 280-290.
- [9]. Weigand-Khilgetag. Experimental methods in organic chemistry, -M. Chemistry. 1968. - 944 p.
- [10]. Method of obtaining 4- (dimethylamino) -1-alkyl -1-methyl-2-butyn-1-ols . RF Patent No. 2378249. 2010, Blue. No. 1. / S Dzhemilev U.M., Shaibakova M.G., Titova I.G., Makhmudiyarov G.A., Ramazanov I.R., Ibragimov A.G./.