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SYNTHESIS AND MICROBIOLOGICAL EVALUATION OF ACETYLENIC AMINO ALCOHOLS N-PHENYL CARBAMATE DERIVATIVES

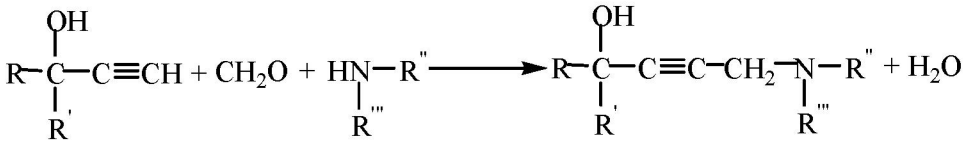
Abstract. The paper presents the results of synthesizing of acetylenic amino alcohols N-phenyl carbamate derivatives and the microbiological evaluation of the latter has been studied. The following microorganisms were considered as objects of microbiological research: *Bacillus subtilis, Botrytis cinerea, Echerchia coli, Ervinia caratovorum, Candida albicans, Fusarum solani u Helminthosporium.* There were researched physicochemical and bactericidal properties of acetylenic amino alcohols N-phenyl carbamate derivatives. The output of carbamates depends on the content and structure of acetylenic amino alcohols and is 68-88%. The purity, identification and structure of the compounds obtained been has determined by thin-layer and gas-liquid chromatography, elemental analysis, IR (Infrared) and PMR (Proton Magnetic Resonance) spectroscopy. It established that these compounds exhibit high antimicrobial activity against the causative agents of certain animal and plant diseases. The relatively high microbiological activity of the phenylcarbamates studied is associated with the presence of various functional groups in the composition of the molecules.

Key words: carbamates, acetylene amino alcohols, bactericidal properties, microorganisms, microbiological activity.

Introduction. Obviously, the search for biologically active compounds is an actual problem of organic chemistry, biological chemistry and pharmacology. Because the efficiency and environmental safety of currently used compounds do not fully meet modern requirements [1-3].

Continuing our work in this direction [4,5], we synthesized a number of acetylenic amino alcohols, obtained N-phenyl carbamate derivatives and studied the antimicrobial activity of the latter.

Methods. Acetylenic alcohols were synthesized by the well-known Favorsky reaction [6] and obtained a series of amino acids by aminomethylation with dibenzylamine under the reaction conditions of Mannich [7] in the presence of formaldehyde:



(I-IV) (V-VIII)

where:

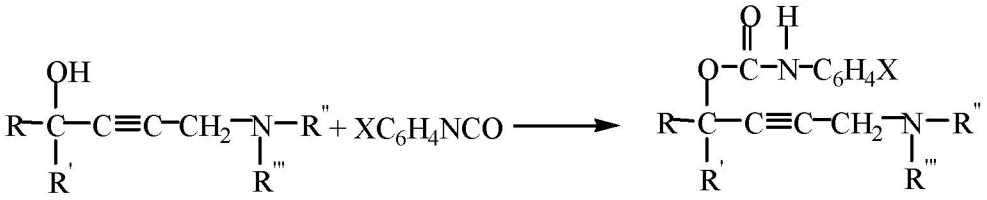
$R = R' = -CH_3$, $R'' = -CH_2C_6H_5$ (I, V)

$R = -CH_3$, $R' = -C_2H_5$, $R'' = -CH_2C_6H_5$ (II, VI)

$R = -CH_3$, $R' = -C_3H_7$-*н*, $R'' = -CH_2C_6H_5$ (III, VII)

$R + R' = -(-CH_2-)_5-$, $R'' = -CH_2C_6H_5$ (IV, VIII)

The obtained amino acids reacted with phenyl and p-chlorophenyl isocyanate for 3-5 hours in an environment of benzene (between 70-80°C) or in an environment of acetone (boiling point). The reaction proceeds as follows:



(V-VIII) (IX-XVI)

where:

$R = R' = -CH_3$, $R'' = -CH_2C_6H_5$, $X = -H$ (V, IX)

$R = -CH_3$, $R' = -C_2H_5$, $R'' = -CH_2C_6H_5$, $X = -H$ (VI, X)

$R = -CH_3$, $R' = -C_3H_7$-*н*, $R'' = -CH_2C_6H_5$, $X = -H$ (VII, XI)

$R + R' = -(-CH_2-)_5-$, $R'' = -CH_2C_6H_5$, $X = -H$ (VIII, XII)

$R = R' = -CH_3$, $R'' = -CH_2C_6H_5$, $X =$ -Cl-*п* (V, XIII)

$R = -CH_3$, $R' = -C_2H_5$, $R'' = -CH_2C_6H_5$, $X =$ -Cl-*п* (VI, XIV)

$R = -CH_3$, $R' = -C_3H_7$-*н*, $R'' = -CH_2C_6H_5$, $X =$ -Cl-*п* (VII, XV)

$R + R' = -(-CH_2-)_5-$, $R'' = -CH_2C_6H_5$, $X =$ -Cl-*п* (VIII, XVI)

The yield of carbamates varied from 68 to 88%, depending on the structure and composition of acetylene amino alcohols. The purity, individuality and structure of the obtained compounds were determined by thin layer and gas chromatography, as well as by elemental analysis using IR and PMR spectra [8,9]. Synthesized carbamates are white needle-like crystals that dissolve in polar organic solvents.

Results and discussions. The main lines and physicochemical characteristics of the IR and PMR spectra of new carbamates are given in Tables 1 and 2.

As can be seen from Table 1, acetylenic amino acids are not absorbed by the hydroxyl group in the IR spectra (in the range of ~ 3600 cm^{-1}), but in the carbonyl group (in the range of 1730 cm^{-1}) and absorption bands on the aromatic rings.

Also, acetylenic amino acids are clearly visible in the absorption bands (IR spectra) and chemical shift lines (PMR spectra) characteristic of functional groups and compounds that determine the composition of carbamates.

White or light yellow crystals, dissolved in many organic solvents, have a weak characteristic of these compounds (Tables 2,3). It is known that the presence of several functional groups in a molecule can give the molecule exceptional properties and increase its biological activity. From this point of view, it was particularly interesting to determine the microbiological activity of carbamates from acetylenic amino alcohols, taking into account the biological, in particular, testing ease and low cost.

To detect microbiological activity, we investigated a number of new carbamates and thiocarbamates using certain methods [10-12]. From the results it can be seen that almost all investigated compounds showed a certain degree of microbiological activity.

For example, were obtained the result of the antimicrobial activity of 1-cyclohexyl-3-diethylaminoprop-3-yl-1-yl ester is given under the name AA-008 - N-phenylcarbamic acid and -2-methyl-5-dibenzylaminopentin-3-yl-2-phenylcarbamate, conditionally called AA-007 - N-phenylcarbamic acid.

For conducting microbiological tests, the obtained 1% solution of AA-007 and AA-008 preparations in ethyl alcohol (1:1 ratio of ethyl alcohol and water) were used, using serial dilution of solutions of 0.05% to 0.0001%.

Table 1 - IR and PMR spectra of carbamates from acetylenic amino alcohols

Number of compounds	IR spectra (KBr), ν, cm^{-1}	PMR spectra, ($CDCl_3$), δ, ppm
(IX)	2190 (C≡C); 3300 (N–H); 1180 (C–O–C); 1755 (C=O); 2920 (-CH_2-); 1580 (-C_6H_5)	0,91 t 3H(CH_3); 1,21 t 3H(CH_3); 1,37 m 2H(CH_2); 2,57 t (C-N); 2,60-2,71 m (cycle H); 3,52 t (C-O)
(X)	2195 (C≡C); 3310 (N–H); 1170 (C–O–C); 1745 (C=O); 2930 (-CH_2-); 1585 (-C_6H_5)	0,93 t 3H(CH_3); 1,20 t 3H(CH_3); 1,37 m 2H(CH_2); 2,58 t (C-N); 2,60-2,71 m (cycle H); 3,53 t (C-O)
(XI)	2195 (C≡C); 3320 (N–H); 1190 (C–O–C); 1750 (C=O); 2940 (-CH_2-); 1583 (-C_6H_5)	0,90 t 3H(CH_3); 1,19 t 3H(CH_3); 1,35 m 2H(CH_2); 2,59 t (C-N); 2,60-2,70 m (cycle H); 3,55 t (C-O)
(XII)	2198 (C≡C); 3315 (N–H); 1180 (C–O–C); 1753 (C=O); 2880 (-CH_2-); 1575 (-C_6H_5)	0,92 t 3H(CH_3); 1,22 t 3H(CH_3); 1,38 m 2H(CH_2); 2,58 t (C-N); 2,61-2,71 t (cycle H); 3,55 t (C-O)
(XIII)	2200 (C≡C); 3310 (N–H); 1185 (C–O–C); 1745 (C=O); 2890 (-CH_2-); 1580 (-C_6H_5)	0,93 t 3H(CH_3); 1,19 t 3H(CH_3); 1,37 m 2H(CH_2); 2,60 t (C-N); 2,61-2,72 m (cycle H); 3,49 t (C-O)
(XIV)	2195 (C≡C); 3313 (N–H); 1190 (C–O–C); 1740 (C=O); 2890 (-CH_2-); 1575 (-C_6H_5)	0,91 t 3H(CH_3); 1,21 t 3H(CH_3); 1,38 m 2H(CH_2); 2,59 t (C-N); 2,60-2,71 m (cycle H); 3,54 t (C-O)
(XV)	2205 (C≡C); 3315 (N–H); 1195 (C–O–C); 1742 (C=O); 2910 (-CH_2-); 1570 (-C_6H_5)	0,92 t 3H(CH_3); 1,21 t 3H(CH_3); 1,36 m 2H(CH_2); 2,56 t (C-N); 2,60-2,70 t (cycle H); 3,55 t (C-O)
(XVI)	2201 (C≡C); 3320 (N–H); 1185 (C–O–C); 1740 (C=O); 2905 (-CH_2-); 1570 (-C_6H_5)	0,91 t 3H(CH_3); 1,20 t 3H(CH_3); 1,38 m 2H(CH_2); 2,57 t (C-N); 2,60-2,71 m (cycle H); 3,53 t (C-O)

Table 2 - Some physicochemical characteristics of carbamates from acetylenic amino alcohols

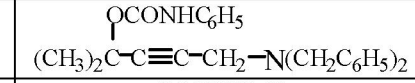
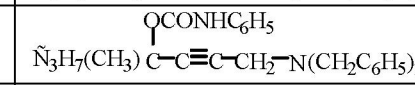
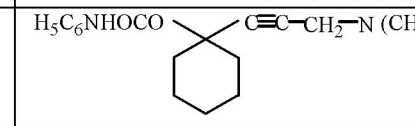
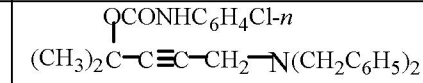
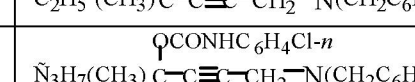
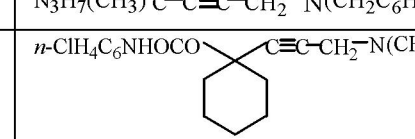
Number of compounds	Formula	Yield, %	$t^{o}_{melting}$, °C	R_f
IX		61	101-102	0,63
X		64	107-108	0,54
XI		58	123-124	0,51
XII		52	135-136	0,39
XIII		53	156-157	0,43
XIV		49	163-164	0,38
XV		47	175-176	0,33
XVI		43	201-202	0,26

Table 3 - Elemental analysis of carbamates from acetylenic amino alcohols

Number of compounds	discovered, %			Gross formulas	calculated, %		
	C	H	N		C	H	N
IX	78,60	7,03	6,81	$C_{27}H_{28}N_2O_2$	78,64	6,79	6,79
X	78,94	7,12	6,68	$C_{28}H_{30}N_2O_2$	78,87	7,04	6,57
XI	79,31	7,37	6,49	$C_{29}H_{32}N_2O_2$	79,09	7,27	6,36
XII	79,76	7,21	6,30	$C_{30}H_{32}N_2O_2$	79,65	7,08	6,19
XIII	76,08	6,46	6,71	$C_{27}H_{27}N_2O_2Cl$	75,97	6,33	6,56
XIV	72,98	6,37	6,26	$C_{28}H_{29}N_2O_2Cl$	72,96	6,29	6,08
XV	73,40	6,58	6,08	$C_{29}H_{31}N_2O_2Cl$	73,34	6,53	5,90
XVI	74,09	6,42	5,86	$C_{30}H_{31}N_2O_2Cl$	73,99	6,37	5,75

The objects of the microbiological test are microorganisms Bacillus subtilis; Botrytis cinerea, Echerchia coli, Ervinia caratovorum, Candida albicans, Fusarum solani и Helminthosporium.

The test results showed that all studied compounds have a certain antimicrobial activity, which inhibits or even aggravates their growth. The results of microbiological testing of drugs AA-007, AA-008 are presented in Table 4.

Table 4 - Results of microbiological testing of synthesized carbamates

A drug	Test microorganisms	Drug concentration % (mass.)*				
		0,0001	0,001	0,005	0,01	0,05
AA-007	Bacillus subtilis	-	-	±	+	++
	Botrytis cinerea	-	-	+	+	++
	Candida albicans	-	±	+	+	++
	Echerchia coli	-	-	+	+	++
	Erivinia caratovorum	-	±	+	+	++
	Fusarum solani	±	±	+	+	++
	Helminthosporium	±	+	+	++	++
AA-008	Bacillus subtilis	-	-	±	+	++
	Botrytis cinerea	±	+	+	++	++
	Candida albicans	±	+	+	+	++
	Echerchia coli	±	+	+	+	++
	Erivinia caratovorum	±	±	+	+	++
	Fusarum solani	±	+	+	++	++
	Helminthosporium	±	+	+	++	++

** - (-) – in this case, do not show biological activity; (±) - the zone for the removal of microorganisms does not exceed 5 mm; (+) - zone for the removal of microorganisms above 5 mm; (++) - zone for the removal of microorganisms above 10 mm*

As can be seen from table 4, any of the phenylcarbates exhibits significant bactericidal activity against microorganisms at significantly lower concentrations.

At the same time, it is clear that the antimicrobial properties of these compounds definitely depend on their composition. For example, the bactericidal activity of the drug AA-008 is significantly higher than AAA-007.

In our opinion, this difference is due to the fact that the drug molecule AA-008 contains an alcohol fragment containing a ring group as a hexyl radical, since the other components of both drugs are the same.

Conclusion. The relatively high microbiological activity of the phenylcarbamate molecules under study may be due to the presence of a set of active functional groups, for example, if the interrelated chemical bonds with using unused electron pairs in outer electron shells (–C≡C–) π--electrons and several

heteroatoms (E, N, Cl) tend to donor-acceptor and chemical-coordinate bonds, methyl groups and carbocycles can enhance these properties and improve their interaction with receptors of microorganisms.

Compared with the current bactericidal activity, in most cases the priority of bactericidal activity of new compounds is observed.

The advantage of new bactericides is that they are obtained without any difficulties on the basis of the compounds obtained in the volume of production, the high bactericidal activity of their highly diluted solutions and the simplicity of their use.

In the case of using new compounds, the socio-economic benefits are as follows:

• well - completed seed stock in agriculture;

• protection against root diseases during the cultivation and development of crops;

• cost reduction during storage of agricultural products;

• reduce the cost of sanitizing the building, warehouses, various premises, securities, and so on, because solutions with a very low concentration are used due to the high bactericidal activity of AA-007 and AA-008;

• possibility of use as a solvent in technical waters of different hardness.

Thus, thanks to the aforementioned benefits, AA-007 and AA-008 and other drugs of the same type can be used in agriculture, medicine and sanitation.

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АЦЕТИЛЕН АМИНСПИРТТЕРІ N-ФЕНИЛКАРБАМАТТАР ТУЫНДЫЛАРЫНЫҢ СИНТЕЗІ ЖӘНЕ МИКРОБИОЛОГИЯЛЫҚ БАҒАЛАУ

Аннотация. Жұмыста бірқатар ацетилен аминспирттері синтезделіп, олардың N-фенилкарбаматтары алынды және соңғыларының микробтарға қарсы әрекеті зерттелді. Микробиологиялық сынақ объектілері ретінде *Bacillus subtilis; Botrytis cinerea, Echerchia coli, Ervinia caratovorum, Candida albicans, Fusarum solani және Helminthosporium* сынды микроорганизмдер қарастырылды. Ацетилен қатары аминспирттерінің N-фенилкарбаматтарының физика-химиялық және бактерицидтік қасиеттері зерттелген. Карбаматтардың шығымы ацетилен аминспирттерінің құрамы мен құрылысына байланысты 68-ден 88% аралығында болды. Алынған қосылыстардың тазалығы, даралығы, құрылысы жұқа қабатты және газсұйық хроматографиялық әдістері бойынша бақыланып, элементтік сараптау және ИҚ мен ПМР спектрлерін түсіру арқылы анықталды. Аталмыш қосылыстардың жануарлар мен өсімдіктер ауруларын қоздыратын микроағзаларға қарсы пәрмеңділігінің жоғары екендігі көрсетілген. Зерттелген фенилкарбаматтардың салыстырмалы түрде микробиологиялық белсенділіктерінің жоғары болуы молекулалары құрамында функционалдық белсенді топтардың болуына байланысты екендігі анықталды.

Түйін сөздер: карбаматтар, ацетилен аминспирттері, бактерицидтік қасиеттері, микроорганизмдер, микробиологиялық белсенділік.

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СИНТЕЗ И МИКРОБИОЛОГИЧЕСКАЯ ОЦЕНКА ПРОИЗВОДНЫХ АЦЕТИЛЕНОВЫХ АМИНОСПИРТОВ N-ФЕНИЛКАРБАМАТОВ

Аннотация. В работе представлены результаты синтеза производных ацетиленовых амино спиртов N-фенилкарбаматов и дана микробиологическая оценка. В качестве объектов микробиологических исследований были рассмотрены микроорганизмы: *Bacillus subtilis; Botrytis cinerea, Echerchia coli, Ervinia caratovorum, Candida albicans, Fusarum solani и Helminthosporium.* Исследованы физико-химические и бактерицидные свойства N-фенилкарбаматов аминоспиртов ацетиленового спирта. Выход карбаматов зависит от содержания и строения ацетиленовых аминоспиртов и составляет 68-88%. Чистота, идентификация и строение полученных соединений определены тонкослойной и газожидкостной хроматографией, методами элементного анализа, ИК- и ПМР- спектроскопии. Установлено, что

указанные соединения проявляют высокую антимикробную активность против возбудителей некоторых болезней животных и растений. Относительно высокая микробиологическая активность исследованных фенилкарбаматов связана с наличием в составе молекул различных функциональных групп.

Ключевые слова: карбаматы, ацетиленовые аминоспирты, бактерицидные свойства, микроорганизмы, микробиологическая активность.

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