2-propanol). PMR spectrum (DMSO-D_6): 2.46 (3H, s, 1-Me); 5.01 (2H, s, 11-CH_2); 6.90 (1H, d, J = 7.5 Hz, 2-H); 7.96 (1H, m, 3-H); 8.66 ppm (1H, br s, N–H).

6-Imino-1-methyl-11-phenyl-6,11-dihydropyrido[1,2-b][2,4]benzodiazepine (Vd). Yield 95% upon treatment of an aqueous solution of salt VId with excess 2 N alkali, mp 201-202°C (from 2-propanol). PMR spectrum (DMSO-D_6): 2.36 (3H, s, 1-Me); 6.56 (1H, s, 11-H); 6.81 (1H, d, J = 7.5 Hz, 2-H); 7.26 (5H, s, 11-Ph); 7.97 ppm (1H, m, 3-H).

1-Amino-2-phenyl-3H-isoindole Hydrobromide (VIII). This was prepared according to [4] from aniline and α-bromo-o-toluinitrile. PMR spectrum (CF_3COOD): 5.28 (2H, s, 3-CH_2); 8.24 (1H, d, J = 7.5 Hz, 7-H); 7.45-8.02 ppm (8H, m, arom).

1-Imino-2-phenylisoindoline (VIIb). This was obtained from salt VIII according to [4]. mp 134°C (from 2-propanol); according to literature data, mp 121°C (from aqueous alcohol). PMR spectrum ($CDCl_3$): 4.84 (2H, s, 3-CH_2); 6.72 (1H, br s, N–H); 7.76 (3H, d, 7- and 2-H); 7.06-7.55 ppm (6H, m). ^{13}C-NMR spectrum ($CDCl_3$): 162.8 ($C_{(1)}$); 140.3 ($C_{(2)}$); 138.2 ($C_{(7a)}$); 133.6 ($C_{(3a)}$); 130.3 ($C_{(7)}$); 128.09 ($C_{(2)}$); 127.5 ($C_{(4)}$); 123.4 ($C_{(2)}$); 122.2 ($C_{(6)}$); 121.6 ($C_{(5)}$); 120.6 ($C_{(2)}$); 53.3 ppm ($C_{(3)}$).

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SYNTHESIS AND STRUCTURE OF HYDROXYISOXAZOLIDINES AND DERIVATIVES OF HYDROXYLAMINE AND ALKENALS

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The reactions of N-substituted hydroxylamines with alkenals serve as a method for the synthesis of the corresponding 2-substituted 3(5)-hydroxyisoxazolidines. The reaction pathway is determined by the nature of the substituent attached to the nitrogen atom. Ring–chain isomerism has been detected in these newly obtained compounds

Only isolated reports have been published concerning the synthesis of hydroxy derivatives of isoxazolidines. The preparation of several 2-aryl-5-hydroxy- [1, 2] and 2-acyl-3-hydroxyisoxazolidines [3-5] via treatment of alkenals with hydroxylamine derivatives has been described, although in most cases the structures of the products were not rigorously proved. The present paper deals with a systematic study of the condensation reactions of hydroxylamine derivatives with α,β-unsaturated aldehydes.

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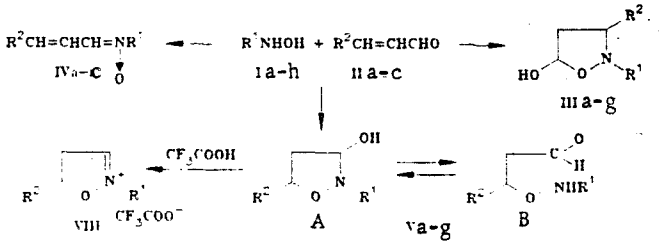
We have found that the reactions of arylhydroxylamines Ia, b with alkenals IIa-d occur readily at equimolar ratios of the reagents and lead to the formation of 1:1 condensation products in high yields.

The only exception was the reaction of phenylhydroxylamine (Ia) with cinnamaldehyde (IIc), which gave N-phenylnitrone IVb as the exclusive product. In all the other cases the products had cyclic structures III, and only in the case of the reaction with a large excess of crotonaldehyde (IIb) was this contaminated with a small amount of N-phenylnitrone IVa. Independent experiments conducted within the probe of a PMR spectrometer did not reveal any signals in the spectra of 1:1 mixtures of alkenals and phenylhydroxylamine which could be assigned to the corresponding nitrones, even in the presence of catalytic amounts of acids, which are known to facilitate condensation at the carbonyl group.



I a $R^1=C_6H_5$; b $R^1=C_6H_4NO_2$-*p*; c $R^1=COC_6H_5$; d $R^1=COC_6H_4NO_2$-*p*; e $R^1=COC_6H_4Br$-*p*; f $R^1=COC_6H_4CH_3$-*p*; g $R^1=COC_6H_4OCH_3$-*p*; h $R^1=COC_6H_2(CH_3)_3$-2,4,5; IIa $R^2=H$; b $R^2=CH_3$; c $R^2=C_6H_5$; III a $R^1=C_6H_5$, $R^2=H$; b $R^1=C_6H_5$, $R^2=CH_3$; c $R^1=C_6H_4NO_2$-*p*, $R^2=H$; d $R^1=COC_6H_5$, $R^2=CH_3$; e $R^1=COC_6H_4CH_3$-*p*, $R^2=H$; f $R^1=COC_6H_4OCH_3$-*p*, $R^2=H$; g $R^1=COC_6H_4OCH_3$-*p*, $R^2=CH_3$; IV a $R^1=C_6H_5$, $R^2=CH_3$; b $R^1=R^2=C_6H_5$; c $R^1=COC_6H_5$, $R^2=C_6H_5$; V a $R^1=COC_6H_4NO_2$-*p*, $R^2=CH_3$; b $R^1=COC_6H_4NO_2$-*p*, $R^2=H$; c $R^1=COC_6H_5$, $R^2=H$; d $R^1=COC_6H_5$, $R^2=CH_3$; e $R^1=COC_6H_2(CH_3)_3$-2,4,5; $R^2=H$; f $R^1=COC_6H_4Br$-*p*, $R^2=H$; g $R^1=COC_6H_4Br$-*p*, $R^2=CH_3$

Reactions of alkenals IIa, b with arylhydroxamic acids Ic-h occur more slowly and require the presence of a basic catalyst. We have tried a variety of metal oxides and hydroxides, amines, as well as alkoxide and hydroxide quaternary ammonium salt derivatives as catalysts in these reactions. The best results were obtained using solid phase catalysts on supports, such as triethylaminoethyl- and diethylaminoethylcelluloses.

The rates of these reactions depend to a significant extent on the accessibility of the double bond in the unsaturated aldehyde; while the yields of hydroxyisoxazolidines are based mostly on the stability of the resulting compounds. For instance, the yields of the corresponding hydroxyisoxazolidines increase with the use of p-nitro-, p-bromo-, and p-methoxybenzhydroxamic acids in these reactions; at the same time, however, formation of isoxazolidines was not observed in the reactions of acetylhydroxamic or chloroacetylhydroxamic acid with acrolein. The reaction of benzohydroxamic acid (Ic) with cinnamaldehyde (IIc) leads to the formation of the corresponding nitrone IVc, which in this case in the exclusive product.

The PMR spectra of 3(5)-hydroxyisoxazolidines contain a characteristic signal for the 3-H (5-H) of the cyclic form A, at 5.2-6.0 ppm. The ^{13}C-NMR spectra contain a signal for an sp^3-hybridized carbon atom in the region 77-100 ppm, which indicates that the latter is bonded to two heteroatoms [6]. The chemical shifts and splitting patterns of the other signals are consistent with the assigned structures for the compounds (cf. Tables 1, 2). The cyclic structure in compounds III and V was also confirmed by the presence of absorption bands in the 3210-3370 (O) and 1590-1640 cm^{-1} (CO) regions in their IR spectra. The lower absorption frequency for the hydroxyl groups in these compounds can be attributed to the presence of strong intermolecular hydrogen bonding.

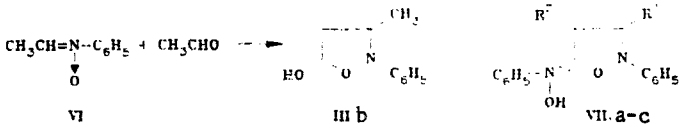
We have previously demonstrated using compounds Vc and Vd as examples that ring–chain tautomerism of the type A ⇄ B [5] is characteristic of 3-hydroxyisoxazolidines. In the series of 2-acyl-3-hydroxyisoxazolidines Va-g ring–chain tautomerism was detected using PMR and ^{13}C-NMR spectroscopy for almost all of the compounds; this is in contrast to the situation observed for their nitrogen analogs, hydroxypyrazolidines. The occurrence of linear structural forms was established based on the appearance of a signal for the aldehyde proton at 9.7 ppm in the PMR spectra, and a carbonyl group carbon atom signal at 190-210 ppm in the ^{13}C-NMR spectra of these compounds. For compounds Va, g (~25% of the linear form) and Vc (~2% of the linear form), the equilibrium is detected even in chloroform solution, while for the other compounds the appearance of the linear forms is observed only in more polar

solvents [$(CD_3)_2CO$, DMF-D_7, DMSO-D_6]. The amount of the linear form increased as the solvent polarity was enhanced.

Ring–chain tautomerism was also observed for 2-acyl-5-hydroxyisoxazolidine IIIf, although for the remaining isoxazolidines in class III this type of equilibrium was not detected.

The presence of significant amounts of the linear tautomer is apparently the factor responsible for the greater lability of 3(5)-hydroxyisoxazolidines. It was found that these compounds decompose readily upon exposure to light and upon heating, and also self-destruct upon prolonged storage in acidic or basic media. Decomposition results in splitting off of the initial hydroxamic acid moiety, while the aldehyde portion polymerizes partially.

Condensation of hydroxylamine derivatives with α,β-unsaturated aldehydes can theoretically lead to the formation of isomeric 3- or 5-hydroxyisoxazolidines, V or III, respectively. The formation of the III isomers in the case of arylhydroxylamines Ia, b was established using compound IIIb as an example; this was prepared by an alternate pathway involving treatment of the N-phenylnitrone derivative of acetaldehyde (VI), which has been characterized previously, with acetaldehyde.



VI III b VII a-c

VII a $R^1=R^2=H$; b $R^1=CH_3$, $R^2=H$; c $R^1=H$, $R^2=CH_3$

We have also found that treatment of alkenals with a twofold excess of phenylhydroxylamine leads to the corresponding 5-hydroxylamino derivatives VIIa-c; in the case of compound VIIb, dimerization of acetaldehyde phenylnitrone has been observed previously [7].

In the case of the reactions of arylhydroxamic acids, it is not possible to choose between structures III and V based on the IR and PMR spectral data; the formation of both of these is equally probable considering the comparable acidities of the NH and OH groups in hydroxamic acids [8].

The structural assignments were made therefore on the basis of their ^{13}C-NMR spectra. In isomers III the signal for the $C_{(5)}$ carbon atom would be expected to absorb further downfield than the $C_{(3)}$ carbon in isomers V. The reverse order would be expected for the methylene carbon atoms bonded to the heteroatom. It is known, for instance, that the anomeric carbon atom signal in monosaccharides [9], as well as the $C_{(5)}$ carbon atom signal in 5-hydroxyisoxazolin-2-ones (O–C–O arrangement), are found in the 95-105 ppm region, while the $C_{(5)}$ carbon atom signal in 5-hydroxypyrazolidines (N–C–O arrangement) appears with a chemical shift of ~80 ppm [10]; in contrast, the chemical shifts of methylene group carbon atoms attached to oxygen occur more downfield (60-70 ppm [6]) than for analogous groups attached to nitrogen (45-55 ppm, [6, 10]). Therefore, compounds with chemical shifts in the region 95-100 (for the $C_{(5)}$ atom) and 49-53 ($C_{(3)}$ atom) correspond to structure III, while compounds with signals at 77-82 ($C_{(3)}$ atom) and 67-75 ppm ($C_{(5)}$ atom) correspond to structure V (cf. Table 2).

The behavior of these compounds in acidic media also offers conclusive proof of structure. For example, treatment of compounds Vc-e with trifluoroacetic acid results in their transformation to 2-isoxazolinium salts VIII. The PMR spectra exhibit simultaneous changes in the chemical shift of the 3-H proton, which moves to 7.3 ppm from 5.5-6.0 ppm in 3-hydroxyisoxazolidines. Under the same conditions, the PMR spectra of derivatives IIId, e do not change, whereas compounds IIIa-c and IIIf-g undergo irreversible decomposition under these conditions.

It should be noted that conversion of compound Ve to its isoxazolinium salt occurs significantly more slowly than conversion of compounds Vc, d, and also does not proceed to completion, probably as a consequence of steric factors.

It has thus been demonstrated that condensation of alkenals with N-arylhydroxylamines, as well as with arylhydroxamic acids containing electron-electron donating substituents, leads to the formation of 5-hydroxyisoxazolidines, while treatment with arylhydroxamic acids with electron-withdrawing substituents gives 3-hydroxyisoxazolidines. Reaction with benzohydroxamic acid leads to the formation of 3-hydroxyisoxazolidine Vd as the main reaction product and also to small amounts (2-5%) of 5-hydroxyisoxazolidine IIId. In some cases the

TABLE 1. Characteristics of Compounds III and V

Compound	T_{mp}, °C†	R_f***	Solvent	PMR spectrum, δ, ppm				R¹	R² (d)	OH	[M⁺], (mass spectral)	Yield, %
				form	3-H	4-H (m)	5-H					
IIIa	47—48	0,35	CCl_4	A	3,17m; 3,51 m	2,16	5,47 d,d,d	6,78—7,16 m	—	4,90 br s	165	93—95
IIIb		0,51	C_5D_5N	A	3,62d.d.q, 3,88 q	2,05; 2,40	5,82 d,d; ; 5,87 d.d	6,87—7,28 m	1,28; 1,67	4,46 br.s 5.85 br.s	—	60
IIIc	77—79	0,33	$(CD_3)_2CO$	A	3,69m	2,33	5,71 d,d,d	6,83 d; 7,90 d	—	5,85 d	—	95—98
IIId	52	0,43	$CDCl_3$	A	4,6 m	2,2	5,5 d	7,2—7,8 m	1,3	5,0 br.s	207	2—5
IIIe	110—112	0,48	$CDCl_3$	A	3,9 m	2,3	5,7 m	7,4 q	—	4,5 br.s	207	70
IIIf	55	0,70	$CDCl_3$	A	3,5 m	2,1	5,8 t	7,25 q; 3,7s	—	4,5 br.s	223	83
				B	3,8 m	2,5	9,7s	7,25q; 3,3 s	—	5,3 s		
IIIg		0,73	$CDCl_3$	A	4,7m	2,3	5,5d	7,2 q, 3,8 s	1,2; 1,4	6,3 br.s	237	79
Va	230	0,70	$CDCl_3$	A	5,45 t, 5,55 t	2,2	3,9m; 4,8 m	8,0 q	1,1; 1,2	7,7 br.s	—	40
				B	9,3 m	2,5	3,3 m	8,0 q	1,05	7,3 s		
Vb	157	0,65	C_5D_5N	A	5,92 t	2,33	3,61 m	8,14 m	—	8,93 br.s	238	69
Vc	53	0,51	$CDCl_3$	A	5,7t	2,2	3,9 m	7,2—7,8 m	—	4,6 br.s	193	73
Vd	51	0,49	$CDCl_3$	A	5,65d; 5,90d	1,6—2,8	4,05 m. 4,60 m	7,1—7,9 m	1,1 t	6,7 br.s	207	57—65
Ve	155—158	0,59	$CDCl_3$	A	5,9m .	2,2; 2,4	3,35m; 3,65m	6,92 d; 7,05 d; 2,15—2,35 m	—	4,6—5,0 br.s	235	80
Vf	91	0,61	C_5D_5N	A	5,7d	2,3	3,6—4,3 m	7,6 m	—	5,6 s	273, 271	89
Vg	113	0,73	$CDCl_3$	A	6,1 m	2,0; 2,40; 2,74	4,22 m; 4,70 m	7,4—7,9 m	1,36; 1,28	4,5 br.s	287, 285	84
				B	9,7 t	3,44	4,48 m	7,4—7,9 m	1,20	5,62 d		

*Elemental analysis data for stable compounds in classes III and V will be published separately. Compounds IIIb, d, g and Va, d, g exist as mixtures of diastereomers. Detailed discussion of the spectra and stereochemistry of these compounds will also be published separately.

†Recrystallized from a mixture of ether—hexane; compound IIIb from benzene—hexane.

‡System for compounds IIIa, b consists of benzene—acetone, 5:1; for compound IIIc, ether—hexane, 5:2; for the other compounds, ethyl acetate—hexane, 4:1.

TABLE 2. ^{13}C-NMR Spectra of Compounds III and V

Compound	Chemical shift, δ, ppm (in $CDCl_3$)				
	$C_{(3)}$	$C_{(4)}$	$C_{(5)}$	R^1	R^2
IIIa	52,3	36,7	96,3	115,6—151,5 4 signals	—
IIIb*	59,2 62,3	44,6 43,9	96,8 96,1	116,0—151,5 6 signals	19,1
IIIc†	49,6	36,1	97,0	112,6—156,8 4 signals	—
IIId*	52,0 53,2	43,2 41,3	98,4 98,5	127,8—130,8 6 signals 171,8 and 171,9 (C=O)	20,7 20,9
IIIe	44,3	34,2	97,4	127,6—130,5 6 signals 169,4 (C=O); 21,0 (CH_3)	—
IIIf	44,9	34,6	97,1	113,1—130,8 3 signals 169,6 (C=O); 55,2 (OCH_3)	—
IIIg*	51,3 52,6	43,0 43,5	98,1 98,4	112,8—131,6 4 signals 161,5 and 161,7 (C=O); 54,8 and 55,1 (OCH_3)	20,1 20,7
Va	81,7	37,6	69,6	127,7—134,9 6 signals 168,9 (C=O); 163,8 (NC=O);	—
	192,5 (HC=O)	72,8 (C_α)	70,3 (C_β)	192,5 (HC=O)	
Vd*	81,0 81,6	42,2 43,0	76,3 77,9	127,5—132,7 5 signals 166,1 and 167,3 (C=O)	17,6 17,8
Ve	79,2	36,0	68,6	128,0—138,8 6 signals 168,1 (C=O); 17,9, 18,8 and 19,3 ($3CH_3$)	—
Vg*	80,8 81,0	41,4 42,1	75,1 75,8	125,8—138,4 5 signals 165,5 and 166,2 (C=O)	17,3 17,5

*Mixture of diastereomers.
†Spectrum taken in $(CD_3)_2CO$.

observed regioselectivity of these reactions may be attributed to the influence of other factors as well. For instance, in the case of the reaction of acrolein with hydroxamic acid Ih, 3-hydroxyisoxazolidine Ve is formed, despite the presence of an electron donating substitutes in the aromatic ring.

Mass spectral decay of compounds III and V is characterized by cleavage of the unsaturated aldehyde or its radical and an acyl group. In addition, compounds III also undergo characteristic loss of a CH_2CHO fragment and formation of an [M − 43] ion, and in the case of 2-phenyl derivatives, loss of water as well. For compounds V formation of an [M − 28] ion is characteristic. In order to determine the composition of these ions accurately, isotopic exchange between the hydroxyl group in isoxazolidine Va and $H_2{}^{18}O$ was conducted. The resulting compound contained approximately 25% of the ^{18}O isotope (according to mass spectrometry). The mass spectrum of this compound contained molecular ion peaks at m/e 193 and 195, and these decayed with loss of fragments having mass 28 and 30, respectively. This verifies that the indicated decay involves loss of CO, which is a somewhat rare observation for aldehydes. Loss of an OH radical or a molecule of water is not characteristic of 2-acyl-3hydroxyisoxazolidines.

EXPERIMENTAL

IR spectra were recorded on a Specord 75 IR spectrophotometer for CH_2Cl_2 solutions and on a UR-20 spectrophotometer for Vaseline mulls. PMR spectra were obtained on Tesla BS-467 (60 MHz), Tesla BS-497, and Varian XL-100 (100 MHz) spectrometers; TMS or HMDS was used as internal standard. Quantitative determinations were carried out based on two measurements of five-fold integrated signals for 10% solutions. The error in these measurements is ±5%. ^{13}C-NMR spectra were obtained on CFT (20 MHz) and Tesla BS-497 (20.41 MHz) spectrometers under pulse conditions with Fourier transformation. Mass spectra were recorded on Varian MAT-212, MX-133, and CH-6 spectrometers with direct sample introduction at temperatures close to the melting points of the materials. The ionizing electron energy was 80 and 70 eV. The

course of the reactions and product purity were assayed by TLC on Silufol plates or on L40/100 silica gel in the following systems: benzene–acetone, 5:1 (1), ether–hexane, 5:2 (2), and hexane–ethyl acetate, 1:4 (3). Plates were visualized by UV light and iodine vapors.

p-Nitrophenylhydroxylamine (Ib). Prepared according to [12]. PMR spectrum (DMSO-D_6): 6.80 and 8.01 (4H, d, J = 10 Hz, Ar); 9.10 (1H, s, NH); 9.64 ppm (1H, s, OH).

Hydroxamic Acids (Ic-h). Prepared by analogy with [13]. To a suspension of 7.0 g (0.1 mole) hydroxylamine hydrochloride and 10.6 g (0.1 mole) sodium carbonate in 100 ml ether was added with stirring 15 ml water; the mixture was allowed to stand 5-10 min and a solution of 0.1 mole of the substituted benzoyl chloride was added in several portions, and after 30-40 min the resulting precipitate was filtered and washed with ether. In the case of the presence of dibenzohydroxamic acid impurities in the products they were recrystallized from ethanol.

2,4,5-trimethylbenzohydroxamic Acid (Ih). Yield 95%, mp 158°C. IR spectrum: 3240 (NH) 3300 (OH), 1640 (C=O), 1620 cm^{-1} (Ar). PMR spectrum ($CDCl_3$): 2.15-2.35 (9H, m, 3 CH_3); 6.9 and 7.1 (1H + 1H, s, Ar); 5.3 (1H, s, NH); 4.5 (1H, br s, OH).

Acetaldehyde Phenylnitrone (VI). Acetaldehyde (0.05 mole) and 0.05 mole phenyldhdroxylamine were maintained in 50 ml ether containing 1 g $CaCl_2$ for 1 day at 20°C. Yield 95-98%. PMR spectrum ($CDCl_3$): 2.15 (3H, d, J = 6 Hz, CH_3); 7.28 (1H, q, J = 6 Hz, HC=N); 7.33-7.43 (3H, m, $2H_{meta}$ + $1H_{para}$); 7.54-7.64 ppm (2H, m, $2H_{ortho}$). ^{13}C-NMR spectrum ($CDCl_3$); 12.9 (q, CH_3); 121.0; 128.4 and 129.3 (d, $C_{ortho,meta,para}$); 136.9 (s, C_{arom}–N); 146.6 ppm (s, C=N).

2-Phenyl-5-hydroxyisoxazolidines (IIIa-c). A solution of 0.05 mole hydroxylamine Ia in 50 ml $CHCl_3$ (Ib, 50 ml methanol) was treated for several days at 0°C with 0.075 mole acrolein (IIa) [or 0.2 mole crotonaldehyde (IIb)]; the solvent was evaporated and the residue recrystallized, or, in the case of compound IIIb, isolated chromatographically on a silica gel L 40/100 column. Physical constants and yields are summarized in Table 1.

The nitrone derivative of crotonaldehyde (IVa) was obtained as a side product in these reactions, in 10% yield. Oil. R_f 0.25 (1). PMR spectrum ($CDCl_3$): 1.60 (3H, d, J = 7 Hz, CH_3); 5.43 (1H, m, α-H); 6.13 (1H, d of q, J_1 = 15, J_2 = 7 Hz, β-H); 7.05-7.54 ppm (5H, Ar + 1H, HC=N).

The nitrone of cinnamaldehyde (IVb) was obtained in an analogous manner in quantitative yield, mp 152-154°C. PMR spectrum ($CDCl_3$): 6.97 (1H, d, J = 13 Hz, α-H); 7.09-7.59 (10H, Ar, + 1H, HC=N + 1H, β-H). ^{13}C-NMR spectrum ($CDCl_3$): 118.8 (C_α); 135.9 (C_β); 139.5 (C=N); 121.0-147.1 ppm (Ar, 8 signals).

2-Phenyl-3-methyl-5-hydroxyisoxazolidine (IIIb). A mixture of 0.05 mole phenylhydroxylamine with a fivefold excess of acetaldehyde in 50 ml chloroform was maintained for 1 day at 20°C in the presence of 1 g $CaCl_2$. The solvent was evaporated and chromatographically pure compound IIIb was obtained in quantitative yield.

2-Phenyl-5-(N-phenylhydroxylamino)isoxazolidines (VIIa-c). A mixture of 0.05 mole alkenal IIa-c in 50 ml $CHCl_3$ with 0.1 mole phenylhydroxylamine Ia was maintained for 1 day at 20°C. Solvent was evaporated and the residue was chromatographed on a column.

2-Phenyl-5-(N-phenylhydroxylamino)isoxazolidine (VIIa). Yield 65%, oil, R_f 0.44 (1). PMR spectrum [$(CD_3)_2CO$]: 2.20 and 2.43 (1H + 1H, m, 4-H), 3.05 and 3.55 (1H + 1H, m, 3-H); 5.83 (1H, d, J = 5 Hz, 5-H); 6.59-7.14 (10H, m, Ar); 7.85 (1H, s, NH). ^{13}C-NMR spectrum ($CDCl_3$): 31.2 (t, $C_{(4)}$); 47.3 (t, $C_{(3)}$); 98.5 (d, $C_{(5)}$); 114.8-151.4 ppm (8 signals, Ar).

2-Phenyl-4-methyl-5-(N-phenylhydroxylamino)isoxazolidine (VIIb). Yield 70%, oil, R_f 0.63 (1). PMR spectrum (DMSO-D_6): 2.27 (1H, m, 4-H); 3.23 (1H, d of d, J_1 = 10, J_2 = 4.5 Hz, 3-H); 3.71 (1H, d of d, J_1 = 10, J_2 = 6.5 Hz, 3-H); 5.35 (1H, d, J = 4.5 Hz, 5-H); 6.71-7.11 (10H, m, Ar); 8.85 ppm (1H, s, NH). ^{13}C-NMR spectrum ($CDCl_3$): 37.9 (d, $C_{(4)}$); 60.8 (t, $C_{(3)}$); 98.9 (d, $C_{(5)}$); 114.2-151.0 ppm (8 signals, Ar).

2-Acyl-3(5)-hydroxyisoxazolidines (IIId-g, Va-g). Hydroxamic acid Ic-h (0.02 mole) and 0.02 mole alkenal IIa,b were dissolved in 70-100 ml methanol (or 40 ml in the case of Ic), 15-20 mg of triethylaminoethylcellulose was added, and the mixture was stirred for 5-7 h at 0-5°C (in the case of Ic,e, the mixtures were allowed to stand 2 days at 0°C, or in the case of Ih, for 2 weeks). The catalyst was filtered and the solvent was evaporated in vacuo

at temperatures lower than 40°C. The residue was recrystallized from ether (IIIe, f; Va, b, f, g) or purified chromatographically on a Silpearl silica gel column using hexane–ethyl acetate (gradient from 2:1 to 1:4) (IIId, g; Vc, d, e). Physical constants and yields are summarized in Tables 1 and 2.

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PREPARATION OF 2,3,4,5-TETRAHYDRO-1,2,4,TRIAZINE-3-ONES

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The reaction of 3-(2-oxoalkyl)-2-benzoxazolones with hydrazine leads to the formation of the corresponding 2,3,4,5-tetrahydro-1,2,4-triazine-3-ones in good yield.

It was shown earlier, in a study of the reaction of 3-(2-oxoalkyl)-2-benzoxazolones (I) with hydrazine hydrate, that, depending on the reaction conditions, hydrazones, azines, or 2,3,4,5-tetrahydro-1,2,3-triazine-3-ones (II) [1] are obtained, the latter, according to the literature, having a wide spectrum of biological activity: they exhibit herbicidal activity [2], strengthen the action of the heart and have anti-hypertension properties [3, 4]. There has in recent years been an increasing interest in the synthesis of compounds of this class [5-8]. The object of the present study was to develop methods for the preparation of 1,2,4-triazine-3-ones II based on 3-(2-oxoalkyl)-2-benzoxazolones (I).

The initial oxoalkylbenzoxazolones I were prepared by alkylation of the corresponding 2-(3H)-benzoxazolones with isomeric bromobutane-2-ones in the presence of solium alkoxide [9]. Two bands due to carbonyl stretching vibrations are observed in the IR spectrum of the ketone I – at 1790-1775 cm^{-1} (amide) and 1760-1730 cm^{-1} (ketone). In addition to other signals, a quadruplet signal from the methine proton at 5.35 ppm (1H) for oxazolones Ia-f and a singlet for the methylene group at 5.1 ppm (2H) for the isomers Ig, h confirmed their structure.

The optimum conditions for the conversion of the benzoxazolones I into 2,3,4,5-tetrahydro,1,2,4-triazine-3-ones (II) proved to be at boiling point in hydrazine hydrate with the

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