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DEHYDRATION OF 4-HYDROXY-4-METHYL-3-PHENYLAMINO-OXAZOLIDIN-2-ONES

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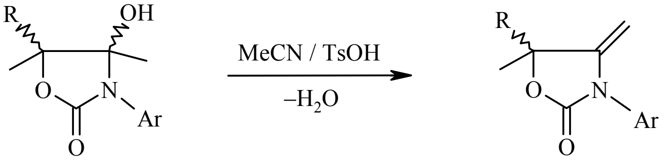
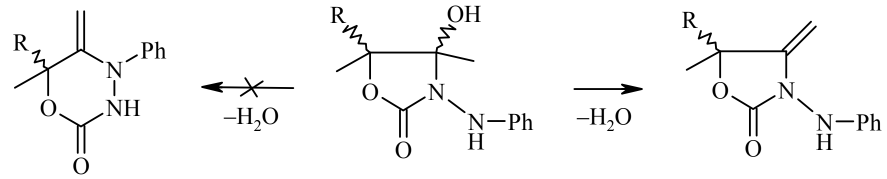
The dehydration of two 5,5-disubstituted 4-hydroxy-4-methyl-3-phenylaminooxazolidin-2-ones into the corresponding 4-methylene-3-phenylaminooxazolidin-2-ones has been carried out. The structure of the products was confirmed by X-ray diffraction analysis.

Keywords: 4-hydroxy-4-methyl-3-phenylaminooxazolidin-2-ones, 4-methylene-3-phenylamino-oxazolidin-2-ones.

The dehydration of 5,5-disubstituted 4-hydroxy-4-methyloxazolidin-2-ones with aryl substituent at position 3 was considered by us previously [1]. Based on analysis of ^{1}H NMR, IR, and mass spectral data the structure of the reaction products was established unequivocally and no doubts were raised.



In the present report the dehydration is described of oxazolidinones **1a,b** bearing a specific substituent, namely PhNH, at position 3. According to the data of [2], where many examples were given of expansion and contraction of rings of related heterocyclic compounds under conditions of acid catalysis, rearrangement of oxazolidinones **1** might have been expected, for example, into 1,3,4-oxadiazinones **A**.



A **1a,b** **2a,b** 69–72%

1, **2** **a** R = Me, **b** R = Et

Such a rearrangement, however, is not observed, but the reaction occurs as usual [1] and leads to 4-methylene derivatives **2**. As established on the example of the conversion of compound **1a** into methylene derivative **2a**, the reaction may also occur without acid catalysis.

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The expected two doublets of the $C=CH_2$ group protons were present in the ^1H NMR spectra of the dehydration products. In the IR spectrum there was an absorption band for this group and there were also absorption bands for NH and C=O. Since on the basis of only IR and ^1H NMR spectra it is difficult to make a final conclusion in favor of the six-membered (**A**) or five-membered (**2**) products, we carried out an X-ray diffraction analysis of the substance obtained from oxazolidinone **1b**. It is five-membered oxazolidinone **2b** (Fig. 1, Tables 1 and 2). In this molecule the five-membered heterocycle O(1)–C(2)–N(3)–C(4)–C(5) is exactly planar (the planarity is fulfilled with a precision of ±0.004 Å). The dihedral angle between it and the plane of the phenyl substituent [C(11)···C(16)] is 85.5°, and the torsion angles C(2)–N(3)–N(10)–C(11) and N(3)–N(10)–C(11)–C(12) at 101.6 and -26.4° respectively indicate the twist of these fragments of the molecule relative to one another. In the crystal the hydrogen atom of the amino group participates in the formation of an intermolecular hydrogen bond N(10)–H(10N)···O(2) (-*x*; ½ + *y*; 1½ - *z*) [N(10)···O(2) 3.035(2), N(10)–H(10N) 0.86(2), H(10N)···O(2) 2.18(2) Å, angle N(10)–H(10N)···O(2) 135(2)°]. These H bonds link the molecules in endless chains (Fig. 2, projection *bc*, the intermolecular hydrogen bonds N–H···O are shown by dotted lines). The remaining geometric parameters (bond lengths and bond angles) in the investigated molecule have standard values [3]. No other shortened intermolecular nonvalence contacts were detected.

TABLE 1. Bond Lengths in Oxazolidinone **2b**

Bond	*d*, Å	Bond	*d*, Å
O(1)–C(2)	1.338(2)	C(5)–C(6)	1.636(8)
O(1)–C(5)	1.478(3)	C(5)–C(6A)	1.627(10)
O(2)–C(2)	1.201(2)	C(7)–C(8)	1.462(9)
N(3)–C(2)	1.366(2)	C(7A)–C(8A)	1.481(10)
N(3)–N(10)	1.383(2)	C(11)–C(12)	1.383(3)
N(3)–C(4)	1.393(2)	C(11)–C(16)	1.386(3)
N(10)–C(11)	1.411(2)	C(12)–C(13)	1.387(3)
C(4)–C(9)	1.308(3)	C(13)–C(14)	1.362(4)
C(4)–C(5)	1.510(3)	C(14)–C(15)	1.367(4)
C(5)–C(7A)	1.437(9)	C(15)–C(16)	1.385(3)
C(5)–C(7)	1.455(6)		

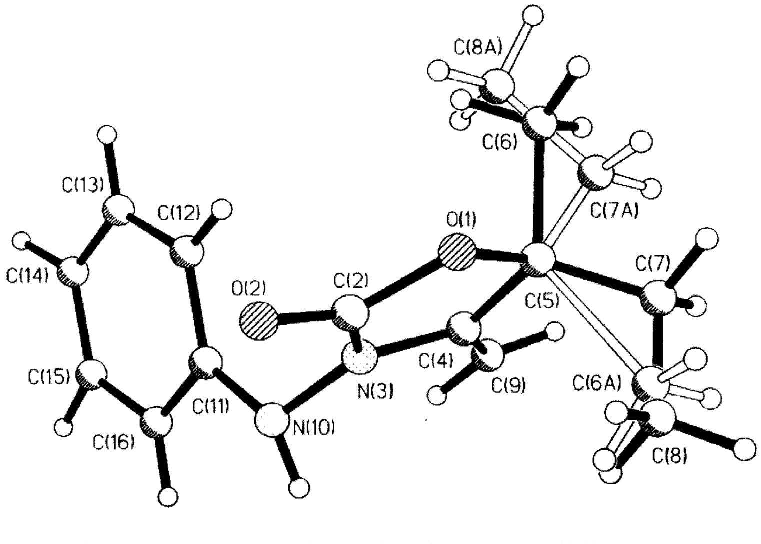

Fig. 1. Structure of the molecule of oxazolidinone **2b**.

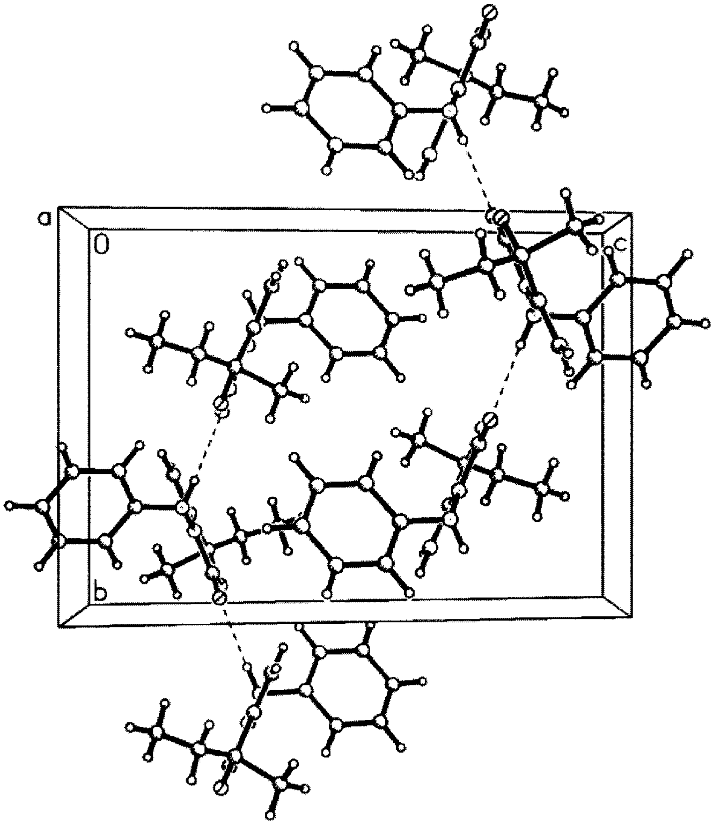

Fig. 2. Packing of oxazolidinone **2b** molecules in the crystal.

TABLE 2. Bond Angles in Oxazolidinone **2b**

Angle	ω, deg.	Angle	ω, deg.
C(2)–O(1)–C(5)	110.9(2)	C(7)–C(5)–C(6)	106.8(4)
C(2)–N(3)–N(10)	122.1(14)	O(1)–C(5)–C(6)	105.0(3)
C(2)–N(3)–C(4)	113.2(2)	C(4)–C(5)–C(6)	107.7(4)
N(10)–N(3)–C(4)	124.8(2)	C(7A)–C(5)–C(6A)	105.5(7)
N(3)–N(10)–C(11)	117.2(2)	O(1)–C(5)–C(6A)	99.3(6)
O(2)–C(2)–O(1)	123.7(2)	C(4)–C(5)–C(6A)	104.2(6)
O(2)–C(2)–N(3)	127.9(2)	C(5)–C(7)–C(8)	104.2(5)
O(1)–C(2)–N(3)	108.4(2)	C(5)–C(7A)–C(8A)	91.8(8)
C(9)–C(4)–N(3)	126.0(2)	C(12)–C(11)–C(16)	119.3(2)
C(9)–C(4)–C(5)	129.5(2)	C(12)–C(11)–N(10)	122.4(2)
N(3)–C(4)–C(5)	104.6(2)	C(16)–C(11)–N(10)	118.2(2)
C(7A)–C(5)–O(1)	114.3(7)	C(11)–C(12)–C(13)	119.6(2)
C(7)–C(5)–O(1)	115.7(4)	C(14)–C(13)–C(12)	121.1(2)
C(7A)–C(5)–C(4)	126.9(6)	C(13)–C(14)–C(15)	119.4(2)
C(7)–C(5)–C(4)	117.8(4)	C(14)–C(15)–C(16)	120.8(2)
O(1)–C(5)–C(4)	102.9(2)	C(15)–C(16)–C(11)	119.8(2)

TABLE 3. Coordinates (×10^4) and Isotropic (for non-hydrogen atoms – equivalent) Temperature Parameters of Atoms in Oxazolidinone **2b**

Atom	*x*	*y*	*z*	*U*
O(1)	2970(2)	328(1)	7580(1)	66(1)
O(2)	52(2)	123(1)	7529(1)	52(1)
N(3)	1556(2)	1879(1)	8058(1)	42(1)
N(10)	126(2)	2544(2)	8246(1)	41(1)
C(2)	1376(2)	723(2)	7703(1)	43(1)
C(4)	3295(3)	2297(2)	8202(2)	59(1)
C(5)	4337(3)	1265(2)	7873(2)	92(1)
C(6)	5584(8)	652(7)	8730(6)	108(3)
C(7)	5489(6)	1572(9)	7242(5)	98(2)
C(8)	4278(10)	1911(10)	6441(4)	92(2)
C(6A)	4700(18)	1741(14)	6914(9)	124(9)
C(7A)	5990(11)	768(14)	8304(8)	125(7)
C(8A)	5215(18)	414(20)	9090(8)	92(5)
C(9)	3842(4)	3360(3)	8544(2)	87(1)
C(11)	-126(2)	2584(2)	9135(1)	38(1)
C(12)	472(3)	1662(2)	9732(1)	52(1)
C(13)	52(3)	1702(3)	10577(2)	64(1)
C(14)	-935(3)	2638(3)	10830(2)	67(1)
C(15)	-1509(3)	3559(3)	10245(2)	66(1)
C(16)	-1099(3)	3549(2)	9400(1)	51(1)
H(10N)	55(29)	3262(24)	8008(16)	60(7)
H(91)	2988(36)	3960(28)	8744(19)	87(8)
H(92)	5072(41)	3564(28)	8640(20)	98(10)
H(12)	1144(31)	1006(24)	9532(16)	67(7)
H(13)	467(37)	1020(30)	10976(21)	93(9)
H(14)	-1267(34)	2683(24)	11419(19)	81(8)
H(15)	-2219(35)	4204(26)	10396(18)	81(8)
H(16)	-1515(27)	4233(22)	8992(15)	56(6)

EXPERIMENTAL

The ^{1}H NMR spectra were recorded on a Bruker WM 250 (250 MHz) instrument in $CDCl_3$, internal standard was TMS. The IR spectra were taken on a Perkin-Elmer 577 instrument in KBr. TLC was carried out on Silufol UV 254 plates, using the system benzene–ethyl acetate, 4:1.

Oxazolidinones **1a,b** were obtained by us previously [4,5].

Colorless crystals of oxazolidinone **2b** were obtained by slow crystallization during 3 days. The crystals of compound **2b** ($C_{13}H_{16}N_2O_2$) are monoclinic; at 25°C: a = 7.678(1), b = 10.852(2), c = 15.354(3) Å; β = 99.41(2)°; V = 1262(1) Å^3; d_{calc} = 1.222 g/cm^3; Z = 4; space group $P2_1/c$. The parameters of the unit cell and the intensities of 3269 reflections were measured on a Siemens automatic four-circle diffractometer P3/PC [λ(Mo$K\alpha$), graphite monochromator, $\theta/2\theta$ scanning, $\theta_{\max}$ = 27°]. The structure was solved by the direct method and refined by the full-matrix least-squares method in anisotropic mode for the non-hydrogen atoms. The C(6), C(7), and C(8) atoms of the methyl and ethyl substituents in the molecule were randomized at two positions with different populations (2:1). The hydrogen atoms were localized objectively with a Fourier difference synthesis and were refined in isotropic mode. The positions of the hydrogen atoms at C(6), C(7), C(8), and C(6A), C(7A), and C(8A) were calculated geometrically and included in the refinement as a rider model. The final values of the divergence factors were wR_2 = 0.144 at 2958 independent reflections [R_1 = 0.056 for 2077 independent reflections with $I > 2\sigma(I)$].

All calculations were carried out on an IBM PC/AT 586 computer with programs SHELXTL PLUS and SHELXL 93 [4].

5,5-Dimethyl-4-methylene-3-phenylaminooxazolidin-2-one (2a). Molecular sieve 4 Å (6.54 g) and *p*-toluenesulfonic acid monohydrate (5-10 mg) were added to oxazolidinone **1a** (0.236 g, 1 mmol) in acetonitrile (10 ml). The mixture was boiled under reflux for 8.5 h (check by TLC). Zeolite 4A was separated, washed with acetonitrile (3 × 10 ml) by boiling for 15 min, the solution and washings were combined, the solvent removed in vacuum, the residue dried, and 0.190 g (87%) of slightly yellow crystals were obtained. If necessary (check by TLC) the substance was recrystallized from mixture (0.74 ml) of benzene–acetonitrile 70:4, and white crystals (0.150 g, 69%) were obtained; mp 159-161°C, R_f 0.61. IR spectrum, ν, cm^{-1}: 1665, 1745, 3310. ^{1}H NMR spectrum, δ, ppm (*J*, Hz): 1.64 (6H, s, 5,5-CH_3); [4.11 (1H, d, *J* = 2.6); 4.40 (1H, d, *J* = 2.6)] (C=CH_2); 6.12 (1H, s, NH); 6.75 (2H, d, *J* = 8.5, 2',6'-H_{Ph}); 6.98 (1H, q, 4'-H_{Ph}); 7.22-7.31 (2H, m, 3',5'-H_{Ph}). Found, %: C 66.16; H 6.46; N 12.82. $C_{12}H_{14}N_2O_2$. Calculated, %: C 66.06; H 6.42; N 12.84.

5-Ethyl-5-methyl-4-methylene-3-phenylaminooxazolidin-2-one (2b). Oxazolidinone **1b** (11.30 g, 45.2 mmol), benzene (45 ml), and acetonitrile (2 ml) were boiled with a Dean–Stark trap for 3.5 h. The precipitated slightly yellow crystals (7.85 g, 75%) were recrystallized from benzene (25 ml) plus acetonitrile (2-3 drops) and snow-white crystals (6.15 g) were obtained. The mother liquors were combined, boiled with activated carbon, evaporated, and a further 1.34 g of substance, slightly cream-colored but pure by TLC, were obtained. Overall yield of product was 7.58 g (72%); mp 124-126°C, R_f 0.60. IR spectrum, ν, cm^{-1}: 1655, 1780, 3280. ^{1}H NMR spectrum, δ, ppm (*J,* Hz): 1.02 (3H, t, $CH_2\underline{CH_3}$); 1.62 (3H, s, 5-CH_3); 1.70-2.00 (2H, m, $\underline{CH_2}CH_3$); [4.08 (1H, d, *J* = 1.5), 4.45 (1H, d, *J* = 1.5)] (C=CH_2); 6.12 (1H, s, NH); 6.78 (2H, d, *J* = 8.5, 2',6'-H_{Ph}); 6.95 (1H, q, 4'-H_{Ph}); 7.22-7.31 (2H, m, 3',5'-H_{Ph}). Found, %: C 67.26; H 6.95; N 12.05. $C_{13}H_{16}N_2O_2$. Calculated, %: C 67.24; H 6.90; N 12.07.

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