5.79 (broad s, OH), 7.35 (2H, m, 6-H and 7-H), 7.52 (1H, broad s, 4-H), 7.64 (1H, m, 8-H), 7.77 (1H, m, 6-H), 8.55 (1H, broad s, 1-H), and 7.1 ppm (5H, broad s, C_6H_5). Found: C 83.0; H 5.5; N 4.8%. $C_{20}H_{17}NO$. Calculated: C 83.6; H 5.9; N 4.9%.

3'-(p-Nitrophenyl)spiro[4-azafluorene-9,2'-oxirane] (X). A mixture of 3 ml of 50% aqueous sodium hydroxide, 1 g (6.0 mmole) of 4-azafluorene (VIII), 1.27 g (8.4 mmole) of p-nitrobenzaldehyde, 15 mg of TEBAC, 3 ml of carbon tetrachloride, and 20 ml of benzene was stirred in a stream of nitrogen for 1 h, after which the mixture was worked up and the products were isolated as in the preparation of IV. This procedure gave 0.32 g (22.7%) of colorless crystals of dichloride IX with mp 139-140°C (from heptane) [1] and 0.25 g (15.4%) of colorless crystals of spiro compound X with mp 164-165°C (from heptane). PMR spectrum (d_6-DMSO), 60°C, azafluorene protons, DSS as the internal standard: 7.85 (1-H), 7.32 (2-H), 8.57 (3-H), 7.89 (5-H), 7.41 (6-H), 7.1 (7-H), and 6.53 ppm (8-H); oxirane ring: 5.33 (1H, broad s, 3'-H); p-$NO_2C_6H_4$, AA'BB' system: 8.16 (2H, m, AA') and 7.70 ppm (2H, m, BB').

LITERATURE CITED

1. N. S. Prostakov, M. A. Beshenko, S. A. Soldatova, E. P. Konstantinu, and S. Lavani-Edogiaverie, Khim. Geterosikl. Soedin., No. 10, 1396 (1982).
2. N. S. Prostakov, V. O. Fedorov, and A. T. Soldatenkov, Zh. Org. Khim., 16, 2372 (1980).
3. A. A. Fomichov, V. A. Svoren, N. I. Golovtsov, A. T. Soldatenkov, and N. S. Prostakov, Org. Magn. Reson., 19, 24 (1982).

REACTION OF DIMETHYLAMINOVINYLPYRIMIDINES WITH CARBOXYLIC ACID CHLORIDES

B. M. Khutova, L. P. Prikazchikova, and V. M. Cherkasov

UDC 547.853.4'333.3'582.1.07:543.422

Phenacyl- and trichloroacetonylpyrimidines were obtained in the reaction of dimethylaminovinylpyrimidines with carboxylic acid chlorides. It is shown that substituents in the pyrmidine and triazine rings affect the course of this reaction.

Dimethylaminovinylpyrimidines and -triazines are formed relatively easily in the reaction of methylpyrimidines and -triazines with dimethylformamide dimethylacetal [1]. The higher reactivities of enamines may make it possible to use the indicated compounds for the preparation of various derivatives of pyrimidines and triazines.

In the present research we studied the reaction of enamines of the pyrimidine and triazine series with carboxylic acid chlorides.

It is known that 2-phenacylnitrobenzene is formed in the reaction of β-dimethylamino-2-nitrostyrene with o-fluorobenzoyl chloride as a result of electrophilic attack on the α-carbon atom [2].

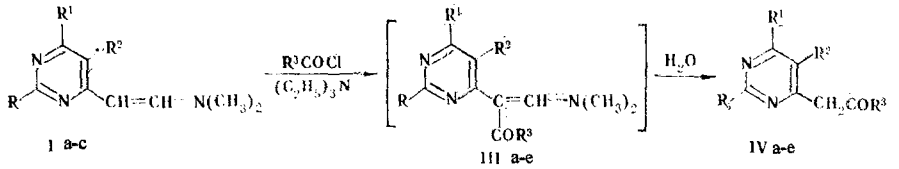
We subjected 4-(β-dimethylaminovinyl)pyrimidine (Ia), 5-nitro-2,4-dimethoxy-6-(β-dimethylaminovinyl)pyrimidine (Ib), 4-methyl-6-(β-dimethylaminovinyl)pyrimidine (Ic), and 2,4-bis(trichloromethyl)-6-(β-dimethylaminovinyl)triazine (II) to reaction with benzoyl chloride.

4-Phenacylpyrimidine (IVa) was obtained in the reaction of enamine Ia with benzoyl chloride in benzene in the presence of triethylamine at 20°C. The reaction probably proceeds through intermediate IIIa.

Institute of Organic Chemistry, Academy of Sciences of the Ukrainian SSR, Kiev 252660.

Translated from Khimiya Geterotsiklicheskikh Soedinenii, No. 4, pp. 531-534, April, 1983. Original article submitted July 28, 1982.

0009-3122/83/1904-0435$07.50

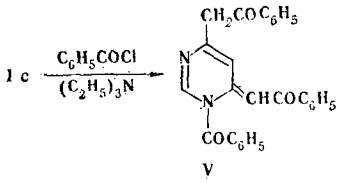


I a-c III a-e IV a-e

I a $R=R^1=R^2=H$; b $R=R^1=OCH_3$, $R^2=NO_2$; c $R=R^2=H$, $R^1=CH_3$; III, IV a $R=R^1=R^2=H$, $R^3=C_6H_5$; b $R=R^1=OCH_3$, $R^2=NO_2$, $R^3=C_6H_5$; c $R=R^1=R^2=H$, $R^3=CCl_3$; d $R=R^1=OCH_3$, $R^2=NO_2$, $R^3=CCl_3$; e $R=R^2=H$, $R^1=CH_3$, $R^3=CCl_3$

Enamine Ib does not react with benzoyl chloride in benzene; 5-nitro-2,4-dimethoxy-6-phenacylpyrimidine (IVb) is formed in the case of refluxing in acetonitrile. We were previously unable to obtain this compound from 5-nitro-2,4-dimethoxy-6-methylpyrimidine [3].

Enamine Ic reacts with benzoyl chloride also at the methyl group, and N-benzoyl-4-phenacyl-6-phenacylidenepyrimidine (V), which we previously described in [4], was also isolated in low yield because of pronounced resinification.



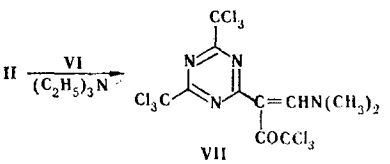
V

Enamine II does not react with benzoyl chloride in the presence of triethylamine in either benzene or acetonitrile. The presence of strong electron-acceptor substituents in the triazine ring facilitates detachment of a proton from the α-carbon atom; however, electrophilic attack by benzoyl chloride becomes impossible as a consequence of delocalization of the negative charge in the triazine ring.

Enamines Ia-c react considerably more vigorously with trichloroacetyl chloride (VI). Enamine Ia reacts with acid chloride VI at 0°C to give 4-trichloroacetonylpyrimidine (IVc) [5]. Enamine Ic reacts with acid chloride VI even in the presence of a weaker base, viz., pyridine, to give 4-methyl-6-trichloroacetonylpyrimidine (IVe) [5].

In contrast to Ia,c, enamine Ib reacts with acid chloride VI to give stable substitution product IIId, which is hydrolyzed by refluxing with water to give 5-nitro-2,4-dimethoxy-6-trichloroacetonylpyrimidine (IVd).

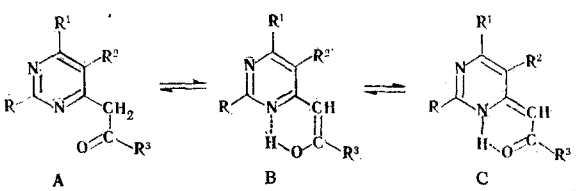
Stable substitution product VII, which, in contrast to IIId, is not hydrolyzed by refluxing with water, is also formed in the reaction of enamine II with acid chloride VI.



VII

The stability of VII is explained by delocalization of the π bond of the enamine under the influence of the electron-acceptor triazine residue.

According to data from the PMR and UV spectra, equilibrium of three tautomeric forms, viz., keto (A), enol (B), and pyrimidinylidene (C) forms, is realized for phenacyl- and trichloroacetonylpyrimidines IV in CCl_4:



A B C

TABLE 1. Spectral Characteristics of Phenacyl- and Trichloroacetonylpyrimidines IVa,b,d

Compound	PMR spectrum (in CCl_4), ppm				λ_{max}, nm (lg ε)	Tautomers, %	
	CH_2	CH	OCH_3	note		=CH	CH_2
IVa	4,23 s	5,83 s		8,76 (s, 2-H, enol); 8,93 (s, 2-H, ketone); 8,3 (d, 4-H, enol); 8,43 (d, 4-H, ketone); 6,77 (d, 5-H); 7,5 (m, C_6H_5)	227 (4,45), 282 sh	88	12
IVb	—	6,43s	4,33 s	7,83 (m, C_6H_5); 14,56 (s, NH)	246 (4,24), 338 (4,31)	100	0
IVd	4,28 s	4,83 s	4,4 s	6,73 (s, OH)	233 (4,33), 310 (4,24)	32	68

The quantitative percentage of the keto form can be determined from the PMR spectra (from the ratio of the integral intensities of the signals of the CH_2 and CH groups). The signals of the methylidyne proton can be assigned equally to forms B and C. The UV spectra of forms A and B contain similar absorption: The long-wave absorption is related to tautomer C, which does not have an aromatic structure but does have a longer conjugation chain [5].

It may be concluded from Table 1 that IVa exists in forms A and B, since long-wave absorption of the pyrimidinylidene structure is absent. Only equilibrium of the B and C form (B ⇌ C) occurs in the case of IVb. Compound IVd exists primarily in the keto form; however, one cannot draw a conclusion regarding the ratio of the B and C forms from the UV spectral data.

EXPERIMENTAL

The PMR spectra of solutions of the compounds in CCl_4 and $CDCl_3$ were recorded on the δ scale with a Tesla BS-467 spectrometer (60 MHz) with hexamethyldisiloxane as the external standard. The electronic spectra of $\sim 10^{-4}$ mole/liter solutions of the compounds in CCl_4 were recorded with a Specord UV-vis spectrophotometer. The individuality of the compounds obtained was monitored by thin-layer chromatography (TLC) on activity II Al_2O_3 in a benzene–methanol system (10:1) with development in UV light.

4-(β-Dimethylaminovinyl)pyrmidine (Ia). A solution of 5 g (50 mmole) of 4-methylpyrimidine and 12.8 g (100 mmole) of dimethylformamide dimethylacetal was heated in a metal test tube at 150°C for 16 h, after which the solvent was removed by distillation, and the product was collected by fractional distillation at 170-172°C (12 mm) to give 2.1 g (28%) of a substance with mp 46-48°C (from hexane) [6].

4-Phenacylpyrimidine (IVa). A solution of 1.4 g (10 mmole) of benzoyl chloride in 5 ml of absolute benzene was added slowly to a solution of 0.75 g (5 mmole) of enamine Ia and 1 g (10 mmole) of triethylamine in 10 ml of absolute benzene, and the mixture was refluxed for 2 h. It was then cooled, and the triethylamine hydrochloride was removed by filtration. The filtrate was evaporated in vacuo, and the residue was treated with methanol to decompose the acid chloride. The methanol was removed by distillation, 10-15 ml of water was added to the residue, and the mixture was extracted with ether. The extract was dried over calcium chloride, the ether was removed by distillation, and the residue was crystallized from heptane to give 0.09 g (10%) of a product with mp 80-82°C. Found: C 72.9; H 5.0; N 14.1%. $C_{12}H_{10}N_2O$. Calculated: C 72.7; H 5.1; N 14.1%.

5-Nitro-2,4-dimethoxy-6-phenacylpyrimidine (IVb). A solution of 1.3 g (5 mmole) of enamine Ib, 1.4 g (10 mmole) of benzoyl chloride, and 1 g (10 mmole) of triethylamine in 15 ml of absolute acetonitrile was refluxed for 2 h, after which it was cooled, and the triethylamine hydrochloride was removed by filtration. The filtrate was evaporated in vacuo, and the residue was treated with water and crystallized from ethanol to give 0.18 g (12%) of a product with mp 132-134°C. Found: C 55.6; H 4.4; N 13.8%. $C_{14}H_{13}N_3O_5$. Calculated: C 55.4; H 4.3; N 13.8%.

N-Benzoyl-4-phenacyl-6-phenacylidenepyrimidine (V). A solution of 1.4 g (30 mmole) of benzoyl chloride in 10 ml of absolute benzene was added slowly at 0°C to a solution of 1.63 g (10 mmole) of enamine Ic and 1 g (30 mmole) of triethylamine in 15 ml of absolute benzene, and the mixture was refluxed for 2 h. It was then cooled, and the triethylamine hydrochloride

was removed by filtration. The filtrate was evaporated in vacuo, and the residue was treated with water and crystallized from heptane to give 0.2 g (5%) of a product with mp 145-148°C. No melting-point depression was observed for a mixture of this product with a genuine sample [3].

4-Trichloroacetonylpyrimidine (IVc). A solution of 2.75 g (15 mmole) of trichloroacetyl chloride (VI) in 10 ml of absolute benzene was added gradually at 0°C to a solution of 0.75 g (5 mmole) of enamine Ia and 1.5 g (15 mmole) of triethylamine in 15 ml of absolute benzene, and the mixture was stirred for 1 h. The triethylamine hydrochloride was removed by filtration, the filtrate was evaporated in vacuo, and the residue was treated with methanol. The methanol was removed by distillation, and the residue was crystallized from petroleum ether to give 0.26 g (22%) of a product with mp 122-124°C. No melting-point depression was observed for a mixture of this product with a genuine sample [5].

4-Methyl-6-trichloroacetonylpyrimidine (IVe). A solution of 1.4 g (7.5 mmole) of acid chloride VI was added gradually at 20°C to a solution of 0.4 g (2.5 mmole) of enamine Ic and 0.6 g (7.5 mmole) of pyridine in 15 ml of absolute benzene, and the mixture was allowed to stand overnight. The triethylamine hydrochloride was removed by filtration, and the filtrate was evaporated in vacuo. The residue was dissolved in methanol, and the solution was treated with water to precipitate 0.15 g (25%) of IVe with mp 138-142°C (from petroleum ether). No melting-point depression was observed for a mixture of this product with a genuine sample [5].

5-Nitro-2,4-dimethoxy-6-(β-dimethylamino-α-trichloroacetylvinyl)-pyrimidine (IIId). A solution of 0.7 g (4 mmole) of acid chloride VI in 5 ml of absolute benzene was added gradually at 20°C to a solution of 0.56 g (2 mmole) of enamine Ib and 0.4 g (4 mmole) of triethylamine in 15 ml of absolute benzene, and the mixture was allowed to stand overnight. The triethylamine hydrochloride was removed by filtration, the filtrate was evaporated in vacuo, and the residue was treated with methanol to give 0.5 g (67.5%) of IIId with mp 138-139°C (from methanol). PMR spectrum ($CDCl_3$): 3.4 [s, 6H, $N(CH_3)_2$] and 4.49 ppm (d, 7H, OCH_3 and =CH—). Found: C 36.0; H 3.4; Cl 26.4; N. 14.0%. $C_{12}H_{13}Cl_3N_4O_5$. Calculated: C 36.1; H 3.3; Cl 26.6; N 14.0%.

5-Nitro-2,4-dimethoxy-6-trichloroacetonylpyrimidine (IVd). A solution of 0.2 g (5 mmole) of IIId in 2 ml of water and 6 ml of dioxane was refluxed for 5 h, after which it was evaporated in vacuo, and the residual oil was extracted with hot heptane to give 0.08 g (50%) of IVd with mp 86-87°C (from heptane). Found: C 31.8; H 2.6; N 12.0%. $C_9H_8Cl_3N_3O_3$. Calculated: C 31.4; H 2.3; N 12.2%.

2,4-Bis(trichloromethyl)-6-(β-dimethylamino-α-trichloroacetylvinyl)triazine (VII). A solution of 0.55 g (3 mmole) of acid chloride VI in 5 ml of absolute benzene was added gradually at 0°C to a solution of 0.55 g (1.5 mmole) of enamine II and 0.3 g (3 mmole) of triethylamine in 10 ml of absolute benzene, and the mixture was stirred for 2 h and allowed to stand overnight at 20°C. The triethylamine hydrochloride was removed by filtration, and the filtrate was evaporated in vacuo. Methanol was added to the residue, and the mixture was filtered to give 0.6 g (75%) of VII with mp 148-149° (from methanol). PMR spectrum ($CDCl_3$): 3.63 [s, 6H, $N(CH_3)_2$] and 8.73 ppm (s, 1H, =CH—). Found: C 25.2; H 1.4; Cl 60.8; N 11.1%. $C_{11}H_{17}Cl_9N_4O$. Calculated: 24.9; H 1.3; Cl 60.2; N 10.6%.

LITERATURE CITED

1. L. P. Prikazchikova, B. M. Khutova, and V. M. Cherkasov, Khim. Geterotsikl. Soedin., No. 7, 974 (1982).
2. E. Garcia and R. Fryer, J. Heterocycl. Chem., 11, 219 (1974).
3. B. M. Khutova, S. V. Klyuchko, L. P. Prikazchikova, and V. M. Cherkasov, Khim. Geterotsikl. Soedin., No. 5, 687 (1982).
4. L. P. Prikazchikova, B. M. Khutova, and V. M. Cherkasov, Khim. Geterotsikl. Soedin., No. 8, 1146 (1974).
5. L. P. Prikazchikova, B. M. Khutova, and E. A. Romanenko, Khim. Geterotsikl. Soedin., No. 9, 1256 (1978).
6. H. Bredereck, G. Simchen, R. Wahl, Chem. Ber., 101, 4048 (1968).