SIGMA-COMPLEXES IN THE PYRIMIDINE SERIES. 11.* 5-ARYLAZO-5-NITRO-2,5- AND -4,5-DIHYDROPYRIMIDINES FROM ANIONIC SIGMA COMPLEXES OF 5-NITROPYRIMIDINE

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We have studied the reaction of acetonyl anionic sigma complexes of 5-nitropyrimidines with aryldiazonium salts. We have established that, independently of the position of the geminal unit in the sigma complex, electrophilic attack by the diazonium ion occurs at the $C_{(5)}$ atom with formation of 5-arylazo-5-nitro-2,5- and 4,5-dihydropyrimidines. The latter are unstable and upon isolation are converted to N-methoxycarbonyl-N'-(1-acetonyl-2-nitro-2-arylhydrazono)ethyl-O-methylisourea. The structure of one of these compounds has been proven by x-ray diffraction. Under alkaline conditions, aromatization of 2,5-dihydropyrimidines to 5-arylazo-2-acetonylpyrimidines occurs.

Hydrogenated pyrimidines are important components of many biologically active compounds and medicinal drugs [2]. We know that the most difficult to obtain and the least studied in the series of dihydropyrimidines are derivatives of 2,5- and 4,5-dihydropyrimidines [2], which is explained by their extreme instability. It has been shown [3] that the presence of donor substituents in the imine moiety of the 2,5-dihydropyrimidine molecule increases its stability. Introduction of a nitro group in the 5 position of the pyrimidine ring combined with introduction of donor substituents at $C_{(4)}$ and $C_{(6)}$ considerably stabilizes these compounds [4]. Earlier in [4] we established that, depending on the position of the geminal unit in the acetonyl anionic sigma complex of 5-nitropyrimidine, alkylation occurs at the $C_{(5)}$ or $N_{(1)}$ atoms with formation of 2,5- and 1,6- dihydropyrimidines, respectively.

Continuing the investigation of the reactivity of anionic σ complexes of the pyrimidine series, we have studied the reaction of acetonyl σ complexes of 5-nitropyrimidine with aryldiazonium salts. We know [5] that the action of aryldiazonium salts on a classical Yanovskii anionic σ complex leads to substitution of the nitro group located para to the acetonyl moiety, with simultaneous aromatization of the benzene ring.

Upon reaction of the acetonyl anionic σ complex I with the aryldiazonium salts IIa-d, containing electronically different substituents on the phenyl ring, in acetone (method A), electrophilic attack by the diazonium ion occurs at the $C_{(5)}$ atom of the pyrimidine ring with formation of 5-arylazo-5-nitro-2-acetonyl-4,6-dimethoxy-2,5-dihydropyrimidines IIIa-d.

In the PMR spectra of compounds IIIa-d, the presence of two triplet (in the 5.62-5.96 region) and two doublet (in the 2.60-2.91 ppm region) signals along with signals from the arylazo groups (Table 1) suggests retention of the geminal unit in the 2 position of the pyrimidine ring upon going from σ complex I to the dihydropyrimidines IIIa-d. In the ^{13}C NMR spectra, the $C_{(5)}$ signal is significantly shifted upfield (by 25 ppm) compared with the $C_{(5)}$ signal in the σ complex I, which characterizes a change in its hybridization from sp^2 to sp^3 (Table 2). Thus, the presence of two sp^3-hybridized carbon atoms in compounds

*For Communication 10, see [1].

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TABLE 1. Characteristics of Synthesized Compounds IIIa-d, Va-d, and IXa-d

Compound	Empirical formula	R_f (chloroform)	T_{mp}, °C	λ_{max}, nm (lg ε); (methanol)	PMR spectrum, δ, ppm (in $CDCl_3$)					Yield, %
					CH	CH_2	CH_3	OCH_3	other protons	
IIIa	$C_{15}H_{16}N_6O_7$	0,37	Oil	292 (4,2), 379 (3,3)	5,94t, 5,68t	2,88 d, 2,69 d	2,28 s, 2,25 s,	3,78 s, 3,75 s	7,46...8,05 m (C_6H_4)	72 (A), 95 (B)
IIIb	$C_{15}H_{16}N_6O_7$	0,40	Oil	290 (3,8)	5,96 t, 5,75 t	2,90 d, 2,71 d	2,29 s, 2,17 s	3,74 s	8,00d.d, 8,39d.d, (C_6H_4)	69 (A), 93 (B)
IIIc	$C_{15}H_{17}N_5O_5$	0,39	Oil	222 (4,0), 294 (4,1), 369 (3,3)	5,95t, 5,74t	2,90 d, 2,71 d	2,28 s	3,73 s, 3,72 s	7,34...7,96 m (C_6H_5)	70 (A), 92 (B)
IIId	$C_{16}H_{19}N_5O_6$	0,44	Oil	228 (3,9), 332 (4,2), 400 (3,1)	5,84t, 5,62t	2,80 d, 2,60 d	2,20 s	3,63s, 3,62 s	6,90 d.d, 7,75d.d, (C_6H_4); 3,80 s (OCH_3); 3,81 c (OCH_3)	65 (A), 89 (B)
Va	$C_{15}H_{15}N_5O_5$	0,15	139 140	235 (4,0), 396 (4,3), 502 (3,4)	4,17 s	—	2,32 s	4,08 s	7,39...8,12 m(C_6H_4), 12,84 br.s(NH)	82
Vb	$C_{15}H_{15}N_5O_5$	0,16	143 144	234 (4,2), 385 (4,3), 502 (3,3)	4,19s	—	2,55 s	4,07 s	7,36 d, 8,34d (C_6H_4); 11,90 br.s(NH)	79
Vc	$C_{15}H_{16}N_4O_3$	0,18	105 106	232 (4,0), 342 (4,2), 455 (3,3)	4,16 s	—	2,63 s	4,18 s	6,94...7,54 m (C_6H_5); 12,77 br.s(NH)	77
Vd	$C_{16}H_{18}N_4O_4$	0,20	135 136	236 (4,1), 358 (4,3), 455 (3,5)	4,08s	—	2,26 s	4,04 s	6,93 d, 7,88 d (C_6H_4); 3,86 s (OCH_3); 13,42 br. c (NH)	68
IXa	$C_{15}H_{18}N_6O_8$	0,23	146 147	410 (4,1)	5,72s, 5,67t	3,11 m	2,18s	3,87 s	14,07 s (NH); 9,34 d (NH); 7,14...8,26 m (C_6H_4)	72 (A), 76 (B)
IXb	$C_{15}H_{18}N_6O_8$	0,24	153 154	397 (4,2)	5,70t, 5,65 t	3,11 m	2,19 s	3,99s, 3,72 s	12,10 s (NH); 9,16 d (NH); 8,26 d, 7,39 d (C_6H_4)	67 (A), 73 (B)
IXc	$C_{15}H_{19}N_5O_6$	0,25	123 124	398 (4,0)	5,53t, 5,50 t	2,94 m	2,02 s	3,71 s, 3,52 s	12,12 s (NH); 9,05 d (NH); 6,95...7,19 m (C_6H_5)	54 (A), 58 (B)
IXd	$C_{16}H_{21}N_5O_7$	0,27	Oil	408 (3,9)	5,72t, 5,68t	3,10 m	2,17 s	3,83s, 3,73 s	12,52 s (NH); 9,23 d (NH); 6,94 d, 7,26 d (C_6H_4); 3,91 s (OCH_3)	51 (A), 55 (B)

TABLE 2. ^{13}C NMR Spectra of Compounds IIIa-d and IXa-d (in $CDCl_3$)

Compound	C—H	C—OCH_3	C—NO_2	OCH_3	Acetonyl group			Aryl substituent
					CH_2	CO	CH_3	
IIIa	73,20 72,88	152,66 152,56	80,10	55,55 55,49	52,25 52,05	205,65 205,50	31,35 31,13	135,69, 135,49, 135,20, 134,05, 126,07, 125,86, 119,32, 119,02, 149,05, 148,39, 145,21, 144,70
IIIb	72,66 72,40	154,55 154,46	79,04	55,04	52,43 51,66	204,76 204,50	30,87 30,31	125,86, 124,97, 152,29, 151,20
IIIc	71,68 71,44	152,16 152,13	77,21	54,27	52,30 51,27	205,41 204,91	30,83 30,39	133,39, 133,24, 124, 24, 129,13, 123,42, 123,38, 150,87, 150,80
IIId	71,30 71,03	152,27 152,22	95,33 94,87	53,76	51,80 50,78	205,53 205,07	30,23 29,92	125,46, 114,15, 114,03, 163,97, 163,85 (C—OCH_3)
IXa	47,18	162,40	136,06	55,32 52,67	46,41	164,09* 204,16	30,31	138,11, 137,76, 136,25, 126,12, 123,51, 116,90
IXb	46,95	162,33	135,00	52,29 52,70	46,45	164,09* 204,31	30,28	146,10, 144,10, 125,81, 115,07
IXc	46,92	162,52	132,86	54,94 52,32	46,24	164,03* 204,59	29,98	141,03, 129,59, 125,26, 115,43
IXd	47,75	163,06	133,15	55,63 53,03	47,06	164,57* 204,80	30,76	117,54, 115,55, 57,29 (OCH_3)

* —CO_2CH_3.

TABLE 3. IR Absorption Spectra of Compounds IIIa-d and Va-d

Compound	Recording conditions	Vibrational frequency, V, cm^{-1}* (tautomer)							
		C=O	1	2	NO_2^{as}	NO_2^{sym}	$N=N^{as}$	$N=N^{sym}$	OCH_3
IIIa	CH_2Cl_2	1718	1680	1610	1582	1345, 1355shl	1440	1203	1296
IIIb	CH_2Cl_2	1720	1680	1608	1580	1354shl	1440	1202	1293
IIIc	CH_2Cl_2	1720	1680	NI	1580	1356	1440	1202	1298
IIId	CH_2Cl_2	1718	1679	1602	1580	1356	1440	1202	1298 1257
Va	KBr	1716 (B) 1640 (C)	1553 1565 shldr.	1607	1536	1340	1440	1208	1283
Vb	KBr	1710 (B)	1560	NI	1535	1340 shl	1438	1207	1282
Vc	KBr	1712 (B) 1652 (C)	1564	NI	—	—	1440	1205	1272
	CH_2Cl_2	1717 (B) 1650 (C)	1567	NI	—	—	1435	NI	NI
Vd	KBr	1710 (B) 1647 (C)	1567 1546	1603	—	—	1440	NI	1254
	CH_2Cl_2	1717 (B) 1646 (C)	1567 1552	1600	—	—	1440	1202 shl	1296
	DMSO	1716 (B) 1645 (C) 1665 (D)	1567 1552	1600	—	—	NI	NI	NI
	HMPTA **	1721 (B) 1645 (C) 1674 shldr (D) 1630 shldr (E)	1565 1552	1600	—	—	NI		NI

*shldr.) Shoulder; 1) vibrational band for the pyrimidine ring; 2) vibrational band for the phenyl ring; NI) band not identified.

**Hexametapol.

IIIa-d unambiguously proves their 2,5-dihydropyrimidine structure. The double set of signals in the NMR spectra is due to the existence of a mixture of Z and E diastereoisomers in these compounds, but the close values of the chemical shifts do not allow us to assign them to a specific isomer.

The electronic spectra of 2,5-dihydropyrimidines IIIa-d are characterized by absorption bands describing the imine moiety of the molecule (in the 222-228 nm region) and the azo-component (in the 290-400 nm region). In the IR spectra of these compounds, we note vibrations which appear as intense absorption bands at 1580-1582 cm^{-1} and 1345-1356 cm^{-1} (antisymmetric and symmetric vibrations of the nitro group) and at 1440 cm^{-1} and 1202 cm^{-1} (antisymmetric and symmetric vibrations of the azo group). Furthermore, the absorption of the carbonyl group in the 1720 cm^{-1} region indicates absence of conjugation of the acetonyl moiety with the pyrimidine ring, which also supports a 2,5-dihydropyrimidine structure for compounds IIIa-d. The same compounds are also obtained in practically quantitative yield upon reaction of 2-acetonyl-5-nitro-5-H-4,6-dimethoxy-2,5-dihydropyrimidine (IV) [4] with aryldiazonium salts IIa-d in tetrahydrofuran in the presence of butyllithium at a temperature of −78°C (method B).

Upon reaction of 5-arylazo-5-nitro-2,5-dihydropyrimidines IIIa-d with an equimolecular amount of potassium hydroxide in methanol solution, aromatization of the pyrimidine ring occurs as a result of cleavage of the nitrous acid, with formation of 5-arylazo-4,6-dimethoxy-2-acetonylpyrimidines Va-d.

These compounds may exist in three tautomeric forms: enol (A), ketone (B), and pyrimidinylidene (C). The presence of signals from the methine proton of the acetonyl moiety (in the 4.08-4.19 ppm region) and the NH proton of the pyrimidine ring (in the 11.90-13.42 ppm region) is characteristic for the PMR spectra of 5-arylazo-2-acetonylpyrimidines Va-d (see Table 1). In the IR spectra (see Table 3) of these compounds (in the solid phase or in solutions of low-polarity solvents), along with bands at 1719-1721 cm^{-1} corresponding to (as in the case of 2,5-dihydropyrimidines IIIa-d) vibrations of the carbonyl group which is not conjugated with the pyrimidine ring, there are bands at 1640-1650 cm^{-1}, characteristic for the carbonyl group of

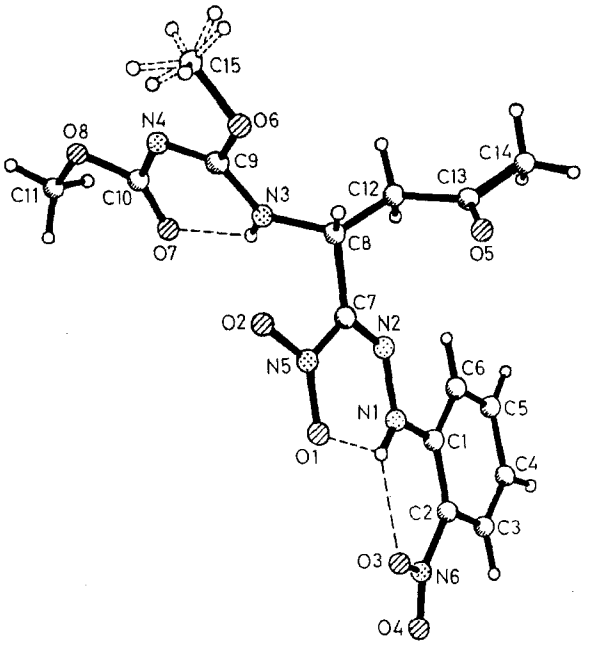
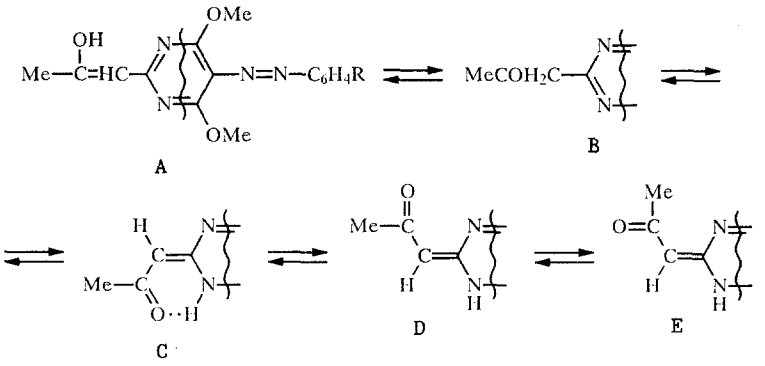


Fig. 1. Structure and numbering scheme for IXa molecule.

the enaminoketone moiety, connected by an intramolecular hydrogen bond (form B) (compare with [6]). Furthermore, low-intensity bands at 1630 cm^{-1} (C=O) and 3420 cm^{-1} (NH) suggest the presence of a small amount of form E in the tautomeric equilibrium. Upon going to a high-polarity solvent, high-frequency (~1670) and low-frequency (~1630 cm^{-1}) shoulders appear on the contour of the band at 1645 cm^{-1} (compound Vd). This is obviously due to rupture of the intramolecular hydrogen bond (form B) and isomerization relative to the C=C bond (forms D and E). Thus, compounds Va-d exist in a complex equilibrium of four forms (B, C, D, and E).

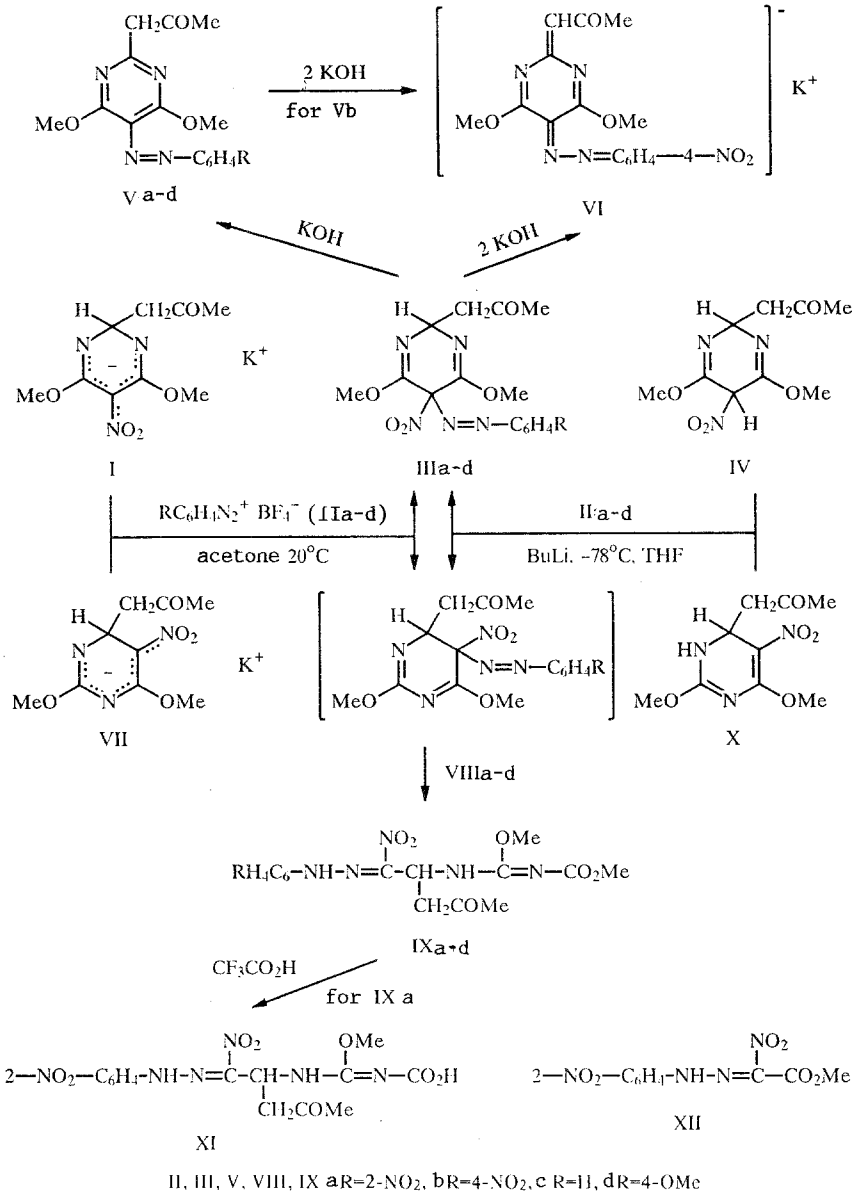


The bathochromic shift of the fundamental absorption bands in the electronic spectra of compounds Va-d compared with IIIa-d (Table 1) also indicates that the acetonyl moiety is involved in a single conjugation chain.

Upon reaction of the azo compound Vb with potassium hydroxide in methanol solution (method A), the salt VI (a Zimmerman salt) is formed. The action of a twofold excess of potassium hydroxide on 2,5-dihydropyrimidine IIIb (method B) leads to the same result. The presence of a para-nitrophenylazo group in the 5 position of the pyrimidine ring leads to a significant bathochromic shift of salt VI. The absorption bands of this compound (406 and 590 nm) are constant in bipolar aprotic solvents, while in alcohols they undergo a hypsochromic shift and correspond to those in the spectrum of acetonylpyrimidine Vb, obviously due to protonation of the nitrogen atom of the pyrimidine ring.

Upon reaction of the acetonyl anionic sigma complex VII, in which the geminal unit is ortho to the nitro group, with the aryldiazonium salts IIa-d (methanol A), N-methoxycarbonyl-N′-(1-acetonyl-2-nitro-2-arylhydrazono)ethyl-O-methylisourea IXa-d are isolated from the reaction mixture as the only reaction products. The structure of these compounds has been established

by x-ray diffraction of compound IXa (Fig. 1). All three substituents at the $C_{(8)}$ atom have a planar conformation, which makes the molecule "propeller-shaped;" the dihedral angles between the planes of the substituents lie in the range 77-80°. In the molecule there are two hydrogen atoms [at the $N_{(1)}$ and $N_{(3)}$ atoms] capable of forming hydrogen bonds, and in both cases formation of intramolecular hydrogen bonds occurs. The hydrogen bond $N_{(3)}$–(3-H)...$O_{(7)}$ [$N_{(3)}$...$O_{(7)}$ 2.638 (3), $O_{(7)}$...(3-H) 1.95 (2), $N_{(3)}$–(3-H) 0.87 (2) Å, angle $N_{(3)}$–(3-H)...$O_{(7)}$ 134°] fixes the planar conformation of the $N_{(3)}$...$C_{(11)}$ chain. The hydrogen atom at the $N_{(1)}$ atom participates in the forked intramolecular hydrogen bond with the $O_{(1)}$ and $O_{(3)}$ atoms of the nitro groups [$N_{(1)}$...$O_{(1)}$ 2.610 (3), $N_{(1)}$...$O_{(3)}$ 2.627 (3), $O_{(1)}$...(1-H) 1.99 (2), $O_{(3)}$...(1-H) 2.01 (2) Å, angles N–H...O 126 and 126°], which is also responsible for the planarity of the $PhN_{(1)}$–$N_{(2)}$–$C_{(7)}$ moiety. The planes of the nitro groups at the $C_{(7)}$ and $C_{(2)}$ atoms from dihedral angles of 6.5° and 18.1° with the plane of the phenyl ring. On the whole the geometric parameters of this molecule (bond lengths and bond angles) have the expected values [7]. Compounds IXa-d are also obtained from 1,6-dihydropyrimidine X according to method B.



In the PMR spectra of compounds IXa-d, the presence of an acetonyl geminal unit is apparent as characteristic signals from the ABX system corresponding to magnetically nonequivalent protons from the methylene group and the methine hydrogen atom, and the signal from the latter is complicated as a result of spin–spin coupling with the proton of the NH group. Based on the established structure for compounds IXa-d, we can hypothesize that electrophilic attack on the anionic σ complex VII by a diazonium ion initially occurs at the $C_{(5)}$ atom of the pyrimidine ring with formation of unstable 5-arylazo-5-nitro-4-acetonyl-2,6-dimethoxy-4,5-dihydropyrimidines VIIIa-d. Then obviously at the time of isolation and purification, opening of the 4,5-

dihydropyrimidine ring occurs at the $C_{(5)}-C_{(6)}$ bond along with addition of a water molecule. Such an orientation for opening of the 4,5-dihydropyrimidine ring has been found to not be unique. Upon reaction of the σ complex VII with salt IIa in benzene in the presence of the equimolecular amount of benzyltriethylammonium chloride, the methyl ester of nitro-nitrophenylhydrazono acetic acid (XII) is isolated along with the derivative of O-methylisourea IXa. Formation of this compound is possible as a result of opening of the 4,5-dihydropyrimidine ring at the $C_{(4)}-C_{(5)}$ and $N_{(1)}-C_{(6)}$ bonds. Upon action of trifluoroacetic acid on O-methylisourea IXa, hydrolysis of the ester group occurs, leading to the acid XI.

Thus, independently of the position of the geminal unit in the acetonyl anionic σ complex of 5-nitropyrimidine, electrophilic attack by a diazonium ion occurs at the $C_{(5)}$ atom bonded to the nitro group. And if donor substituents are present in the α position of the imine moieties of the pyrimidine ring, the stability of the 2,5-dihydropyrimidines IIIa-d increase, which obviously is insufficient for stabilization of the molecules of the 4,5-dihydropyrimidines VIIIa-d, a consequence of which is opening of the pyrimidine ring.

EXPERIMENTAL

The NMR spectra were recorded on the Bruker WP-200 spectrometer in $CDCl_3$ and DMSO-d_6, internal standard TMS. The IR spectra were recorded on the Specord M-80. The UV spectra were recorded on the Specord M-40. The course of the reactions and the purity of the synthesized compounds were monitored by TLC on Silufol UV-254 plates in chloroform, visualization in UV light.

X-Ray Diffraction Study. Single crystals of IXa are monoclinic; at −120°C a = 27.928(7), b = 8.904(2), c = 19.960(5) Å, β = 133.03(1)°, U = 3628(3) Å^3, D_{calc} = 1.502 g/cm^3, Z = 8, space group C2/c. The cell parameters and the intensities of 4147 independent reflections, 3290 of which with $I \geq 4\sigma(I)$ were used for deciphering and refining the structure, were measured on the Siemens P3/PC diffractometer (λMoKα graphite monochromator, $\Theta/2\theta$ scanning, $\Theta \leq 30°$). The structure was deciphered by the direct method and refined by full-matrix least-squares in the anisotropic approximation for all nonhydrogen atoms. The positions of the hydrogen atoms were determined from a differential Fourier map and refined isotropically, except for the hydrogen atoms belonging to the methyl group disordered over two positions, which were refined for U_{iso} = 0.05 and G = 0.5. The final values of the residuals were R = 0.035, R_W = 0.035 for 3290 independent observable reflections ($F \geq 4\sigma$).

The C, H, and N elemental analysis data for the synthesized compounds correspond to the calculated values.

The anionic σ complexes I and VII were obtained according to the techniques in [9] and [8], respectively.

2-Acetonyl-5-nitro-5-(2-nitrophenylazo)-4,6-dimethoxy-2,5-dihydropyrimidine (IIIa, $C_{15}H_{16}N_6O_7$). **A**. 0.83 g (3.5 mmoles) 2-nitrophenyldiazonium borofluoride was added in portions to a solution of 1.0 g (3.5 mmoles) of the σ complex I in 5 ml acetone ~20°C with stirring. After 18 h, the mixture was evaporated to dryness and the reaction product was isolated by column chromatography on silica gel (20 g; eluting agent, chloroform).

B. 1.7 ml of 2.35 N butyllithium in hexane was added to a solution of 1.0 g (4.1 mmoles) 2,5-dihydropyrimidine IV in 10 ml THF, cooled down to −78°C, under an argon atmosphere. After 15 min, 0.97 g (4.1 mmoles) 2-nitrophenyldiazonium tetrafluoroborate (IIa) was added in portions. The mixture was held at this temperature for 2 h. After reaching room temperature, the mixture was evaporated to dryness and the residue was treated according to method A.

5-Arylazo-5-nitro-2,5-dihydropyrimidines IIIb-d (starting from I and IV) and also the derivatives of O-methylisourea IXa-d (starting from VII and X) were synthesized analogously.

N-Methoxycarbonyl-N′-[1-acetonyl-2-nitro-2-(2-nitrophenylhydrazono)]ethyl-O-methylisourea (IXa, $C_{15}H_{18}N_6O_8$) and the Methyl Ester of Nitro(2-nitrophenylhydrazono)acetic Acid (XII, $C_9H_8N_4O_6$). 0.84 g (3.5 mmoles) salt IIa was added with stirring to a suspension of 1.0 g (3.5 mmoles) of the σ complex VII and 0.8 g (3.5 mmoles) benzyltriethylammonium chloride in 5 ml absolute benzene. After 18 h, the reaction mixture was filtered, the mother liquor was evaporated to dryness, the residue was chromatographed on a column with silica gel (20 g; eluting agent, chloroform). The ester XII was eluted from the lower zone. Yield, 0.18 g (12%). T_{mp}, 161-162°C (methanol); R_f 0.7. PMR spectrum (in $CDCl_3$): 13.69 (1H, br.s, NH); 7.76-8.29 (4H, m, arom.); 4.06 ppm (3H, s, CO_2CH_3). Upon further elution, the O-methylisourea IXa was washed out. Yield, 0.50 g (21%).

5-Arylazo-2-acetonyl-4,6-dimethoxypyrimidines Va-d. A solution of 0.15 g (2.7 mmoles) potassium hydroxide in 2 ml methanol was added with stirring to a solution of 2.7 mmoles of the corresponding 2,5-dihydropyrimidine IIIa-d in 3 ml methanol. The reaction mixture was stirred for 2 h, the precipitate was filtered and dried.

Potassium Salt of 2-Acetylmethine-5-(4-nitrophenylazo)-4,6-dimethoxypyrimidine (VI, $C_{15}H_{14}KN_5O_5$). **A.** A mixture of 0.65 g (1.9 mmoles) of azopyrimidine Vb and 0.11 g (1.9 mmoles) ground potassium hydroxide was stirred in 5 ml methanol for 3 h. The reaction mixture was filtered and the salt VI was precipitated in 100 ml absolute ether. Yield, 0.60 g (83%). UV spectrum, λ_{max} (log ε): 406 (4.2), 590 (4.4) [DMSO]; 406 (4.0), 590 (4.2) [DMF]; 406 (3.8), 590 (4.1) [acetone]; 387 (4.3) [methanol]; 387 (4.2) nm [ethanol]. PMR spectrum (in DMSO-d_6): 7.99, 8.62 (4H, d.d, arom.); 4.37 (1H, s, CH); 3.87 (6H, s, OCH_3); 1.89 ppm (3H, s, CH_3).

B. A mixture of 0.60 g (1.53 mmoles) 2,5-dihydropyrimidine IIIb and 0.17 g (3.06 mmoles) potassium hydroxide was stirred in 22 ml methanol for 3 h. The reaction mixture was treated according to method A. Yield, 0.53 g (91%).

N-Carboxy-N'-[1-acetonyl-2-nitro-(2-nitrophenylhydrazono)]ethyl-O-methylisourea (XI, $C_{14}H_{16}N_6O_8$). 0.1 ml (1.31 mmoles) trifluoroacetic acid was added to a solution of 0.5 g (1.22 mmoles) compound IXa in 10 ml benzene and the reaction mixture was boiled with stirring for 6 h. The precipitate was filtered. Yield, 0.23 g (48%). T_{mp} 173-174°C; R_f 0.35. PMR spectrum (in acetone-d_6): 12.15 (1H, s, NH); 9.04 (1H, s, OH); 8.43 (1H, d, NH); 7.70-8.22 (4H, m, arom.); 5.74, 5.71 (1H, 2t, CH); 3.69 (3H, s, OCH_3); 3.26 (2H, m, CH_2); 2.14 ppm (3H, s, CH_3).

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