Bis(dimethylaminomethyl)-5-hydroxyflavone (VI). This compound had mp 168-170°C. UV spectrum, λ_{max} (log ε): 275 (4.37), 285 (4.29), 340 nm (3.79). IR spectrum: 1652 (C=O), 3080, 1600, 1465 (Ar), 1375 $(CH_3)_2$, 2960, 2870 (CH_2), 1190, 1060, 1039 (C-N, C-O-C), 3200-3600 cm^{-1} (OH). $C_{21}H_{24}N_2O_3$.

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SYNTHESIS OF FURAZANO[3,4-b]PYRAZINE DERIVATIVES

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UDC 547.793.2'866.5.07

Various furazano[3,4-b]pyrazine derivatives were synthesized by condensation of 3,4-diaminofurazan with substituted phenylglyoxals, cyclic di- and triketones, and diethyl acetylenedicarboxylate.

Aminofurazans have recently attracted attention in connection with the detection of their physiological activity. 3-Aryl-4-aminofurazans have been found to be effective anticonvulsants and depressants [1]. Substances that have anesthetizing and antibacterial action have been found among other aminofurazan derivatives [2, 3]. In this connection, it seemed of interest to us to investigate the possibilities of obtaining compounds in which the furazan ring is condensed with a pyrazine ring [4]. 3,4-Diaminofurazan (I) [5] was used as the starting reagent.

The furazan ring has pronounced electron-acceptor properties, as a consequence of which the nucleophilicity of the amino groups in furazan I is markedly lowered, and its reaction with carbonyl derivatives proceeds under more severe conditions than, let us say, with o-phenylenediamine. We obtained a number of 5-arylfurazano[3,4-b]pyrazines (II) in reactions with I with substituted phenylglyoxals.

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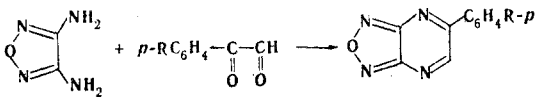
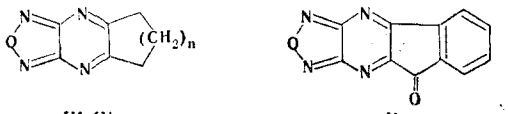


I IIa-e

IIa R=H b R=Cl c R=Br d R=CH_3O e R=NO_2

The signal of a pyrazine ring proton at τ 0.17-0.34 ppm and signals of phenyl ring protons at 1.5-3.0 ppm are observed in the PMR spectra of II.

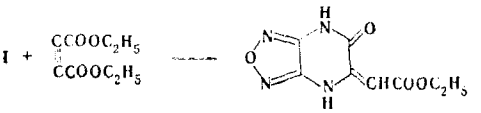
Cycloalkeno[e]furazano[3,4-b]pyrazines III and IV were obtained under similar conditions in the condensation of diamine I with 1,2-cyclohexane- and 1,2-cycloheptanedione. The reaction of I with a cyclic triketone — ninhydrin — which leads to the formation of 5-oxoindeno[1,2-e]furazano[3,4-b]pyrazine (V), proceeds readily.



III, IV V

III n=2; IV n=3;

6-Carbethoxymethylene-5-oxo-4,5,6,7-tetrahydrofurazano[3,4-b]pyrazine (VI) was obtained by reaction of furazan I with diethyl acetylenedicarboxylate. The presence in the IR spectrum of an intense band at 1652 cm^{-1}, which is characteristic for a six-membered cyclic amide, provides evidence that VI exists in the keto form. Its enamine structure is confirmed by the presence in its PMR spectrum of a signal at 4.34 ppm, the integral intensity of which corresponds to one proton. Cleavage of the pyrazine ring to give the starting 3,4-diaminofurazan (I) was observed during an attempt to hydrolyze the ester group in VI.



VI

EXPERIMENTAL

The PMR spectra of the compounds in d_6-DMSO were recorded with a Perkin-Elmer R12B spectrometer with tetramethylsilane as the internal standard. The IR spectra of mineral oil suspensions of the compounds were recorded with a UR-20 spectrometer.

The characteristics of all of the compounds obtained are presented in Table 1.

5-Phenylfurazano[3,4-b]pyrazine (IIa). A solution of 1.0 g (10 mmole) of I and 1.34 g (10 mmole) of phenylglyoxal in a mixture of 4 ml of alcohol and 4 ml of acetic acid was re-

TABLE 1. Furazano[3,4-b]pyrazine Derivatives II-VI

Compound	mp, °C*	Empirical formula	Found, %			Calc., %			Yield, %
			C	H	N	C	H	N	
IIa	140—141	$C_{10}H_6N_4O$	60,1	3,1	28,7	60,6	3,0	28,3	68
IIb	155—156	$C_{10}H_5ClN_4O$	51,2	2,1	24,4	51,6	2,2	24,1	69
IIc	151—152	$C_{10}H_5BrN_4O$	42,8	1,9	19,9	43,3	1,8	20,2	73
IId	154—155	$C_{11}H_8N_4O_2$	58,3	3,6	24,3	57,9	3,5	24,6	65
IIe	144—145	$C_{10}H_5N_5O_3$	49,1	2,2	28,5	49,4	2,1	28,8	78
III	268—269	$C_8H_8N_4O$	55,0	4,6	31,5	54,5	4,5	31,8	45
IV	183—185	$C_9H_{10}N_4O$	56,4	5,2	29,7	56,8	5,3	29,5	39
V	283—284	$C_{11}H_4N_4O_2$	58,5	1,7	25,3	58,9	1,8	25,0	86
VI	230—232	$C_8H_8N_4O_4$	43,4	3,6	25,0	42,9	3,6	25,0	74

*Compounds IIa-e, V, and VI were recrystallized from alcohol, and III and IV were recrystallized from xylene.

fluxed for 1 h, after which the mixture was cooled, and the precipitate was removed by filtration.

Compounds IIb-e were similarly obtained.

Cyclohexeno[e]furazano[3,4-b]pyrazine (III). A mixture of 1.0 g (10 mmole) of furazan I, 1.12 g (10 mmole) of 1,2-cyclohexanedione, 5 ml of ethanol, and 5 ml of acetic acid was refluxed for 1 h, after which it was poured into 100 ml of water, and the precipitate was removed by filtration.

Cyclohepteno[e]furazano[3,4-b]pyrazine (IV). A solution of 1.0 g (10 mmole) of furazan I and 1.26 g (10 mmole) of 1,2-cycloheptanedione in 5 ml of ethanol and 5 ml of acetic acid was refluxed for 3 h, after which the solvent was removed by evaporation. Benzene was added to the residue, and the resulting precipitate was removed by filtration.

5-Oxoindeno[1,2-e]furazano[3,4-b]pyrazine (V). A 1.0-g (10 mmole) sample of furazan I and 1.78 g (10 mmole) of ninhydrin in a solution of 10 ml of alcohol was refluxed for 10 min. At the end of the reaction, the mixture was cooled, and the precipitate was removed by filtration. IR spectrum: 1735 cm^{-1} (C=O).

6-(Carbethoxymethylene)-5-oxo-4,5,6,7-tetrahydrofurazano[3,4-b]pyrazine (VI). A solution of 1.0 g (10 mmole) of furazan I and 1.7 g (10 mmole) of diethyl acetylenedicarboxylate in a mixture of 5 ml of acetic acid and 5 ml of ethanol was refluxed for 45 min, after which it was cooled, and the precipitate was removed by filtration. IR spectrum: 1652 (amide C=O), 1711 (ester C=O), and 3213 and 3091 cm^{-1} (N-H). PMR spectrum, τ: 8.90 (3H, t, CH_3), 5.85 (2H, q, CH_2), and 4.34 ppm (1H, s, CH).

Hydrolysis of Ester VI. A suspension of 0.5 g (2.2 moles) of ester VI was refluxed in 15 ml of 4 N hydrochloric acid for about 1 h until the ester dissolved completely. The solution was cooled and neutralized with potassium carbonate, and the reaction product was extracted with five 40-ml portions of ether and purified by recrystallization from water to give 0.05 g (22%) of furazan I, which was identified by comparison of the IR spectrum with the spectrum of an authentic sample and by the absence of a melting-point depression.

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