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AMINO ACID DERIVATIVES AND OXIMES OF FLAVONES

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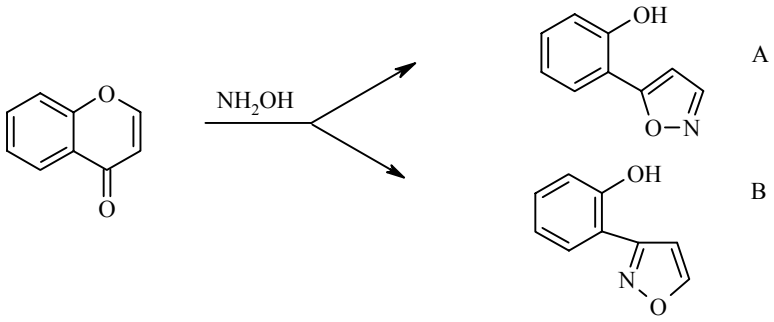
4-Ethoxyflavylium tetrafluoroborates with substituents in rings A and B were synthesized. Their reaction with nitrogen-containing nucleophiles was investigated. It was shown that derivatives of flavones at the carbonyl group are formed as a result of these reactions. The major distinctive physicochemical characteristics of the oximes of flavones and isoxazoles were determined.

Keywords: flavone amino acid derivatives, flavone oximes, 4-ethoxyflavylium tetrafluoroborates.

The synthetic possibilities and biological properties of the chromone system have been investigated in a fair amount of detail. However, the reliable published information on the characteristics of chromone derivatives with respect to the carbonyl group is insufficient, although these compounds can be used both for the synthesis of new heterocyclic systems and are themselves biologically active compounds. The formation of the C=N fragment at position 4 of the chromone ring promotes elongation of the principal conjugation chain and increase in the polarity of the molecule as a whole, thereby ensuring that these compounds are soluble in a polar medium and improving their assimilation by the organism as drugs [1].

The low degree of study of these compounds is explained by the diversity of the reactions of chromones with nucleophilic reagents, which can result in opening of the pyrone ring followed by recyclization of the intermediate with the formation of the corresponding five-membered heterocycles. For example, isoxazoles with structures A and B can be formed during the reaction of flavones with hydroxylamine.



According to data in [2], the most reliable method for the synthesis of 4-substituted flavones may be the path through the thioxochromones. In this case, however, the formation of the desired compounds is accompanied by cleavage of the pyrone ring [3].

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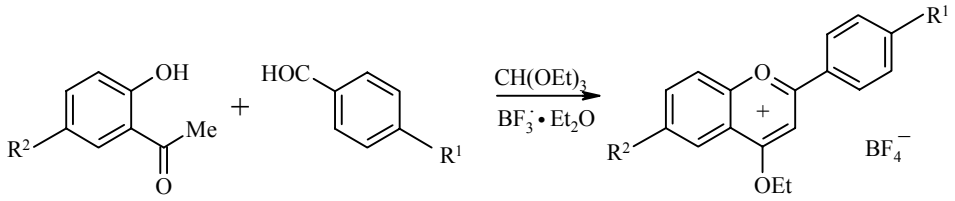
Another method for the synthesis of 4-substituted derivatives of flavones is the reaction of 4-ethoxyflavylium salts with nucleophilic reagents [4], but only derivatives with respect to position 4, a mixture with their recyclization products, or the latter alone may be formed, depending on the medium, the anion, and the substituents. The structure of the products of this reaction depends on the nucleophilic reagent [5]. For example, the action of hydrazine gives pyrazoles, while the reaction with phenylhydrazine leads to the phenylhydrazones of the flavones. Irrespective of the structure of the flavylium salts, their reaction with aniline in acetic acid leads to substitution of the 4-ethoxy group by an amino group. The reaction with hydroxylamine gives the flavone oxime, the structure of which was only confirmed by means of its melting point (without spectral data). Although it agrees with the melting point obtained by Baker [2] it does not provide reliable evidence for the structure of the obtained products.

On the basis of data [4] for the synthesis of flavone derivatives at the carbonyl group we first used 4-ethoxyflavylium salts containing the perchlorate anion as counterion. However, on account of their thermal stability, explosion resistance, higher solubility, and somewhat greater activity the tetrafluoroborates are preferred for practical use. At the beginning of our work, however, the synthesis of 4-ethoxyflavylium tetrafluoroborates had hardly been described at all. We prepared 4-ethoxyflavylium tetrafluoroborates with various substituents both in ring A and in ring B.

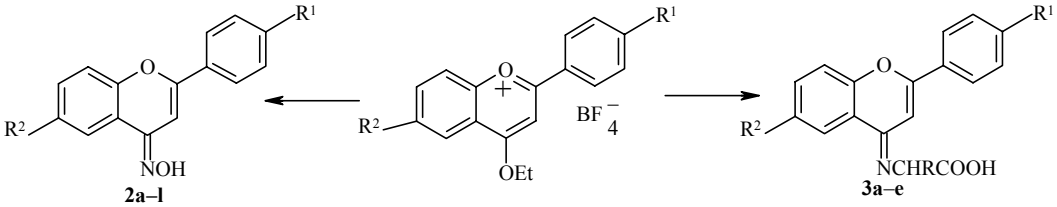


1a–i

1 a R^1 = OMe, R^2 = H; **b** R^1 = Me, R^2 = H; **c** R^1 = OH, R^2 = F; **d** R^1 = H, R^2 = F; **e** R^1 = OMe, R^2 = F; **f** R^1 = Me, R^2 = F; **g** R^1 = H, R^2 = Br; **h** R^1 = OH, R^2 = Br; **i** R^1 = OMe, R^2 = Br

The ^{1}H NMR spectra of the salts **1a-i** (Table 1) contain a triplet in the region of 1.05-1.07 ppm and a quartet in the region of 3.43-3.46 ppm, corresponding to an ethoxy group at position 4 of the chromone ring. The presence of signals in the range of 6.96-7.04 ppm (3-H) confirms that the chromone structure is retained.

The synthesized tetrafluoroborates were brought into reaction with hydroxylamine, aniline, and phenylhydrazine. As a result of these reactions we obtained derivatives of the flavones at position 4 with various substituents in rings A and B. Their characteristics agreed fully with the characteristics of the analogous compounds obtained from the perchlorates.



2a–l **3a–e**

2 a R^1 = H, R^2 = H; **b** R^1 = OH, R^2 = H; **c** R^1 = OMe, R^2 = H; **d** R^1 = Me, R^2 = H; **e** R^1 = H, R^2 = F; **f** R^1 = OH, R^2 = F; **g** R^1 = OMe, R^2 = F; **h** R^1 = OMe, R^2 = Cl; **i** R^1 = OMe, R^2 = Br; **j** R^1 = Me, R^2 = Br; **k** R^1 = OH, R^2 = NO_2; **l** R^1 = OMe, R^2 = NO_2; **3 a** R = H, R^1 = OMe, R^2 = H; R = H, R^1 = OMe, R^2 = Br; **c** R = *i*-C_3H_7, R^1 = OH, R^2 = H; **d** R = *i*-C_3H_7, R^1 = OH, R^2 = Br; **e** R = *i*-C_3H_7, R^1 = OMe, R^2 = Br

TABLE 1. The Physicochemical Characteristics of Compounds **1a-i***

Compound	Empirical formula	Found, % / Calculated, %			mp, °C	Characteristic signals in the ^{1}H NMR spectrum (DMSO), δ, ppm (*J*, Hz)	Yield, %
		C	H	Br			
1a	$C_{18}H_{17}BF_4O_3$	59.1 / 58.73	4.31 / 4.62		184	1.05 (3H, t, 4-OCH$_2$CH$_3$); 3.43 (2H, q, 4-OCH$_2$CH$_3$); 3.83 (3H, s, 4'-OCH$_3$); 6.93 (1H, s, 3-H); 7.12 (2H, d, *J* = 9, 3'-,5'-H); 8.07 (2H, d, *J* = 9, 2'-,6'-H); 7.2-8.2 (4H, m, H$_{arom}$)	75.7
1b	$C_{18}H_{17}BF_4O_2$	61.55 / 61.36	5.05 / 4.83		176	1.06 (3H, t, 4-OCH$_2$CH$_3$); 3.46 (2H, q, 4-OCH$_2$CH$_3$); 2.39 (3H, s, 4'-CH$_3$); 6.98 (1H, s, 3-H); 7.4 (2H, d, *J* = 9, 3'-,5'-H); 8.0 (2H, d, *J* = 9, 2'-,6'-H); 7.45-8.1 (4H, m, H$_{arom}$)	65.1
1c	$C_{17}H_{14}BF_5O_3$	54.5 / 54.84	4.15 / 3.76		267	1.05 (3H, t, 4-OCH$_2$CH$_3$); 3.46 (2H, q, 4-OCH$_2$CH$_3$); 6.89 (1H, s, 3-H); 6.95 (2H, d, *J* = 8.5, 3'-,5'-H); 7.97 (2H, d, *J* = 8.5, 2'-,6'-H); 7.36-7.9 (4H, m, H$_{arom}$)	72.3
1d	$C_{17}H_{14}BF_5O_2$	56.71 / 56.98	4.35 / 3.91		224	1.05 (3H, t, 4-OCH$_2$CH$_3$); 3.46 (2H, q, 4-OCH$_2$CH$_3$); 7.0 (1H, s, 3-H); 6.55-8.3 (8H, m, H$_{arom}$)	67.1
1e	$C_{18}H_{16}BF_5O_3$	55.61 / 55.96	4.25 / 4.14		212	1.06 (3H, t, 4-OCH$_2$CH$_3$); 3.45 (2H, q, 4-OCH$_2$CH$_3$); 3.87 (3H, s, 4'-OCH$_3$); 6.93 (1H, s, 3-H); 7.12 (2H, d, *J* = 9, 3'-,5'-H); 8.01 (2H, d, *J* = 9, 2'-,6-H); 7.6-8.0 (4H, m, H$_{arom}$)	82.3
1f	$C_{18}H_{16}BF_5O_2$	59.15 / 58.98	4.41 / 4.32		222	1.05 (3H, t, 4-OCH$_2$CH$_3$); 3.43 (2H, q, 4-OCH$_2$CH$_3$); 2.39 (3H, s, 4'-CH$_3$); 7.0 (1H, s, 3-H); 7.4 (2H, d, *J* = 8.5, 3'-,5'-H); 8.0 (2H, d, *J* = 8.5, 2'-,6'-H); 7.65-7.92 (4H, m, H$_{arom}$)	72.1
1g	$C_{17}H_{14}BBrF_4O_2$			18.95 / 19.18	196	1.07 (3H, t, 4-OCH$_2$CH$_3$); 3.43 (2H, q, 4-OCH$_2$CH$_3$); 7.04 (1H, s, 3-H); 8.12 (1H, d, *J* = 2.8, 5-H); 7.76 (1H, d, *J* = 8.8, 8-H);	65.4
1h	$C_{17}H_{14}BBrF_4O_3$			18.35 / 18.48	261	1.06 (3H, t, 4-OCH$_2$CH$_3$); 3.46 (2H, q, 4-OCH$_2$CH$_3$); 6.85 (1H, s, 3-H); 6.93 (2H, d, *J* = 9, 3'-, 5'-H); 7.95 (2H, d, *J* = 9, 2'-,6'-H); 7.7 (1H, d, *J* = 9, 8-H)	78.2
1i	$C_{18}H_{16}BBrF_4O_3$			18.05 / 17.8	231	1.07 (3H, t, 4-OCH$_2$CH$_3$); 3.43 (2H, q, 4-OCH$_2$CH$_3$); 3.87 (3H, s, 4'-OCH$_3$); 6.95 (1H, s, 3-H); 7.11 (2H, d, *J* = 8, 3'-,5'-H); 8.05 (2H, d, *J* = 8, 2'-,6'-H); 7.92 (1H, d, *J* = 2.9, 5-H); 7.75 (1H, d, *J* = 8.9, 8-H)	83.1

*In the IR spectra of the salts **1a-i** there were absorption bands for the symmetric and asymmetric vibrations of the pyrilium ring in the region of 1550-1510 cm^{-1}.

We examined in greater detail the reaction of the 4-ethoxyflavylium tetrafluoroborates with amino acids in acetic acid and with hydroxylamine in pyridine and in acetic acid in the presence of sodium acetate. Derivatives of flavones at the carbonyl group **2** and **3** were formed in acetic acid irrespective of the nature of the substituents in the molecules of the flavylium salts. In pyridine under analogous conditions about 30% of 5-(*o*-hydroxyphenyl)-3-phenylisoxazole, the constants of which agreed fully with published data [3], was obtained in addition to the flavone oxime.

All the synthesized oximes **2** gave a negative reaction with an alcohol solution of ferric chloride and did not dissolve in a 2 N solution of alkali or sodium carbonate either in the cold or on heating. This indicates retention of the pyrone ring and the absence of recyclization products containing a phenolic hydroxyl group and therefore soluble in alkali and sodium carbonate. In addition, when the oximes **2** and amino acid derivatives **3** that we obtained were boiled in acidified methanol they changed into the corresponding flavones. This provides another argument in favor of retention of the flavone structure.

The presence of a signal for the 3-H proton of the chromone ring in the region of 6.96-7.65 ppm in the ^{1}H NMR spectra of compounds **2** and **3** (Table 2) indicates retention of the flavone ring. In the region of 11 ppm there is a signal for the proton of the NOH group of the oximes, while in the region of 10.9-11.8 there is a signal for the proton of the COOH group in amino acids. Under the influence of the unshared electron pair of the nitrogen atom the signal of the 5-H proton (Table 2) is shifted downfield compared with the spectrum of the flavone. In the IR spectra of these derivatives there is a band for the stretching vibrations of the C=N bond in the region of 1600-1625 cm^{-1}. In the ^{13}C NMR spectra of the glycine derivatives **3a**,**b** there is a signal for the carbon atom of the COOH group in the region of 169 ppm.

To obtain more rigorous evidence for the formation of the 4-amino acid derivatives **3** in the reaction of the 4-ethoxyflavylium salts with amino acids we brought glycine diethyl ester into this reaction. The presence of signals for the protons of the ethoxy group (4.25, q, CH_2; 1.28, t, CH_3) and the N–CH_2 group (4.87, s) in the ^{1}H NMR spectrum of the product favors the proposed structure.

Earlier [5] the structure of 4'-methylflavone oxime was proved conclusively on the basis of the mass spectra. We obtained the compound both from the perchlorate and from 4-ethoxy-4'-methylflavylium tetrafluoroborate (**1b**) and by an alternative synthesis from thioxochromone. The physicochemical characteristics of the oxime **4d**, which we synthesized by various methods, agreed completely with published data. The samples did not give a melting point depression in a mixed melting test.

In order to study the chemical characteristics of the derivatives of flavones with respect to the carbonyl group we obtained the acetyl derivatives of the oximes **2i** and **2l**, the structure of which was proved by elemental analysis and spectroscopy. The ^{1}H NMR spectra of the acetates of the oximes **4a**,**b** contain a signal for the three protons of the acetyl group at 2.28 ppm. The signal of the 3-H proton (~7 ppm) confirms the retention of the chromone system. The IR spectra of the acetates **4a**,**b** contain bands for the stretching vibrations of the carbonyl bond in the acetyl group in the region of 1750 cm^{-1} and the band of the C=N bond at 1620 cm^{-1}.

The possibility of the formation of oximes and isoxazoles as a result of the reactions created the problem of assigning the obtained compounds. By analyzing and collating data [3, 6, 7] on the reaction of chromones, thioxochromones, and 4-ethoxychromylium salts with hydroxylamine we determined criteria by means of which it was possible to assign the obtained products instantly to one of these classes of compound (Table 3).

EXPERIMENTAL

The IR spectra were recorded in tablets of potassium bromide on a Pye Unicam SP-300 instrument. The ^{1}H NMR spectra were recorded on a Bruker WP-100 spectrometer (100 MHz) with TMS as internal standard. The reaction and the purity of the synthesized compounds were monitored by TLC (Silufol UV-254, 9:1 benzene–ethanol and 85:15 chloroform–methanol).

TABLE 2. The Characteristics of Compounds **2a-l**, **3a-e**

Com-pound	Empirical formula	Found, % / Calculated, %		mp, °C	IR spectrum (KBr), ν, cm^{-1}			Characteristic signals in ^1H NMR spectra (DMSO), δ, ppm (*J*, Hz)	Yield, %
		N	Hal		CN	OH	NO		
1	2	3	4	5	6	7	8	9	10
2a	$C_{15}H_{11}NO_2$	5.83 / 5.90		184	1610	3200	1010	7.14 (1H, s, 3-H); 11.01 (1H, s, NOH); 7.15-7.8 (9H, m, H_{arom})	81.0
2b	$C_{15}H_{10}NO_3$	5.66 / 5.55		236	1604	3100	1020	10.95 (1H, s, NOH); 10.0 (1H, s, 4'-OH); 6.94 (1H, s, 3-H); 6.9 (2H, d, *J* = 8.6, 3'-,5'-H); 7.78 (2H, d, *J* = 8.6, 3'-,6'-H); 7.88 (1H, dd, *J* = 2.1, 5-H)	97.4
2c	$C_{16}H_{13}NO_3$	5.18 / 5.24		207	1602	3100	1020	11.04 (1H, s, NOH); 3.8 (3H, s, 4'-OCH_3); 6.97 (1H, s, 3-H); 7.1 (2H, d, *J* = 8.5, 3'-,5'-H); 7.92 (2H, d, *J* = 8.5, 2'-,6'-H)	72.8
2d	$C_{16}H_{13}NO_2$	5.61 / 5.57		213	1605	3150	1010	10.94 (1H, s, NOH); 2.37 (3H, s, 4'-CH_3); 7.07 (1H, s, 3-H); 7.3 (2H, d, *J* = 8.0, 3'-,5'-H); 7.82 (2H, d, *J* = 8.0, 2'-,6'-H)	65.3
2e	$C_{15}H_{10}FNO_2$	5.38 / 5.49		145	1610	2980	1019	11.14 (1H, s, NOH); 7.08 (1H, s, 3-H)	75.0
2f	$C_{15}H_{10}FNO_3$	5.31 / 5.16		263	1600	3100	1040	11.0 (1H, s, NOH); 10.02 (1H, s, 4'-OH); 6.93 (1H, s, 3-H); 6.88 (2H, d, *J* = 8.5, 3'-,5'-H); 7.75 (2H, d, *J* = 8.5, 2'-,6'-H)	62.5
2g	$C_{16}H_{12}FNO_3$	4.88 / 4.91		209	1604	3100	1020	11.05 (1H, s, NOH); 3.83 (3H, s, 4'-OCH_3); 6.98 (1H, s, 3-H); 7.05 (2H, d, *J* = 8.5, 3'-,5'-H); 7.86 (2H, d, *J* = 8,5, 2',6'-H);	93.3
2h	$C_{16}H_{12}ClNO_3$	4.88 / 4.64	11.67 / 11.75	210 decomp.	1600	3100	1020	11.0 (1H, s, NOH); 3.82 (3H, s, 4'-OCH_3); 7.31 (1H, s, 3-H); 7.1 (2H, d, *J* = 9.0, 3'-,5'-H); 7.89 (2H, d, *J* = 9.0, 2'-,6'-H); 7.77 (1H, d, *J* = 3.0, 5-H); 7.45 (1H, dd, *J* = 9.0; 3,0, 7-H); 7.08 (1H, d, *J* = 9.0, 8-H)	89.5
2i	$C_{16}H_{12}BrNO_3$	3.91 / 4.05	23.22 / 23.08	216	1605	2980	1020	11.1 (1H, s, NOH); 3.87 (3H, s, 4'-OCH_3); 6.95 (1H, s, 3-H); 7.07 (2H, d, *J* = 9.0, 3'-,5'-H); 8.12 (2H, d, *J* = 9.0, 2'-,6'-H); 7.92 (1H, d, *J* = 3.0, 5-H); 7.12 (1H, d, *J* = 9.0, 8-H)	87.7

TABLE 2 (continued)

1	2	3	4	5	6	7	8	9	10
2j	$C_{16}H_{12}BrNO_2$	3.81 / 4.24	24.25 / 24.20	193	1610	3080	1028	11.05 (1H, s, NOH); 2.37 (3H, s, 4'-CH_3); 7.6 (1H, s, 3-H); 7.35 (2H, d, *J* = 9.0, 3'-,5'-H); 7.8 (2H, d, *J* = 9.0, 2'-,6'-H)	78.0
2k	$C_{15}H_{10}N_2O_5$	9.28 / 9.39		253	1600	3100	1040	12.32 (1H, s, NOH); 9.91 (1H, s, 4'-OH); 7.32 (1H, s, 3-H); 7.78 (2H, d, *J* = 9.0, 3'-,5'-H); 8.22 (2H, d, *J* = 9.0, 2'-,6'-H); 8.6 (1H, d, *J* = 3.0, 5-H); 7.12 (1H, d, *J* = 9.5, 8-H)	93.3
2l	$C_{16}H_{12}N_2O_5$	9.01 / 8.96		268	1604	3000	1020	12.32 (1H, s, NOH); 3.84 (3H, s, 4'-OCH_3); 7.4 (1H, s, 3-H); 7.08 (2H, d, *J* = 9.0, 3'-,5'-H); 7.87 (2H, d, *J* = 9.0, 2'-,6'-H); 8.6 (1H, d, *J* = 3.0, 5-H); 8.23 (1H, dd, *J* = 9.0; 3.0, 7-H); 7.23 (1H, d, *J* = 9.0, 8-H)	73.8
3a	$C_{18}H_{15}NO_4$	4.21 / 4.54		290	1620			3.92 (3H, s, 4'-OCH_3); 4.79 (2H, s, CH_2); 7.20 (2H, d, *J* = 8.5, 3'-,5'-H); 8.36 (2H, d, *J* = 8.5, 2'-,6'-H)	85.2
3b	$C_{18}H_{14}BrNO_4$	3.31 / 3.61	20.65 / 20.59	285	1625			3.93 (3H, s, 4'-OCH_3); 4.78 (2H, s, CH_2); 7.0 (2H, d, *J* = 8.5, 3'-,5'-H); 8.37 (2H, d, *J* = 8.5, 2'-,6'-H); 7.73 (1H, s, 3-H)	89.1
3c	$C_{20}H_{19}NO_4$	4.01 / 4.15		274	1615			5.13 (1H, d, *J* = 6.5, NCH); 7.05 (2H, d, *J* = 8.5, 3'-,5'-H); 8.3 (2H, d, *J* = 8.5, 2'-,6'-H); 7.68 (1H, s, 3-H)	83.2
3d	$C_{20}H_{18}BrNO_4$	3.25 / 3.36	19.01 / 19.20	268	1620			5.1 (1H, d, *J* = 6.5, NCH); 7.05 (2H, d, *J* = 8.5, 3'-,5'-H); 8.1 (2H, d, *J* = 8.5, 2'-,6'-H); 7.3 (1H, s, 3-H)	84.5
3e	$C_{21}H_{20}BrNO_4$	3.61 / 3.26	18.42 / 18.57	272	1625			3.93 (3H, s, 4'-OCH_3); 5.22 (1H, d, *J* = 6.5, NCH); 7.3 (2H, d, *J* = 8.5, 3'-,5'-H); 8.4 (2H, d, *J* = 8.5, 2'-,6'-H); 7.8 (1H, s, 3-H)	88.4
4a	$C_{18}H_{14}BrNO_4$	3.88 / 3.61	20.35 / 20.58	145.5	1600		1020	3.95 (3H, s, 4'-OCH_3); 7.15 (1H, s, 3-H); 2.28 (3H, s, 4-$CNOCOCH_3$)	72.5
4b	$C_{18}H_{15}NO_4$	4.48 / 4.53		150	1610		1025	3.92 (3H, s, 4'-OCH_3); 7.10 (1H, s, 3-H); 2.25 (3H, s, 4-$CNOCOCH_3$)	69.2

TABLE 3. The Principal Distinctive Characteristics of the Oximes of Flavones and Isoxazoles

Characteristics	Oximes	Isoxazoles
Reaction with $FeCl_3$	Does not form colored complex	A. Does not form colored complex B. Forms colored complex
Solubility in alkalis	Does not dissolve	Dissolves
Solubility in acids	Dissolves	Does not dissolve
Transformation to flavone	Is transformed	Is not transformed
^{1}H NMR spectrum (DMSO), ppm	11.0-11.3 (N–OH); 6.8-7.2 (3-H); 7.8-8.2 (5-H); 7.3-7.6 (8-H)	10.2-10.8 (OH), A. 7.3-7.5 (4-H); B. 7.4-7.8 (4-H), 7.1-7.8 (6-H)
IR spectrum, cm^{-1}	1630-1650 (C=N); 1615-1645 (C=C); 1120-1125 (C–O–C); 3000-3300 (OH)	1610-1615 (C=N, C=C); 1270-1275 (C–O–N); 3100-3170 (OH)

4-Ethoxyflavylium Tetrafluoroborates (1a-i). A solution of the respective acetophenone (2 mmol) and substituted benzaldehyde (6 mmol) in orthoformic ester (8.3 ml, 40 mmol) was brought to boiling, and boron trifluoride etherate (2.8 mmol) was added drop by drop. The reaction mixture was left at room temperature for 12-24 h. The precipitate was filtered off, washed with isopropyl alcohol, and recrystallized from acetic acid.

Flavone Oximes (2a-l). A mixture of 4-ethoxyflavylium tetrafluoroborate, hydroxylamine hydrochloride, and sodium acetate in molar ratios 1:2:1 was boiled in glacial acetic acid for 1 h. At the end of the reaction (TLC) the reaction mixture was poured onto ice. The precipitate was filtered off, washed repeatedly with water, and recrystallized from isopropyl alcohol.

5-(*o*-Hydroxyphenyl)-3-phenylisoxazole. A mixture of flavylium perchlorate and hydroxylamine hydrochloride in molar ratio 1:2 was boiled in pyridine for 1 h. After the reaction (chromatographic control) the reaction mixture was poured onto ice. The precipitated mixture of products (oxime and isoxazole) was filtered off, washed repeatedly with water and separated by fractional crystallization from isopropyl alcohol. The yield of 5-(*o*-hydroxyphenyl)-3-phenylisoxazole was 30%; mp 234-235°C.

Amino Acid Derivatives of Flavones (3a-e). A mixture of 4-ethoxyflavylium tetrafluoroborate **1** (2.6 mmol) and the respective amino acid (5 mmol) was boiled in glacial acetic acid (monitored by TLC). The reaction mixture was cooled, and the precipitate was filtered off and recrystallized from acetic acid.

Acetates of Flavone Oximes (4a, b). A solution of the oxime **2i**,**f** (0.1 mmol) in acetic anhydride (6 ml) and pyridine (1 ml) was heated for 0.5-1 h. The reaction mixture was poured onto ice, and the precipitate was filtered off, washed thoroughly with water, and recrystallized from acetic acid.

REFERENCES

1. M. Yu. Oganesyan and V. V. Gushchin, *Khim.-Farm. Zh.*, **23**, 1238 (1989).
2. W. Baker, J. B. Harborne, and W. D. Ollis, *J. Chem. Soc.*, **4**, 1303 (1952).
3. V. Basinski and S. Jermanovska, *Roczn. Chem.*, **48**, 989 (1984).
4. G. N. Dorofeenko, V. V. Mezheritskii, and N. A. Lopatina, *Khim. Geterotsikl. Soedin.*, 1163 (1972).
5. G. N. Dorofeenko, V. V. Tkachenko, and V. V. Mezheritskii, *Khim. Geterotsikl. Soedin.*, 465 (1975).
6. A. L. Kazakov, V. P. Khilya, V. V. Mezheritskii, and Yu. Litkei, *Natural and Modified Isoflavonoids* [in Russian], Izd. Rost. Un-ta, Rostov-on-Don (1985).
7. V. Szabo, J. Borda, and L. Losonczi, *Acta Chim. Acad. Sci. Hung.*, **97**, 69 (1978).