Syntheses of Isoalloxazines, Alloxazines, Toxoflavins, and Fervenulins by Oxidative Cyclization of the Michael-type Adducts from Substituted 6-Aminouracils and Azo-compounds

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Treatment of the Michael-type adducts from 6-anilinouracil derivatives and diethyl azodiformate (DAD) or 4-phenyl-1,2,4-triazoline-3,5-dione (PTAD) with an oxidizing agent caused oxidative rearrangement, followed by thermal or photochemical cyclization, to give the corresponding (iso)alloxazines. Similarly, oxidative cyclization of the Michael-type adducts form 6-benzylidenehydrazinouracil derivatives and DAD gave toxoflavin and fervenulin derivatives.

DIETHYL AZODIFORMATE (DAD) reacts readily with 6-aminopyrimidines unsubstituted in position 5 to give Michael-type adducts [6-amino-5-(1,2-bisethoxycarbonylhydrazino)pyrimidines].[1] 4-Phenyl-1,2,4-triazoline-3,5-dione (PTAD) is also effective in such Michael-type additions, giving the corresponding 5-(3,5-dioxo-4-phenyl-1,2,4-triazolidin-1-yl)pyrimidines.[2,3] These adducts are useful starting materils for preparations of several fused pyrimidines,[4-7] the DAD or PTAD acting as a nitrogen source for direct cyclization. We now describe a new synthesis of biologically interesting fused pyrimidines (isoalloxazines, alloxazines, toxoflavins, and fervenulins) by oxidative cyclization of the Michael-type adducts with several oxidizing agents. The reaction proceeds through *NN*-bisethoxycarbonylhydrazones, formed by dehydrogenation of the Michael-type adducts followed by rearrangement.

Synthesis of Isoalloxazines.—Treatment of 6-(*N*-ethylanilino)-3-methyluracil (Ib) [8] with an equimolar amount of DAD under reflux in chlorobenzene gave 5-(1,2-bisethoxycarbonylhydrazino)-6-(*N*-ethylanilino)-3-methyluracil (IIb). Heating the product (IIb) with an excess of lead tetra-acetate in dioxan under reflux for 5 h gave 10-ethyl-3-methylisoalloxazine (IIIb) [8] in good yield. When this reaction was carried out at lower temperature (*ca.* 40 °C) for 3 h, the product was the oxidised and rearranged intermediate *NN*-bisethoxycarbonylhydrazone (IVb). Compound (IVb) was readily converted into the isoalloxazine (IIIb) by heating its solution in tetramethylene sulphone at 200 °C, in good yield. Irradiation of (IVb) in ethanol with a tungsten lamp also gave the isoalloxazine (IIIb).

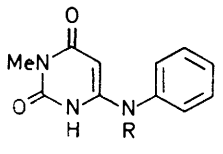
The structure of the intermediate (IVb) was based on the following facts. The two carbonyl bands (1 752 and 1 732 cm^{-1}) of the 1,2-bisethoxycarbonylhydrazino-group of (IIb) were replaced by two equivalent carbonyl bands (1 755 cm^{-1}), and the two amino-absorptions (3 230 and 3 180 cm^{-1}) of (IIb) had disappeared. The n.m.r. spectrum showed signals for two equivalent ethyl ester groups, whereas that of (IIb) showed those of two different ethyl ester systems. The mass spectrum of (IVb) revealed a strong molecular ion peak at *m/e* 417.

Similarly, the Michael-type adducts (IIa and c) from other 6-(*N*-alkylanilino)-3-methyluracils (Ia and c) with DAD gave the corresponding isoalloxazines (IIIa and c) by oxidative cyclization with lead tetra-acetate. Oxidation of the adducts (II) with lead dioxide in dioxan under reflux also gave (III), in lower yields. Although other oxidizing agents, such as DAD itself and nitrobenzene, can be used for the cyclization, the yields are poor. However, these adducts did not give any isoalloxazines on pyrolysis or on refluxing in solvents without oxidizing agents.

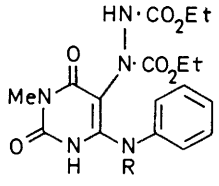
The oxidizing agents probably abstract two hydrogen atoms from the adduct to give the 1,5- or 1,3-dipolar intermediate (V), which undergoes intramolecular rearrangement to the *NN*-bisethoxycarbonylhydrazone (IV).[9] Compound (IV) could then cyclize thermally or photochemically to the dihydro-isoalloxazine derivative (VI), which is converted into the isoalloxazine by the loss of diethyl iminodiformate, although this product was not detected. The mechanism of the other reactions described below could be similarly explained.

Synthesis of Alloxazines.—Next, the oxidative cyclization of 6-anilino-5-(1,2-bisethoxycarbonylhydrazino)-

[1] E. C. Taylor and F. Sowinski, *J. Org. Chem.*, 1974, **39**, 907.
[2] F. Yoneda, S. Matsumoto, and M. Higuchi, *J.C.S. Chem. Comm.*, 1974, 551.
[3] F. Yoneda, S. Matsumoto, and Y. Sakuma, *Chem. and Pharm. Bull. (Japan)*, 1975, **23**, 2425.
[4] E. C. Taylor and F. Sowinski, *J. Org. Chem.*, 1975, **40**, 2321.
[5] E. C. Taylor and F. Sowinski, *J. Org. Chem.*, 1975, **40**, 2329.
[6] F. Yoneda, S. Matsumoto, and M. Higuchi, *J.C.S. Chem. Comm.*, 1975, 146.
[7] F. Yoneda, S. Fukazawa, and S. Nishigaki, *J.C.S. Chem. Comm.*, 1971, 83.
[8] F. Yoneda, Y. Sakuma, M. Ichiba, and K. Shinomura, *J. Amer. Chem. Soc.*, 1976, **98**, 830.
[9] There is precedent for a rearrangement of this type of 1,3-dipolar compound to the *NN*-bisethoxycarbonylhydrazone: E. Fahr, K. Döppert, and F. Scheckenbach, *Angew. Chem.*, 1963, **75**, 670.

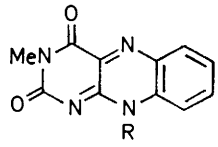


(I)

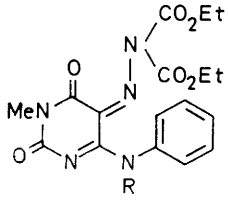


(II)

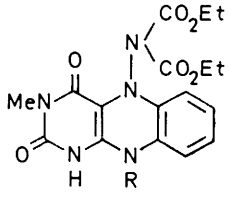
a ; R = Me
b ; R = Et
c ; R = Bu^n



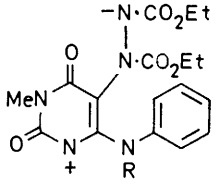
(III)

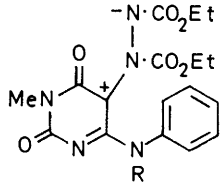


(IV) a ; R = Me
b ; R = Et

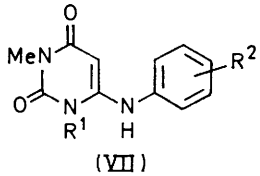


(VI)

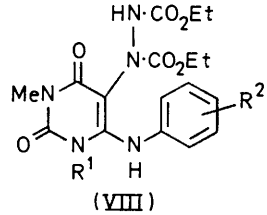




(V)

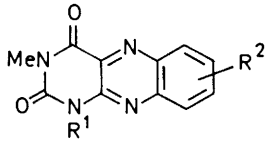


(VII)



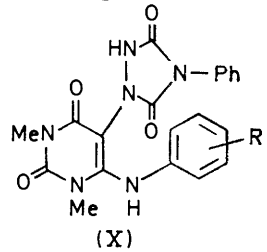
(VIII)

a ; R^1 = Me , R^2 = H
b ; R^1 = Me , R^2 = 3,4-Me_2
c ; R^1 = H , R^2 = 3,4-Me_2



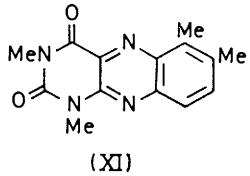
(IX)

a ; R^1 = Me , R^2 = H
b ; R^1 = Me , R^2 = 7,8-Me_2
c ; R^1 = H , R^2 = 7,8-Me_2



(X)

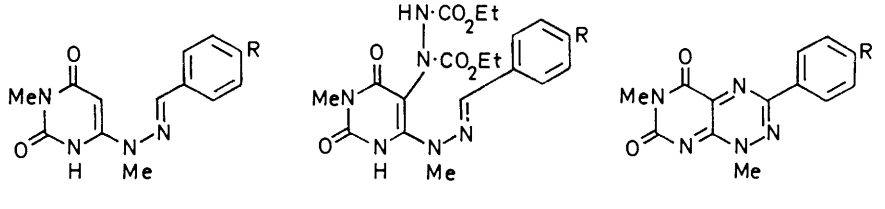
a ; R = H
b ; R = 3,4-Me_2



(XI)

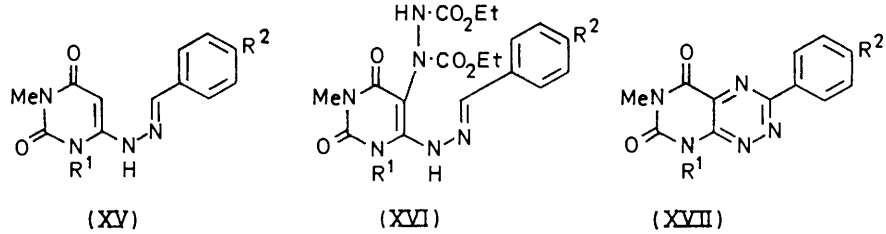
uracils (VIII) was carried out. This type of adduct has been shown previously to undergo dehydrogenative cyclization with DAD to give the corresponding alloxazine.[10] Further studies with several oxidizing agents showed that nitrobenzene is the reagent of choice. Typically, 1,3-dimethyl-6-(3,4-xylidino)uracil (VIIb) was treated with DAD in chlorobenzene to give the adduct (VIIIb). Heating (VIIIb) in a small amount of nitrobenzene followed by dilution with ethanol caused separation of 1,3-dimethyl-lumichrome (IXb) in high yield. Treatment of 5-(3,5-dioxo-4-phenyl-1,2,4-triazolidin-1-yl)-1,3-dimethyl-6-(3,4-xylidino)uracil (Xb) [3] with nitrobenzene likewise gave (IXb) in almost the same yield. This cyclization method is regiospecific, giving yields of alloxazines (IXa and c) by treatment with nitrobenzene. Oxidations with lead tetra-acetate, lead dioxide, or mercury(II) acetate also gave alloxazines (IX), albeit in lower yields.

Synthesis of Toxoflavin Derivatives.—The reaction was extended to the synthesis of toxoflavin derivatives possessing an isoalloxazine-like conjugated system. Treatment of 6-(2-benzylidene-1-methylhydrazino)-3-methyluracils (XII) [13] with DAD in dioxan in the presence of aluminium oxide * gave the corresponding 5-(1,2-bisethoxycarbonylhydrazino)uracils (XIII). Treatment of (XIII) with an excess of lead tetra-acetate in dioxan, followed by dilution with water, caused separation of the corresponding toxoflavin derivatives



(XII) (XIII) (XIV)

a ; R = H
b ; R = Cl
c ; R = OMe
d ; R = NMe_2
e ; R = O_2CH_2-3,4



(XV) (XVI) (XVII)

a ; R^1 = Me , R^2 = H
b ; R^1 = Me , R^2 = Cl
c ; R^1 = Me , R^2 = OMe
d ; R^1 = Me , R^2 = NMe_2
e ; R^1 = H , R^2 = H

only one product. The nitrosation method [11] for cyclization of (VIIb) gave a small amount of 1,3,6,7-tetramethylalloxazine (XI) as well as (IXb). Reductive cyclization [12] of 1,3-dimethyl-5-nitro-6-(3,4-xylidino)-uracil with triethyl phosphite also gave a mixture of (XI) and (IXb). The regiospecificity may be ascribed to steric hindrance by the bulky 1,2-bisethoxycarbonylhydrazino- or 4-phenyltriazolidinyl group at C-5 of the adduct.

Similarly, other adducts (VIIIa and c) gave good (XIV).[13] Heating (XIII) in nitrobenzene gave the corresponding 1-demethyltoxoflavins (8-demethylfervenulins) (see later) by thermal elimination of the 1-methyl group.

Synthesis of Fervenulin Derivatives.—Treatment of the 6-benzylidenehydrazino-1,3-dimethyluracils (XV) [14] with DAD in dioxan in the presence of aluminium oxide * gave the corresponding Michael-type adducts (XVI). Heating the adducts in nitrobenzene, followed by dilution with ethanol, gave the corresponding fervenulin derivatives (XVII).[15] Treatment of (XV) with an excess of

* Without aluminium oxide the reaction did not proceed; starting material was recovered.

[10] F. Yoneda, S. Matsumoto, and Y. Sakuma, *J.C.S. Perkin I*, 1975, 1907.
[11] F. Yoneda and M. Ichiba, unpublished data.
[12] E. C. Taylor, F. Sowinski, T. Yee, and F. Yoneda, *J. Amer. Chem. Soc.*, 1967, **89**, 3369.
[13] F. Yoneda and T. Nagamatsu, *Chem. and Pharm. Bull. (Japan)*, 1975, **23**, 2001.
[14] F. Yoneda and T. Nagamatsu, *Bull. Chem. Soc. Japan*, 1975, **48**, 1484.
[15] F. Yoneda and T. Nagamatsu, *Bull. Chem. Soc. Japan*, 1975, **48**, 2884.

DAD in dimethylformamide under reflux gave (XVII) directly, in lower yields.

Treatment of 6-benzylidenehydrazino-3-methyluracil (XVe) [14] with DAD gave 6-benzylidenehydrazino-5-(1,2-bisethoxycarbonylhydrazino)-3-methyluracil (XVIe), which was heated in nitrobenzene to give 3-phenyl-1-demethyltoxoflavin (3-phenyl-8-demethylfervenulin) (XVIIe).[13]

EXPERIMENTAL

5-(1,2-Bisethoxycarbonylhydrazino)-6-(N-ethylanilino)-3-methyluracil (IIb).—A mixture of 6-(*N*-ethylanilino)-3-methyluracil (Ib) (4.9 g, 0.02 mol) and DAD (3.8 g, 0.022 mol) in methylcellosolve (50 ml) was refluxed for 5 h. The mixture was evaporated *in vacuo* to dryness and the residue was treated with ether. The crystals which separated were filtered off and recrystallized from ethanol to give *needles* (5.5 g, 65%), m.p. 141°, $\nu_{max.}$ (Nujol) 3 230, 3 180, 1 752, 1 732, 1 695, 1 640, 1 609, and 1 583 cm^{-1}, M^+ 419 (Found: C, 54.5; H, 6.2; N, 16.7. $C_{19}H_{25}N_5O_6$ requires C, 54.4; H, 6.0; N, 16.7%).

5-(1,2-Bisethoxycarbonylhydrazino)-6-(N-methylanilino)-3-methyluracil (IIa).—A mixture of 6-(*N*-methylanilino)-3-methyluracil (Ia) (2.3 g, 0.01 mol) and DAD (2.1 g, 0.012 mol) in methylcellosolve (20 ml) was treated as above to give the *adduct* (3.2 g, 70%), m.p. 205°, $\nu_{max.}$ (Nujol) 3 235, 3 185, 1 753, 1 735, 1 700, 1 640, 1 612, 1 595, and 1 585 cm^{-1}, M^+ 405 (Found: C, 53.4; H, 5.8; N, 17.2. $C_{18}H_{23}N_5O_6$ requires C, 53.35; H, 5.7; N, 17.3%).

5-(1,2-Bisethoxycarbonylhydrazino)-6-(N-n-butylanilino)-3-methyluracil (IIc).—This was prepared analogously from 6-(*N*-n-butylanilino)-3-methyluracil (Ic) and DAD in 60% yield; m.p. 143°, $\nu_{max.}$ (Nujol) 3 240, 1 758, 1 739, 1 700, 1 635, 1 615, 1 599, and 1 585 cm^{-1}, M^+ 447 (Found: C, 56.4; H, 6.5; N, 15.55. $C_{21}H_{29}N_5O_6$ requires C, 56.35; H, 6.55; N, 15.65%).

6-(N-Ethylanilino)-3-methyl-5-oxouracil 5-NN-Bisethoxycarbonylhydrazone (IVb).—To a solution of the adduct (IIb) (2.1 g, 0.005 mol) in dioxan (30 ml) was added lead tetra-acetate (4.5 g, 0.01 mol); the mixture was stirred at 40 °C for 3 h, then filtered, and the filtrate was diluted with water (50 ml) and set aside overnight. The separated product was filtered off, washed with water, dried, and extracted with hot ethanol. The extracts were evaporated *in vacuo* to give the *hydrazone* (1.6 g, 76%). Recrystallization from ethanol gave pale yellow prisms, m.p. 143°, $\nu_{max.}$ (Nujol) 1 755, 1 708, 1 652, 1 602, 1 540, and 1 496 cm^{-1}, M^+ 417 (Found: C, 54.45; H, 5.45; N, 16.5. $C_{19}H_{23}N_5O_6$ requires C, 54.65; H, 5.55; N, 16.8%).

3-Methyl-6-(N-methylanilino)-5-oxouracil 5-NN-Bisethoxycarbonylhydrazone (IVa).—To a solution of the adduct (IIIa) (2 g, 0.005 mol) in dioxan (30 ml) was added lead tetra-acetate (4.5 g, 0.01 mol), and the mixture was treated as above to give pale yellow *crystals* (1.7 g, 75%), m.p. 115°, M^+ 403 (Found: C, 53.85; H, 5.3; N, 17.05. $C_{18}H_{21}N_5O_6$ requires C, 53.6; H, 5.25; N, 17.35%).

10-Ethyl-3-methylisoalloxazine (IIIb).—*Method A*. The hydrazone (IVb) (0.3 g, 0.000 7 mol) was dissolved in tetramethylene sulphone (5 ml) and heated at 200 °C for 2 h. The solution was evaporated to dryness and the residue was recrystallized from ethanol to give yellow needles (0.15 g, 78%), m.p. 299°.[8]

Method B. A solution of the hydrazone (IVb) (0.1 g, 0.000 23 mol) in ethanol (20 ml) was irradiated with a tungsten lamp (300 W) at 50 cm range for 5 h. The mixture was evaporated to dryness and the residue was washed with ether to give yellow needles (0.05 g, 78%), m.p. 299°.[8]

In the dark, refluxing (IVb) in ethanol or dioxan for 4 h did not give the product (IIIb); starting material was recovered.

TABLE 1

Michael-type adducts from 6-benzylidenehydrazinouracils and DAD

			Found (%)				Required (%)		
Compd.	M.p. (°C)	Yield (%)	C	H	N	Formula	C	H	N
(XIIIa)	179	61	52.65	5.3	19.5	$C_{19}H_{24}N_6O_6$	52.75	5.6	19.45
(XIIIb)	205	68	49.0	4.9	17.75	$C_{19}H_{23}ClN_6O_6$	48.9	4.95	18.0
(XIIIc)	219	78	51.75	5.6	18.05	$C_{20}H_{26}N_6O_7$	51.95	5.65	18.15
(XIIId)	216	66	52.95	6.2	20.4	$C_{21}H_{29}N_7O_6$	53.05	6.15	20.6
(XIIIe)	235	79	50.7	5.2	17.75	$C_{20}H_{24}N_6O_8$	50.4	5.1	17.65
(XVIa)	192	76	52.7	5.55	19.2	$C_{19}H_{24}N_6O_6$	52.75	5.6	19.45
(XVIb)	186	72	48.8	5.0	18.2	$C_{19}H_{23}ClN_6O_6$	48.9	4.95	18.0
(XVIc)	195	63	51.85	5.6	18.1	$C_{20}H_{26}N_6O_7$	51.95	5.65	18.15
(XVId)	193	59	53.25	6.15	20.45	$C_{21}H_{29}N_7O_6$	53.05	6.15	20.6

3,10-Dimethylisoalloxazine (IIIa).—The hydrazone (IVa) (0.4 g, 0.001 mol) was heated in tetramethylene sulphone (3 ml) at 200 °C for 1 h and the mixture was diluted with water. The crystals which separated were filtered off and washed with ethanol to give almost pure *isoalloxazine* (0.2 g, 83%), m.p. 334°.[8]

Direct Synthesis of Isoalloxazines from the Michael-type Adducts. General Procedure.—A solution of the adduct (0.001 mol) with lead tetra-acetate (0.003 mol) in dioxan (10 ml) was refluxed for 5 h. After cooling, the mixture was filtered, and the filtrate was diluted with water and set aside overnight. The separated product was extracted with hot ethanol, the extracts were evaporated to dryness, and the residue was recrystallized from ethanol to give the isoalloxazine. By this method compounds (IIIa), (IIIb), and 10-n-butyl-3-methylisoalloxazine (IIIc) were obtained in 70, 75, and 55% yields respectively.

6-Anilino-5-(1,2-bisethoxycarbonylhydrazino)-1,3-dimethyluracil (VIIIa).—A mixture of 6-anilino-1,3-dimethyluracil (VIIa) (2.3 g, 0.01 mol) and DAD (2.1 g, 0.012 mol) in chlorobenzene (25 ml) was refluxed for 4 h. Evaporation to a small volume and dilution with ether caused separation of crystals, which were filtered off and washed with ether. Recrystallization from ethanol gave *needles* (2.4 g, 60%), m.p. 145°, $\nu_{max.}$ (Nujol) 3 237, 3 200, 1 739, 1 715, 1 635, and 1 620 cm^{-1}, M^+ 405 (Found: C, 53.4; H, 5.8; N, 17.25. $C_{18}H_{23}N_5O_6$ requires C, 53.35; H, 5.7; N, 17.3%).

5-(1,2-Bisethoxycarbonylhydrazino)-1,3-dimethyl-6-(3,4-xylidino)uracil (VIIIb).—A mixture of 1,3-dimethyl-6-(3,4-xylidino)uracil (VIIb) (2.6 g, 0.01 mol) and DAD (1.9 g, 0.011 mol) in chlorobenzene (25 ml) was refluxed for 3 h and

treated as above. Recrystallization from ethanol gave *needles* (3.2 g, 75%), m.p. 143°, $\nu_{max.}$ (Nujol) 3 235, 3 175, 1 740, 1 702, 1 622, 1 610, and 1 582 cm^{-1}, M^+ 433 (Found: C, 55.5; H, 6.35; N, 16.2. $C_{20}H_{27}N_5O_6$ requires C, 55.4; H, 6.3; N, 16.15%).

5-(1,2-*Bisethoxycarbonylhydrazino*)-3-*methyl*-6-(3,4-*xylidino*)*uracil* (VIIIc).—A mixture of 3-methyl-6-(3,4-xylidino)-uracil (VIIc) (2.5 g, 0.01 mol) and DAD (1.9 g, 0.011 mol) in chlorobenzene (25 ml) was refluxed for 3 h and treated as above. Recrystallization from ethanol gave *needles* (3.1 g, 74%), m.p. 245°, $\nu_{max.}$ (Nujol) 3 190, 1 738, 1 700, 1 619, 1 599, and 1 518 cm^{-1}, M^+ 419 (Found: C, 54.44; H, 6.2; N, 16.55. $C_{19}H_{25}N_5O_6$ requires C, 54.4; H, 6.0; N, 16.7%).

1,3-*Dimethylalloxazine* (IXa).—*Method A*. The adduct (VIIIa) (0.3 g, 0.000 7 mol) was heated in nitrobenzene (2 ml) at 220 °C for 4 h. After cooling, the mixture was diluted with ether and set aside overnight. The crystals were filtered off and recrystallized from ethanol to give yellow needles (0.15 g, 84%), m.p. 247°.[10]

Method B. 6-Anilino-5-(3,5-dioxo-4-phenyl-1,2,4-triazolidin-1-yl)-1,3-dimethyluracil (Xa) [3] (0.41 g, 0.001 mol) was heated in nitrobenzene (3 ml) at 240 °C for 4 h and then treated as above to give (IXa) (0.24 g, 90%), m.p. 247°.[10]

1,3-*Dimethyl-lumichrome* (IXb).—*Method A*. The adduct (VIIIb) (0.5 g, 0.001 mol) was heated in nitrobenzene (3 ml) at 240 °C for 4 h. After cooling, the mixture was diluted with ethanol–ether to cause separation of crystals. Recrystallization from ethanol gave pale yellow needles (0.25 g, 89%), m.p. 255°.[10]

Method B. 5-(3,5-Dioxo-4-phenyl-1,2,4-triazolidin-1-yl)-1,3-dimethyl-6-(3,4-xylidino)uracil (Xb) [3] (0.44 g, 0.001 mol) was heated in nitrobenzene (3 ml) at 240 °C for 3 h and treated as above to give (IXb) (0.21 g, 77%), m.p. 255°.[10]

3-*Methyl-lumichrome* (IXc).—The adduct (VIIIc) (0.42 g, 0.001 mol) was refluxed in nitrobenzene (5 ml) for 8 h. After cooling, the mixture was diluted with ethanol and set aside overnight. Recrystallization of the resulting crystals from dimethyl formamide gave pale yellow *needles* (0.2 g, 79%), m.p. >300°, M^+ 256 (Found: C, 61.1; H, 4.75; N, 21.55. $C_{13}H_{12}N_4O_2$ requires C, 60.95; H, 4.7; N, 21.85%).

Michael-type Adducts (XIII) *from* 6-(2-*Benzylidene*-1-*methylhydrazino*)-3-*methyluracil and DAD*. *General Procedure*.— 6-(2-Benzylidene-1-methylhydrazino)-3-methyluracil (XII) (0.01 mol) was dissolved in dioxan (120 ml), DAD (0.015 mol) and aluminium oxide (2 g) were added, and the mixture was refluxed for 3—6 h. The aluminium oxide was then filtered off, and the filtrate evaporated *in vacuo*. The residue was recrystallized from ethanol to give crystals of the *adduct* (XIII) (Table 1).

3-*Substituted Toxoflavins* (XIV). *General Procedure*.— To a solution of the adduct (XIII) (0.002 mol) in dioxan (50 ml) was added lead tetra-acetate (0.0045 mol), and the mixture was heated at 90 °C for 5 h with stirring. The solution was diluted with water and set aside several days. The separated *toxoflavin* (XIV) was filtered off, washed with water, and recrystallized from ethanol or dioxan (Table 2).

6-*Benzylidenehydrazino*-5-(1,2-*bisethoxycarbonylhydrazino*)-1,3-*dimethyluracils* (XVI). *General Procedure*.— The 6-Benzylidenehydrazino-1,3-dimethyluracil (XV) (0.01 mol), DAD (0.014 mol), and aluminium oxide (3 g) were added to dioxan (140 ml), and the mixture was refluxed for 3—6 h. The aluminium oxide was then filtered off and the filtrate evaporated to dryness. The residue was recrystallized from ethanol to give the *adduct* (XVI) (Table 1).

3-*Substituted Fervenulins* (XVII). *General Procedure*.— The adduct (XVI) (0.002 mol) was heated in nitrobenzene (2 ml) at 200 °C for 1 h. The mixture was diluted with ethanol and set aside overnight. The *fervenulin* (XVII) was filtered off, washed with ether, and recrystallized from ethanol (Table 2).

TABLE 2

3-substituted toxoflavins and fervenulins

Compd.	M.p. (°C)	Yield (%)	Oxidizing agent
(XIVa) [13]	228 (decomp.)	44	$Pb(OAc)_4$
(XIVb) [13]	227	50	$Pb(OAc)_4$
(XIVc) [13]	244 (decomp.)	40	$Pb(OAc)_4$
(XIVd) [13]	270 (decomp.)	38	$Pb(OAc)_4$
(XIVe) [13]	264 (decomp.)	52	$Pb(OAc)_4$
(XVIIa) [15]	270	55	$PhNO_2$
(XVIIb) [15]	280	57	$PhNO_2$
(XVIIc) [15]	268	48	$PhNO_2$
(XVIId) [15]	>330	42	$PhNO_2$

6-*Benzylidenehydrazino*-5-(1,2-*bisethoxycarbonylhydrazino*)-3-*methyluracil* (XVIe).—6-Benzylidenehydrazino-3-methyluracil (XVe) [14] (2.4 g, 0.01 mol), DAD (2.1 g, 0.012 mol), and aluminium oxide were added to dioxan (150 ml) and the mixture was refluxed for 6 h. Aluminium oxide was filtered off, the filtrate was evaporated *in vacuo* to dryness, and the residue was diluted with ethanol and set aside overnight. The precipitated crystals were recrystallized from ethanol to give *prisms* (3.1 g, 75%), m.p. 237°, $\nu_{max.}$ (Nujol) 3 220, 1 739, 1 700, 1 620, and 1 520 cm^{-1}, M^+ 418 (Found: C, 51.55; H, 5.5; N, 20.25. $C_{18}H_{22}N_6O_6$ requires C, 51.65; H, 5.3; N, 20.1%).

3-*Phenyl*-1-*demethyltoxoflavin* (3-*Phenyl*-8-*demethylfervenulin* (XVIIe).—The adduct (XIX) (2.1 g, 0.005 mol) was gently refluxed in nitrobenzene (3 ml) for 1 h. The mixture was diluted with ethanol and set aside overnight to precipitate a pale yellow powder (0.7 g, 55%), m.p. >300°.[13]

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