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Uracil Derivatives. III.[1] Syntheses and Growth-inhibitory Activity against L-1210 Cells of 5,6-Disubstituted Uracils

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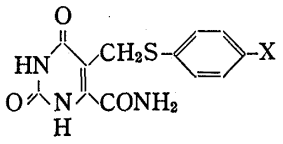
5-(4-Halophenylthiomethyl)-6-alkoxycarbonyluracils (IIa—i) and 5-(4-halophenylthiomethyl)-6-alkylcarbamoyluracils (IVa—p) were prepared from 5-(4-halophenylthiomethyl)-6-ethoxycarbonyluracils (Ia—c). The compounds thus prepared were examined for growth inhibition of L-1210 cells *in vitro*.

Keywords——6-alkoxycarbonyluracil; 6-alkylcarbamoyluracil; transesterification; 5,6-disubstituted uracil; L-1210 cells

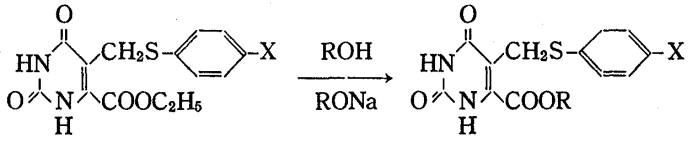
5-Substituted-uracils have been explored as potential antitumor agents.[2—6] In our previous papers, we synthesized 5-substituted-methyl-6-carbamoyluracils and examined their growth-inhibitory activity against L-1210 cells.[1,7] Some active compounds, including 5-(4-bromophenylthiomethyl)-6-carbamoyluracil (Vc) and its analogs (Va, b), were discovered. Thus, we attempted to prepared the 6-alkoxycarbonyl- and 6-alkylcarbamoyluracil derivatives in order to obtain information on the effects of modifications at the 6-position.



Va—c

a, X=F; b, X=Cl; c, X=Br

Chart 1



Ia—c IIa—i

a, X=F; b, X=Cl; c, X=Br

Chart 2

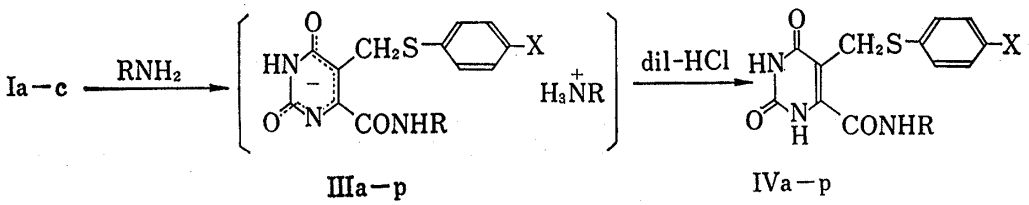
Chemistry

5-(4-Halophenylthiomethyl)-6-ethoxycarbonyluracils (Ia—c)[1,7] were converted to the 6-alkoxycarbonyluracil derivatives (IIa—i) in the usual way (Chart 2). According to the procedure of Mori *et al.*,[8] transesterification of Ia—c using potassium cyanide as a catalyst afforded the corresponding esters in approximately equal yields.

5-(4-Halophenylthiomethyl)-6-alkylcarbamoyluracils (IVa—p) were prepared as shown in Chart 3. Compounds IIIa—p were presumed to be intermediates, because IIIk (X=Br, R=CH_3) was isolated and its structure was confirmed as described below.

By elemental analysis of IIIk, the empirical formula $C_{14}H_{17}BrN_4O_3S$ was confirmed. The mass spectrum (MS) of IIIk was identical with that of the free amide (IVk). The proton nuclear magnetic resonance (^{1}H-NMR) spectrum of IIIk indicated the presence of a methylcarbamoyl group at δ 2.66 (3H, s, $-CONHC\underline{H}_3$) and 8.34 (1H, broad, $-CON\underline{H}CH_3$), and another methyl group at 2.38 (3H, s). The N-1 and N-3 protons did not appear in the range of δ 10—11 (dilactam-type protons), but were absorbed into a broad signal at δ 6.48. In addition, this compound shows a downfield shift of methylene protons ($C^5-C\underline{H}_2-$) of 0.28 ppm compared to the free amide (IVk). The infrared (IR) spectrum (KBr) of IIIk exhibited a broad absorption band at 3200—2500 cm^{-1}, and a carbonyl ($-CONHCH_3$) absorption band at 1640 cm^{-1}, but no bands due to the carbonyl groups of a uracil ring were observed. These data are consistent with the proposed structure.

On treatment with dilute hydrochloric acid, IIIk was easily converted to the desired compound IVk. Other compounds IIIa—p were structurally confirmed by IR spectroscopy only, and then converted to the corresponding 6-alkylcarbamoyluracils (IVa—p).



IIIa—p IVa—p

Chart 3

Pharmacological Results

The uracil derivatives described above were tested for growth inhibition of L-1210 cells *in vitro*. The method has been described previously.[1] The results are listed in Table I.

Since most of the activities were independent of concentration due to poor solubility, it seems reasonable to compare them at low concentrations (0.3 and/or 1 μg/ml). Transesterification of the ethyl esters (Ia—c) resulted in almost no change or a slight decrease in

Table I. Growth Inhibition of L-1210 Cells *in Vitro*, % Inhibition

Compd. No.	Concentration (μg/ml)			
	0.3	1	3	10
Ia	15	—	17	11
Ib	—	—	—	1
Ic	42	—	37	49
IIa	15	21	18	−6
IIb	13	20	15	−11
IIc	10	13	15	3
IId	—	—	—	7
IIe	—	—	—	10
IIf	—	—	—	−1
IIg	17	27	23	3
IIh	23	25	25	17
IIi	18	18	20	16
IVa	13	5	7	0
IVb	13	12	20	9
IVc	19	15	26	21
IVd	22	22	28	28
IVe	—	—	—	27
IVf	—	—	—	15
IVg	—	—	—	9
IVh	—	—	—	16
IVi	18	24	20	24
IVj	18	24	18	30
IVk	4	11	4	1
IVl	16	20	19	12
IVm	25	30	25	19
IVn	25	33	31	20
IVo	23	30	31	22
IVp	21	26	34	21
Va	43	—	32	32
Vb	—	—	3	42
Vc	30	—	33	65
6-MPR[a]	66	78	84	91

a) 6-MPR=6-mercaptopurine riboside.

activity (IIa—i). 6-Alkylcarbamoyluracils (IVa—p) also exhibited generally low activity compared with 5-(4-halophenylthiomethyl)-6-carbamoyluracils (Va—c).[1,7]

Experimental

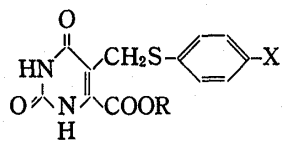
Melting points were determined with a Yanagimoto micro melting point apparatus and are uncorrected. IR spectra were measured with a Hitachi 260-10 spectrometer. ^{1}H-NMR spectra were taken at 60 MHz with a JEOL JNM-RMX 60 spectrometer using tetramethylsilane (TMS) as an internal standard in dimethyl sulfoxide (DMSO)-d_6. Chemical shifts are expressed as δ (ppm) downfield from TMS. The following abbreviations are used: s=singlet, d=doublet, t=triplet, q=quartet, m=multiplet and br=broad. Mass spectra were measured with a JEOL JMS-01SG-2 mass spectrometer.

General Procedure for the Preparation of 5-(4-Halophenylthiomethyl)-6-alkoxycarbonyluracils (IIa—i) ——Method A: A Typical Example: 5-(4-Fluorophenylthiomethyl)-6-methoxycarbonyluracil (IIa): A suspension of Ia (0.5 g, 1.5 mmol) in methanol (65 ml) containing sodium (5 mg, 0.2 mmol) was refluxed for 2 h. The reaction mixture was then concentrated *in vacuo*. The residual crystals were filtered off and recrystallized from methanol to give 0.3 g (62.7%) of IIa: mp 202—204°C. IR ν_{max}^{Nujol} cm^{-1}: 1740, 1705, 1660, 1270. NMR (DMSO-d_6) δ: 3.67 (3H, s), 4.01 (2H, s), 6.8—7.6 (4H, m), 10.83 (1H, br s), 11.50 (1H, br s). MS m/z: 310 (M$^+$).

Method B: A Typical Example: 5-(4-Fluorophenylthiomethyl)-6-propoxycarbonyluracil (IIb): A mixture of Ia (2 g, 6.2 mmol) and potassium cyanide (0.3 g, 4.6 mmol) in propanol (30 ml) was refluxed for 12 h. After cooling, the products were filtered off, washed with water and recrystallized from propanol to give 1.6 g (76.7%) of IIb: mp 245—247°C. IR ν_{max}^{Nujol} cm^{-1}: 1735, 1705, 1660, 1270. NMR (DMSO-d_6) δ: 0.90 (3H, t, J=7 Hz), 4.01 (2H, s), 4.03 (2H, t, J=7 Hz), 6.8—7.6 (4H, m), 10.89 (1H, br s), 11.50 (1H, br s). MS m/z: 338 (M$^+$).

Data for the esters IIa—i prepared as described above are listed in Table II. IR, NMR and mass spectral data are given below.

TABLE II.



Compd. No.	X	R	Yield (%)	mp (°C)	Recryst. solv.	Formula	Analysis (%) Calcd (Found) C	H	N
IIa	F	CH_3	62.7[a]	202—204	MeOH	$C_{13}H_{11}FN_2O_4S$	50.32 (50.23	3.57 3.45	9.03 8.89)
IIb	F	$CH_2CH_2CH_3$	69.0[a] 76.7[b]	245—247	*n*-PrOH	$C_{15}H_{15}FN_2O_4S$	53.25 (53.12	4.47 4.77	8.28 8.34)
IIc	F	$CH_2CH_2CH_2CH_3$	81.0[a] 50.1[b]	217—219	*n*-BuOH	$C_{16}H_{17}FN_2O_4S$	54.53 (54.35	4.86 4.93	7.95 7.88)
IId	Cl	CH_3	79.8[a]	205—207	MeOH	$C_{13}H_{11}ClN_2O_4S$	47.79 (47.56	3.39 3.38	8.57 8.49)
IIe	Cl	$CH_2CH_2CH_3$	69.2[a] 96.1[b]	241—242	*n*-PrOH	$C_{15}H_{15}ClN_2O_4S$	50.78 (50.49	4.26 4.26	7.90 7.75)
IIf	Cl	$CH_2CH_2CH_2CH_3$	73.9[a] 65.2[b]	217—219	*n*-BuOH	$C_{16}H_{17}ClN_2O_4S$	52.10 (52.29	4.65 4.83	7.59 7.78)
IIg	Br	CH_3	84.3[a]	222—224	MeOH	$C_{13}H_{11}BrN_2O_4S$	42.06 (42.03	2.99 2.87	7.55 7.39)
IIh	Br	$CH_2CH_2CH_3$	75.1[a] 64.3[b]	243—244	*n*-PrOH	$C_{15}H_{15}BrN_2O_4S$	45.12 (45.19	3.79 3.64	7.02 6.88)
IIi	Br	$CH_2CH_2CH_2CH_3$	68.4[a] 54.6[b]	229—231	*n*-BuOH	$C_{16}H_{17}BrN_2O_4S$	46.50 (46.52	4.15 4.13	6.78 6.78)

a) Method A, *b*) Method B.

6-Butoxycarbonyl-5-(4-fluorophenylthiomethyl)uracil (IIc): IR ν_{max}^{Nujol} cm^{-1}: 1735, 1705, 1660, 1265. NMR (DMSO-d_6) δ: 0.88 (3H, t, J=7 Hz), 4.01 (2H, s), 4.07 (2H, t, J=7 Hz), 6.8—7.6 (4H, m), 10.90 (1H, br s), 11.52 (1H, br s). MS m/z: 352 (M$^+$).

5-(4-Chlorophenylthiomethyl)-6-methoxycarbonyluracil (IId): IR ν_{max}^{Nujol} cm^{-1}: 1730, 1700, 1650, 1260.

NMR (DMSO-d_6) δ: 3.70 (3H, s), 4.04 (2H, s), 7.34 (4H, s), 10.90 (1H, br s), 11.50 (1H, br s). MS m/z: 328 (M^++2), 326 (M^+).

5-(4-Chlorophenylthiomethyl)-6-propoxycarbonyluracil (IIe): IR ν_{max}^{Nujol} cm^{-1}: 1730, 1700, 1655, 1260. NMR (DMSO-d_6) δ: 0.92 (3H, t, J=7 Hz), 4.05 (2H, t, J=7 Hz), 4.06 (2H, s), 7.35 (4H, s), *ca.* 10.6 (2H, br). MS m/z: 356 (M^++2), 354 (M^+).

6-Butoxycarbonyl-5-(4-chlorophenylthiomethyl)uracil (IIf): IR ν_{max}^{Nujol} cm^{-1}: 1725, 1700, 1655, 1260. NMR (DMSO-d_6) δ: 4.03 (2H, s), 7.31 (4H, s), 10.45 (1H, br s), 11.05 (1H, br s). MS m/z: 370 (M^++2), 368 (M^+).

5-(4-Bromophenylthiomethyl)-6-methoxycarbonyluracil (IIg): IR ν_{max}^{Nujol} cm^{-1}: 1730, 1700, 1660, 1260. NMR (DMSO-d_6) δ: 3.72 (3H, s), 4.07 (2H, s), 7.28 (2H, d, J=8.8 Hz), 7.44 (2H, d, J=8.8 Hz), 10.86 (1H, br s), 11.49 (1H, br s). MS m/z: 372 (M^++2), 370 (M^+).

5-(4-Bromophenylthiomethyl)-6-propoxycarbonyluracil (IIh): IR ν_{max}^{Nujol} cm^{-1}: 1725, 1700, 1660, 1260. NMR (DMSO-d_6) δ: 0.90 (3H, t, J=7 Hz), 4.07 (2H, s), 4.10 (2H, t, J=7 Hz), 7.29 (2H, d, J=8.8 Hz), 7.47 (2H, d, J=8.8 Hz), *ca.* 11.4 (2H, br). MS m/z: 400 (M^++2), 398 (M^+).

5-(4-Bromophenylthiomethyl)-6-butoxycarbonyluracil (IIi): IR ν_{max}^{Nujol} cm^{-1}: 1730, 1700, 1660, 1260. NMR (DMSO-d_6) δ: 0.88 (3H, t, J=7 Hz), 4.07 (2H, s), 4.13 (2H, t, J=7 Hz), 7.31 (2H, d, J=8.6 Hz), 7.45 (2H, d, J=8.6 Hz), 10.91 (1H, br s), 11.51 (1H, br s). MS m/z: 414 (M^++2), 412 (M^+).

General Procedure for the Preparation of 5-(4-Halophenylthiomethyl)-6-alkylcarbamoyluracil (IVa—p) ——A Typical Example: 5-(4-Bromophenylthiomethyl)-6-methylcarbamoyluracil (IVk): Compound Ic (1.5 g, 3.9 mmol) was added to a methanolic solution (50 ml) of methylamine (2.5 g, 81 mmol) and the mixture was stirred for 2 d at room temperature. The resulting solution was concentrated *in vacuo* and the residual crystals were collected by filtration to give 1.50 g of the crude adduct (IIIk). The adduct IIIk was suspended in MeOH–H_2O (50 ml, 5: 1) and the mixture was adjusted to pH 3 with 10% hydrochloric acid. The products were filtered off and recrystallized from MeOH–H_2O to give 1.08 g (74.8%) of IVk: mp 236°C (dec.). IR ν_{max}^{Nujol} cm^{-1}: 3280, 1700, 1650. NMR (DMSO-d_6) δ: 2.65 (3H, d, J=5 Hz), 3.87 (2H, s), 7.26 (2H, d, J=8.8 Hz), 7.43 (2H, d, J=8.8 Hz), 8.58 (1H, q, J=5 Hz), 11.10 (1H, br s), 11.25 (1H, br s). MS m/z: 371 (M^++2), 369 (M^+).

Adduct IIIk was recrystallized from MeOH–H_2O for analysis, but other adducts were employed directly in the next step.

Adduct IIIk: mp 248°C (dec.). IR ν_{max}^{KBr} cm^{-1}: 1640. NMR (DMSO-d_6) δ: 2.38 (3H, s), 2.66 (3H, s), 4.15 (2H, s), 6.48 (5H, br), 7.28 (2H, d, J=8.6 Hz), 7.41 (2H, d, J=8.6 Hz), 8.34 (1H, br). MS m/z: 371 (M^++2−CH_3NH_2), 369 (M^+−CH_3NH_2). *Anal.* Calcd for $C_{14}H_{17}BrN_4O_3S$: C, 41.90; H, 4.27; N, 13.96. Found: C, 41.95; H, 4.10; N, 13.98.

Data for the amides IVa—p are listed in Table III. IR, NMR and mass spectral data are given below.

5-(4-Fluorophenylthiomethyl)-6-methylcarbamoyluracil (IVa): IR ν_{max}^{Nujol} cm^{-1}: 3350, 1710, 1660—1650. NMR (DMSO-d_6) δ: 2.64 (3H, d, J=5 Hz), 3.83 (2H, s), 6.9—7.6 (4H, m), 8.55 (1H, q, J=5 Hz), 11.03 (1H, br s), 11.26 (1H, br s). MS m/z: 309 (M^+).

6-Ethylcarbamoyl-5-(4-fluorophenylthiomethyl)uracil (IVb): IR ν_{max}^{Nujol} cm^{-1}: 3300, 1710, 1660—1650. NMR (DMSO-d_6) δ: 1.04 (3H, t, J=7 Hz), 3.83 (2H, s), 6.9—7.6 (4H, m), 8.62 (1H, t, J=5 Hz), 11.10 (1H, br s), 11.26 (1H, br s). MS m/z: 323 (M^+).

5-(4-Fluorophenylthiomethyl)-6-propylcarbamoyluracil (IVc): IR ν_{max}^{Nujol} cm^{-1}: 3340, 1730, 1660—1650. NMR (DMSO-d_6) δ: 0.86 (3H, t, J=7 Hz), 3.84 (2H, s), 6.9—7.6 (4H, m), 8.65 (1H, t, J=5 Hz), 11.2 (2H, br s). MS m/z: 337 (M^+).

6-Butylcarbamoyl-5-(4-fluorophenylthiomethyl)uracil (IVd): IR ν_{max}^{Nujol} cm^{-1}: 3340, 1725, 1660—1650. NMR (DMSO-d_6) δ: 3.83 (2H, s), 6.9—7.6 (4H, m), 8.63 (1H, t, J=5 Hz), 11.13 (1H, br s), 11.25 (1H, br s). MS m/z: 351 (M^+).

5-(4-Chlorophenylthiomethyl)-6-methylcarbamoyluracil (IVe): IR ν_{max}^{Nujol} cm^{-1}: 3260, 1705, 1655—1640. NMR (DMSO-d_6) δ: 2.63 (3H, d, J=4.6 Hz), 3.87 (2H, s), 7.30 (4H, s), 8.58 (1H, q, J=4.6 Hz), 11.08 (1H, br s), 11.27 (1H, br s). MS m/z: 327 (M^++2), 325 (M^+).

5-(4-Chlorophenylthiomethyl)-6-ethylcarbamoyluracil (IVf): IR ν_{max}^{Nujol} cm^{-1}: 3260, 1705, 1655—1640. NMR (DMSO-d_6) δ: 1.06 (3H, t, J=7 Hz), 3.89 (2H, s), 7.32 (4H, s), 8.65 (1H, t, J=5 Hz), 11.20 (1H, br), 11.26 (1H, br). MS m/z: 341 (M^++2), 339 (M^+).

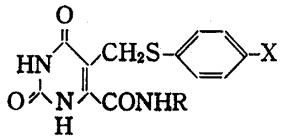
5-(4-Chlorophenylthiomethyl)-6-propylcarbamoyluracil (IVg): IR ν_{max}^{Nujol} cm^{-1}: 3330, 1720, 1655—1640. NMR (DMSO-d_6) δ: 0.86 (3H, t, J=7 Hz), 3.88 (2H, s), 7.28 (4H, s), 8.62 (1H, t, J=5 Hz), *ca.* 11.2 (2H, br). MS m/z: 355 (M^++2), 353 (M^+).

6-Butylcarbamoyl-5-(4-chlorophenylthiomethyl)uracil (IVh): IR ν_{max}^{Nujol} cm^{-1}: 3340, 1720, 1655—1640. NMR (DMSO-d_6) δ: 3.89 (2H, s), 7.29 (4H, s), 8.61 (1H, t, J=5 Hz), *ca.* 11.1 (2H, br). MS m/z: 369 (M^++2), 367 (M^+).

5-(4-Chlorophenylthiomethyl)-6-(2-hydroxyethylcarbamoyl)uracil (IVi): IR ν_{max}^{Nujol} cm^{-1}: 3500, 1740, 1660. NMR (DMSO-d_6) δ: 3.89 (2H, s), 4.63 (1H, br s), 7.30 (4H, s), 8.69 (1H, t, J=5 Hz), 11.09 (1H, br s), 11.31 (1H, br s). MS m/z: 357 (M^++2), 355 (M^+).

5-(4-Chlorophenylthiomethyl)-6-(3-hydroxypropylcarbamoyl)uracil (IVj): IR ν_{max}^{Nujol} cm^{-1}: 3480, 1735, 1660. NMR (DMSO-d_6) δ: 1.69 (2H, m), 3.86 (2H, s), 4.37 (1H, br s), 7.30 (4H, s), 8.63 (1H, t, J=5 Hz),

TABLE III.



Compd. No.	X	R	Yield (%)	mp (°C)	Recryst. solv.	Formula	Analysis (%) Calcd (Found) C	H	N
IVa	F	CH_3	65.4	247 (dec.)	MeOH–H_2O	$C_{13}H_{12}FN_3O_3S$	50.48 (50.54	3.91 3.83	13.58 13.49)
IVb	F	C_2H_5	82.1	267 (dec.)	MeOH–H_2O	$C_{14}H_{14}FN_3O_3S$	52.00 (51.90	4.36 4.28	13.00 12.83)
IVc	F	$CH_2CH_2CH_3$	91.0	235 (dec.)	MeOH–H_2O	$C_{15}H_{16}FN_3O_3S$	53.40 (53.64	4.78 5.02	12.45 12.63)
IVd	F	$CH_2CH_2CH_2CH_3$	76.2	230 (dec.)	MeOH–H_2O	$C_{16}H_{18}FN_3O_3S$	54.69 (54.85	5.16 5.15	11.96 11.96)
IVe	Cl	CH_3	53.4	248 (dec.)	MeOH–H_2O	$C_{13}H_{12}ClN_3O_3S$	47.93 (47.85	3.71 3.78	12.90 12.86)
IVf	Cl	C_2H_5	67.5	254 (dec.)	MeOH–H_2O	$C_{14}H_{14}ClN_3O_3S$	49.49 (49.46	4.15 4.17	12.37 12.37)
IVg	Cl	$CH_2CH_2CH_3$	79.5	236 (dec.)	MeOH–H_2O	$C_{15}H_{16}ClN_3O_3S$	50.92 (51.01	4.56 4.41	11.88 11.94)
IVh	Cl	$CH_2CH_2CH_2CH_3$	77.2	227 (dec.)	MeOH–H_2O	$C_{16}H_{18}ClN_3O_3S$	52.24 (52.19	4.93 4.87	11.42 11.49)
IVi	Cl	CH_2CH_2OH	78.8	241—244	MeOH–H_2O	$C_{14}H_{14}ClN_3O_4S$	47.26 (47.44	3.97 3.78	11.81 11.87)
IVj	Cl	$CH_2CH_2CH_2OH$	72.2	228—235	MeOH–H_2O	$C_{15}H_{16}ClN_3O_4S$	48.72 (48.53	4.36 4.14	11.36 11.20)
IVk	Br	CH_3	74.8	236 (dec.)	MeOH–H_2O	$C_{13}H_{12}BrN_3O_3S$	42.17 (42.34	3.27 3.14	11.35 11.19)
IVl	Br	C_2H_5	80.1	275.5 (dec.)	MeOH–H_2O	$C_{14}H_{14}BrN_3O_3S$	43.76 (43.76	3.67 3.71	10.94 11.02)
IVm	Br	$CH_2CH_2CH_3$	90.2	248 (dec.)	MeOH–H_2O	$C_{15}H_{16}BrN_3O_3S$	45.24 (45.16	4.05 3.85	10.55 10.50)
IVn	Br	$CH_2CH_2CH_2CH_3$	86.5	241 (dec.)	MeOH–H_2O	$C_{16}H_{18}BrN_3O_3S$	46.61 (46.41	4.40 4.22	10.19 10.06)
IVo	Br	CH_2CH_2OH	84.6	247—251	MeOH–H_2O	$C_{14}H_{14}BrN_3O_4S$	42.01 (42.20	3.53 3.48	10.50 10.55)
IVp	Br	$CH_2CH_2CH_2OH$	86.4	232—236	MeOH–H_2O	$C_{15}H_{16}BrN_3O_4S$	43.49 (43.45	3.89 3.86	10.14 10.28)

11.15 (1H, br s), 11.29 (1H, br s). MS m/z: 371 (M^++2), 369 (M^+).

5-(4-Bromophenylthiomethyl)-6-ethylcarbamoyluracil (IVl): IR ν_{max}^{Nujol} cm^{-1}: 3260, 1710, 1660. NMR (DMSO-d_6) δ: 1.05 (3H, t, J=7 Hz), 3.88 (2H, s), 7.29 (2H, d, J=8.4 Hz), 7.43 (2H, d, J=8.4 Hz), 8.65 (1H, t, J=5 Hz), 11.26 (2H, br). MS m/z: 385 (M^++2), 383 (M^+).

5-(4-Bromophenylthiomethyl)-6-propylcarbamoyluracil (IVm): IR ν_{max}^{Nujol} cm^{-1}: 3320, 1725, 1660. NMR (DMSO-d_6) δ: 0.84 (3H, t, J=7 Hz), 3.85 (2H, s), 7.23 (2H, d, J=8.8 Hz), 7.40 (2H, d, J=8.8 Hz), 8.63 (1H, t, J=5 Hz), 11.12 (1H, br s), 11.21 (1H, br s). MS m/z: 399 (M^++2), 397 (M^+).

5-(4-Bromophenylthiomethyl)-6-butylcarbamoyluracil (IVn): IR ν_{max}^{Nujol} cm^{-1}: 3330, 1730, 1660. NMR (DMSO-d_6) δ: 3.88 (2H, s), 7.26 (2H, d, J=8.8 Hz), 7.44 (2H, d, J=8.8 Hz), 8.65 (1H, t, J=5 Hz), 11.27 (2H, br). MS m/z: 413 (M^++2), 411 (M^+).

5-(4-Bromophenylthiomethyl)-6-(2-hydroxyethylcarbamoyl)uracil (IVo): IR ν_{max}^{Nujol} cm^{-1}: 3520, 3320, 1745, 1665. NMR (DMSO-d_6) δ: 3.91 (2H, s), 4.65 (1H, br), 7.27 (2H, d, J=8.6 Hz), 7.42 (2H, d, J=8.6 Hz), 8.68 (1H, t, J=5 Hz), 11.03 (1H, br s), 11.26 (1H, br s). MS m/z: 401 (M^++2), 399 (M^+).

5-(4-Bromophenylthiomethyl)-6-(3-hydroxypropylcarbamoyl)uracil (IVp): IR ν_{max}^{Nujol} cm^{-1}: 3490, 1740, 1665. NMR (DMSO-d_6) δ: 3.87 (2H, s), 4.39 (1H, br), 7.28 (2H, d, J=8.6 Hz), 7.43 (2H, d, J=8.6 Hz), 8.65 (1H, t, J=5 Hz), 11.14 (1H, br s), 11.26 (1H, br s). MS m/z: 415 (M^++2), 413 (M^+).

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