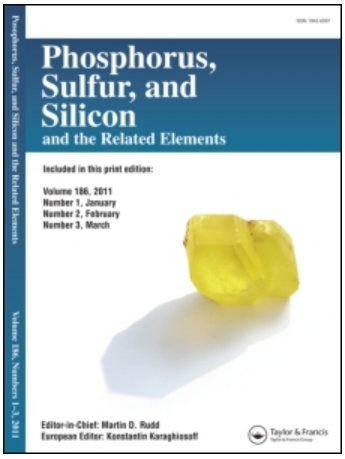


Phosphorus, Sulfur, and Silicon and the Related Elements
Publication details, including instructions for authors and subscription information:
http://www.informaworld.com/smpp/title~content=t713618290

ALKYLATION OF THIOHYDANTOINS INCLUDING SYNTHESIS, CONFORMATIONAL AND CONFIGURATIONAL STUDIES OF SOME ACETYLATED S-PYRANOSIDES

Youssef L. Aly[a]; Ahmed A. El-Barbary[b]; Ashraf A. El-Shehawy[a]
[a] Chemistry Department, Faculty of Education, Tanta University, Tanta, Egypt [b] Chemistry Department, Faculty of Science, Tanta University, Tanta, Egypt

Online publication date: 11 August 2010

To cite this Article Aly, Youssef L. , El-Barbary, Ahmed A. and El-Shehawy, Ashraf A.(2004) 'ALKYLATION OF THIOHYDANTOINS INCLUDING SYNTHESIS, CONFORMATIONAL AND CONFIGURATIONAL STUDIES OF SOME ACETYLATED S-PYRANOSIDES', Phosphorus, Sulfur, and Silicon and the Related Elements, 179: 1, 185 — 202
To link to this Article: DOI: 10.1080/10426500490257131
URL: http://dx.doi.org/10.1080/10426500490257131

Phosphorus, Sulfur, and Silicon, 179:185–202, 2004

ISSN: 1042-6507 print / 1563-5325 online
DOI: 10.1080/10426500490257131

Taylor & Francis
Taylor & Francis Group

ALKYLATION OF THIOHYDANTOINS INCLUDING SYNTHESIS, CONFORMATIONAL AND CONFIGURATIONAL STUDIES OF SOME ACETYLATED S-PYRANOSIDES

Youssef L. Aly,[a] *Ahmed A. El-Barbary,*[b]
and Ashraf A. El-Shehawy[a]
Chemistry Department, Faculty of Education, Tanta University, Tanta, Egypt[a] *and Chemistry Department, Faculty of Science, Tanta University, Tanta, Egypt*[b]

(Received April 4, 2003; accepted July 26, 2003)

*5-Benzylidene-2-thiohydantoin (**1**) and 5,5-dimethyl-2,4-dithiohydantoin (**6**) undergo Mannich reaction with formaldehyde and morpholine to give the corresponding Mannich products **2** and **7**, respectively. Subsequent reaction of the product **2** and **7** with phenacyl bromide gives the corresponding 2-benzolmethylthiohydantoin Reactionof 5-benzylidene-2-carbomethoxythiohydantoin (**5b**) with P_2S_5 afforded 4-benzylideneimidazo[2,1-b]-thiazole-2-thione-5-one (**13**) as the sole product. Reaction of 2-thio and 2,4-dithiohydantoin derivatives **2** and **7** with (2,3,4,6-tetra-*O*-acetyl-α–D-gluco- or galgcto- pyranosyl) bromide or (2,3,4-tri-*O*-acetyl-α-xylopyranosyl) bromide afforded the corresponding S-gluco- galacto- or xylosides (**14–19**). Many attempts to deacetylation of the resulting S-nucleosides and to get N-nucleosides were tried.*

Keywords: Ethylchloroacetate; morpholine; phenacyl bromide; S-Pyranosides; thiohydantoins

Hydantoin derivatives have found use in medicine; they have mainly been described as anticonvulsant agent.[1] Authors reported that 2-deoxyuridine with 5-methyl-2-thiohydantoin as the heterocycle in the 5-position showed cytotoxicity against MT-4 cell at 100 mM.[2] Some acylic nucleoside analogues have achieved considerable success as antiviral agents[3] because of their low toxicity for normal cells with having an inhibitory activity against herpes simplex virus (HSV).

Thanks are due to Danish International Development Agency (DANIDA) for their support.

Address correspondence to Y. L. Aly, Chemistry Department, Faculty of Education, Kafr El-Sheikh, Tanta University, Tanta, Egypt. E-mail: ylaly2002@hotmail.com

Several 5-substituted pyrimidine nucleosides show potent activity against the HSV.[4] There should be an obvious interest in glycosylated hydantoin derivatives because of their resemblance with natural nucleosides. Hydantoin nucleosides are not common described in the literature.[5–12] Recently pentofuranosyl-2-thiohydantoin[13] and pentofuranosyl-1-hydantoin derivatives[14,15] have been reported. The present article deals with the synthesis of some new pyranosides, containing a hydantoin nucleus as an aglycone moiety.

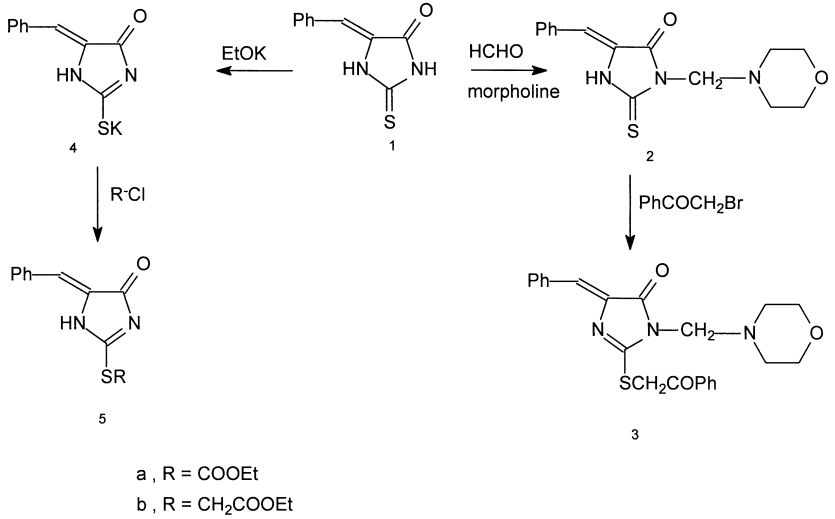
RESULTS AND DISCUSSION

The synthesis of Mannich bases derived from 5-substituted-2-thiohydantoin was previously studied and the site of attack was reported to be only at position three.[16] Thus, when 5-benzylidene-2-thiohydantoim (**1**) was allowed to react with formaldehyde and morpholine in ethanol at room temperature, 5-benzylidene-3-morpholinomethyl-2-thiohydantoin (**2**) was obtained. The reaction of compound **2** with phenacyl bromide in aqueous sodium hydroxide and ethanol at room temperature afforded the corresponding 5-benzylidene-3-morpholinomethyl-2-benzoylmethylthiohydantoin (**3**). Microanalytical and spectral data of compounds **2** and **3** were fully consistent with the structures assigned (cf. Experimental).

The reaction of **1** with ethyl chloro- formate or acetate in different alkaline medium was also investigated, but the starting materials were recovered unchanged. Thus, we have tried the reaction of **4**, as potassium salt of **1**, with ethyl chloro- formate or acetate by fusion at 90–100°C for 10 hours yielded the corresponding 5-benzylidene -2-carboethoxythiohydantoin (**5a**) and 5-benzylidene-2-carboethoxymethylthiohydantoin (**5b**), respectively microanalytical and spectral data of **5b** were found to be completely identical with reported values.[16]

The structure of compound **5a** is established by the correct analytical and spectral data. Its IR spectrum of showed the absence of the stretching vibration frequency of C=S at 1310 cm^{-1}, and the appearance of a strong stretching vibration frequency of C=O (ester) at 1760 cm^{-1}, and C=N at 1566 cm^{-1}. ^{1}H-NMR spectrum of **5a** showed a triplet at 1.42–1.53 ppm corresponding to 3H (CH_3) and a quartet at 4.51–4.59 ppm corresponding to 2H (CH_2). Moreover, ^{13}C-NMR spectrum of **5a** showed signals at 147.73 ppm (C=O of hydantoin) and 194.38 ppm (C=O, ester), while signals at 65.17 and 13.95 ppm are corresponding to CH_2 and CH_3, respectively.

To the best of our knowledge, no work has been done on the reaction of 2,4-dithiohydantoins with Mannich base. Thus, when, 5,5-dimethyl-

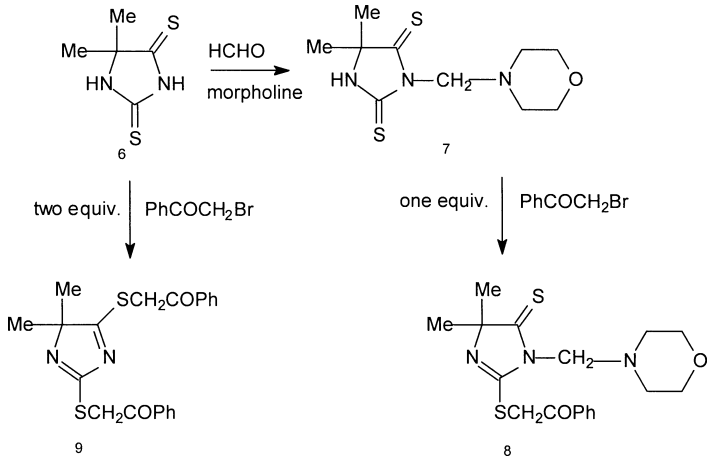


2,4-dithiohydantoin (**6**) was treated with formaldehyde and morpholine, it yields the corresponding 5,5-dimethyl-3-morpholinomethyl-2,4-dithiohydantoin (**7**). Microanalytical and spectral data of compound **7** were fully consistent with the assigned structure (*cf*. Experimental).

On treatment of **7** with one equivalent of phenacyl bromide in the presence aqueous sodium hydroxide, 5,5-dimethyl-3-morpholinomethyl-2-benzoylmethylthio-4-thiohydantoin (**8**) was obtained. While, one equivalent of compound **(6)** reacts with two equivalents of phenacyl bromide under the same reaction conditions yielded 5,5-dimethyl-2,4-dibenzoylmethylthiohydantoin (**9**). The structure of compounds **8** and **9** was proven by their spectral data. Their IR spectra exhibited a strong carbonyl stretching frequency at 1690 cm^{-1}, whereas they lack absorption in the region of 3300 cm^{-1}, confirming the absence of NH group. ^{1}H-NMR, ^{13}C-NMR and M.S. spectroscopy were found in agreement with the proposed structures (cf. Experimental).

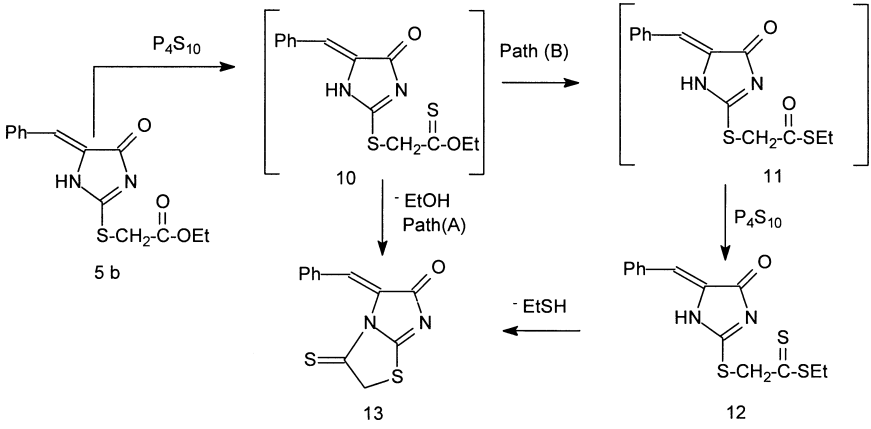
It is well known that phosphorous pentasulphide is a good thionating reagent for the transformation of hydantoin to the corresponding thiohydantoin.[17] In our work, we have found that 5-benzylidene-2-carboethoxymethylthiohydantoin (**5b**) reacts with phosphorous pentasulphide in boiling anhydrous dioxane to furnish 4-benzylideneimidazo[2,1-b]-thiazole-2-thione-5-one (**13**) as the sole product.

For the formation of compound **13**, it is postulated that compound **5b** was first thiated with phosphorous pentasulphide to give the thionoester **10** which either looses ethanol followed by ring closure to give **13** (path A) or rearranges[18,19] to give the thionoester **11**. Subsequent



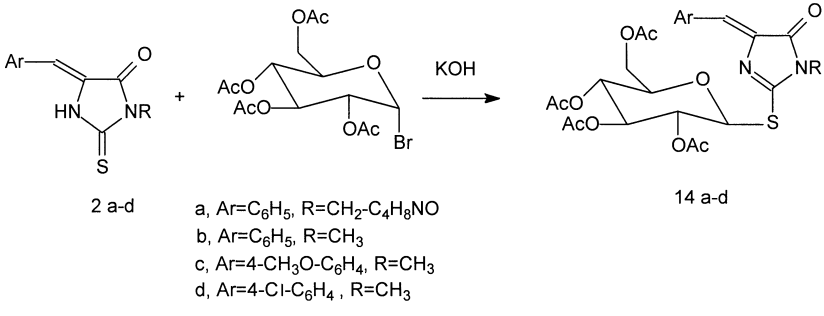
thiation of **11** affords **12** that suffers expulsion of ethanethiol accompanied by ring closure to yield the final product **13** (path B). The structure of compound **13** was proven by microanalysis and spectral data, its IR spectrum showed the absence of the stretching frequency of C=O (ester) at 1760 cm^{-1}, and NH at 3300 cm^{-1}, while a strong absorption at 1720 cm^{-1} corresponding to C=O of hydantoin moiety still appears. Its ^{1}H-NMR showed a signlet at 4.03 ppm (2H, S-CH_2). Its ^{13}C-NMR spectrum showed peaks at 140.69 (C=N), 169.17 (C=O of hydantoin moiety), in addition to two peaks at 61.12 and 194.80 ppm, characteristic of CH_2 and C=S, respectively.

Treatment of 5-arylidene-3-substituted-2-thiohydantoins (**2a–d**) and 5,5-Dimethyl-3-morpholinomethyl-2,4-dithiohydantoin (**7**) with 2,3,4, 6-tetra-*O*-acetyl-α-*D*-glucopyranosyl- bromide [21,22] in acetone in the presence of aqueous potassiuum hydroxide yielded the *S*-glucosides,



5-arylidene-3-substituted-2-(2′,3′,4′,6′-tetra-*O*-acetyl-β-*D*-thioglucopyranosyl)hydantoins (**14a–d**) and 5,5-dimethyl-3-orpholinomethyl-2-(2′,3′,4′,6′-tetra-*O*-acetyl-β-*D*-thioglucopyranosyl)-4-thiohydantoin (**15**), respectively, presumably through Walden inversion.[20] The structure of compounds **14a–d** and **15** is established by microanalytical and spectral data.

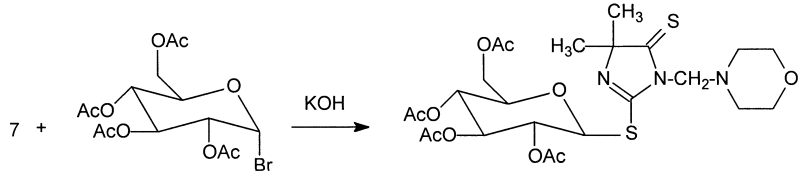
In the IR spectra of **14a–d** and **15**, a strong absorption bands at 1760–1755 cm^{-1} were observed due to the acetate carbonyl, in addition to the absorption bands at 920–910 and 770–760 cm^{-1} region characterized for asymmetrical and symmetrical vibration of the glucopyranoside ring.[21]



2 a-d

a, Ar=C_6H_5, R=CH_2-C_4H_8NO
b, Ar=C_6H_5, R=CH_3
c, Ar=4-CH_3O-C_6H_4, R=CH_3
d, Ar=4-Cl-C_6H_4 , R=CH_3

14 a-d

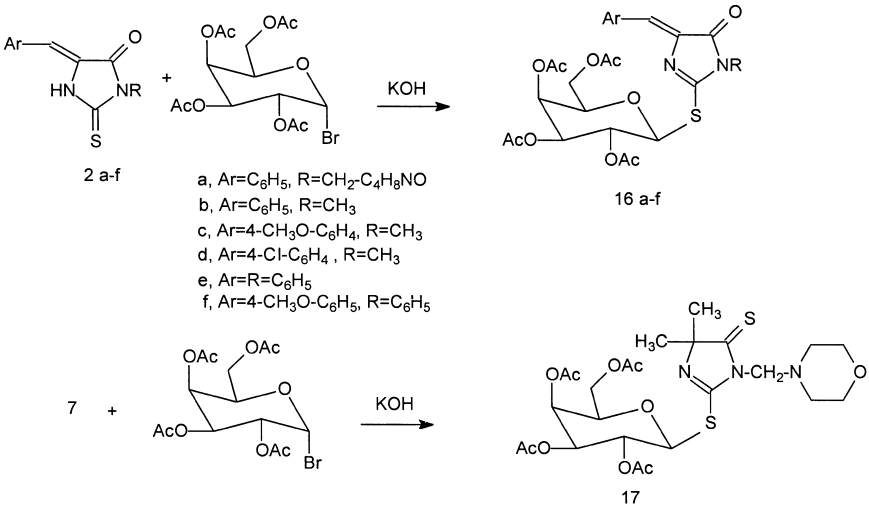


15

^{1}H-NMR spectra of compounds **14** and **15** show two doublets of the anomeric protons at $\delta = 6.06$ and 6.64 ppm region with a large coupling constant (J = 10.18 and 10.20 Hz), respectively corresponding to the diaxial orientation of H-1′ and H-2′ protons indicating the presence of only isomers in the $^4C_1$ (*D*) conformation.[22] ^{13}C-NMR spectra of compounds **14** and **15** are characterized by a signal at $\delta = 80.03$–80.97 ppm region corresponding to C-1′ atom of β-anomer.[23] No signals are observed for the C=S at C-2 of the thiohydantoin indicating that the coupling reaction took place at the sulfur atom giving the 2-*S*-glucosides.

Reaction of compounds **2a–f** and **7** with 2,3,4,6-tetra-*O*-acetyl-α-*D*-galactopyranosyl bromide[21,22] yielded the corresponding 5-arylidene-3-substituted-2-(2′,3′,4′,6′-tetra-*O*-acetyl-β-*D*-thiogalactopyranosyl)-hydantoins (**16a–f**) and 5,5-dimethyl-3-morpholinomethyl-2-(2′,3′,4′,6′-tetra-*O*-acetyl-β-*D*-thiogalctopyranosyl)-4-thiohydantoin (**17**), respectively, The Structure of **16a–f** and **17** is established by microanalytical

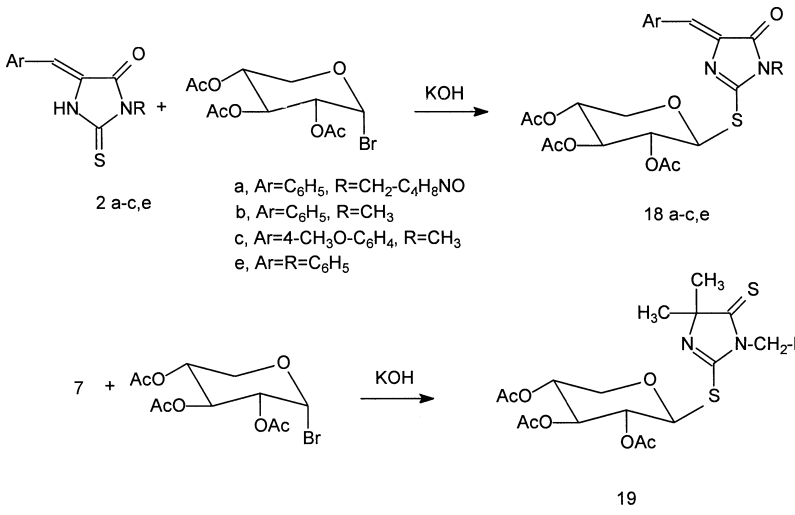
and spectral data. IR spectra of **16a–f** and **17** show strong absorption band at 1760–1755 cm^{-1}, due to the acetate carbonyl, in addition to the absorption band at 915–910 and 770–760 cm^{-1} region characterized for asymmetrical and symmetrical vibrations of the pyranoside ring of *D*-galactose[21], respectively.



[1]H-NMR spectra of compounds **16** and **17** show anomeric proton with coupling constant (J1′, 2′) in the order of 10.30–10.34 Hz and that the (J2′, 3′) is 10.12–10.16 Hz indicating that the H-1′, H-2′ and H-3′ protons are all axially oriented. The splitting constants of (J3′, 4′) and (J4′, 5′) are between 3.26–3.29 and 2.89–3.17 Hz showing their axial-equatorial relationship. Thus, the $^4C_1$ (*D*) conformation and the β-configuration predominate over the other possible structures.[22] Further support of the structures was confirmed by the chemical shifts of the acetoxy groups. A lower field acetoxy at 2.15 ppm assigned as the axial acetoxy groups at C-4′ and the other three remaining acetoxy groups were relatively at higher fields $\delta = 1.63$–2.09 ppm indicating their equatorial orientation. The $^4C_1$ (*D*) conformation and the β-configuration was also confirmed by ^{13}C-NMR spectrum which showed a signal at $\delta = 80.56$ ppm corresponding to C-1′ of β-anomer.[23] No signals are observed for the C=S at C-2 of the thiohydantoin indicating the formation of the 2-thiogalactosides.

Reaction of compounds **2a–c,e** and **7** with 2,3,4-tri-*O*-acetyl-α-*D*-xylopyranosyl bromide[28,29] was also investigated which afforded the corresponding 5-arylidene-3-substituted-2-(2′,3′,4′-tri-*O*-acetyl-β-*D*-thioxylopyranosyl)hydantoins (**18a–d**) and 5,5-dimethyl-3-morpholinomethyl-2-(2′,3′,4′-tri-*O*-acetyl-β-*D*-thioxylopyranosyl)-4-thiohydantoin

(**19**), respectively. The structure of compounds **18a–d** and **19** is established by microanalytical and spectral data.

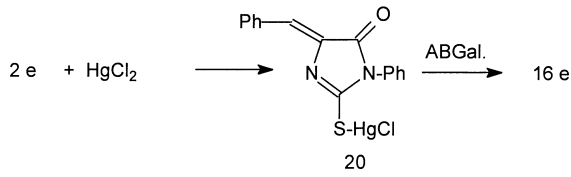


IR spectra of compounds **18** and **19** show the absence of the stretching vibration frequencies of NH within 3200–3150 cm^{-1}, and appearance of the strong bands at 1760–1755 cm^{-1} due to the acetate carbonyl. The absorption bands at 920–910 and 770–760 cm^{-1} region are characterized for asymmetrical and symmetrical vibrations of the xylopyranoside ring[21], respectively.

^{1}H-NMR spectra of compounds **18** and **19** were similar to that of the previously synthesized *S*-glucosides **14–17**. The anomeric protons were found to be at lower field ($\delta = 6.05$–6.08 ppm) than the other sugar ring protons with coupling constants (J1′, 2′) in the order of 7.73–7.52 Hz due to the diaxial orientation between H-1′ and H-2′ which indicates the β-configuration and $^4C_1$ (*D*) conformation.[22] The acetoxy group signals of these compounds provided further verification of the favored $^4C_1$ (*D*) confirmation and β-configuration, since these signals lie within the range expected for equatorial secondary acetoxy groups. ^{13}C-NMR spectra of compounds **18** and **19** showed signals at the region of $\delta = 80.65$–81.26 ppm corresponding to C-1′ of β-anomer.[23] No signals are observed for the C=S at C-2 of the thiohydantoin indicating the formation of the S-xylosides.

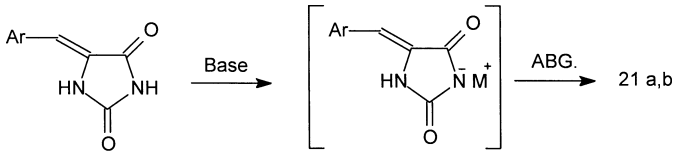
In all cases, the ^{I3}C-NMR spectra of compounds **14–19** showed no signals corresponding to C=S of hydantoin moiety at C-2 indicating that the coupling took place at sulfur atom to give the S-gluco-, galacto- and xylo-sides. These results are in good agreement with earlier findings

reported by Wagner and Dietzsch[24] and Abdel-Megeid et al.[25] for similar structures. We have tried to get N-nucleosides through the reaction of 5-benzylidene-3-phenyl-2-(chloromercurithio)hydantoin (**20**), prepared by the reaction of **2e** with mercuric chloride,[26] with (2,3,4,6-tetra-*O*-acetyl-α-*D*-galactopyranosyl) bromide (ABGal.) in dry toluene or xylene, in the presence of sodium hydroxide, but we obtained the S-galactoside **16e** as the sole prduct.



20

It is worth to mention that all attempts to get *N*-glucosides from the reaction of sodium or potassium salt of some arylidene hydantoin derivatives (**21a,b**) with (2,3,4,6-tetra-*O*-acetyl-α-*D*-glucopyranosyl) bromide (ABG) in different basic mediums (NaOH, EtONa, NaH, KOH, K_2CO_3 or NaOMe/MeOH) at different temperatures (0°C, room temperature) were unsuccessful.



21

a, Ar=C_6H_5

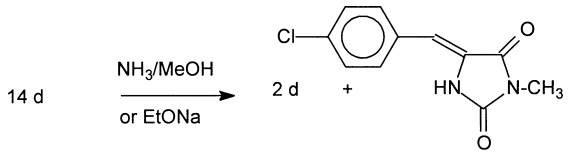
b, Ar=4-NO_2-C_6H_4

Moreover, we have tried the rearrangement of the S-galactosides **16a,e** to the crrosonding *N*-Galactosides by their reaction with mercuric bromide in toluene or xylene, but cleavage for **16a,e** took place giving **2a,e** may be due to the decomposition of the S-galactosides under the reaction conditions.

$$16a,e + HgBr_2 \rightarrow 2a,e$$

Deacetylation of the S-glucoside **14d** with different concentrations of methanolic ammonia or sodium ethoxide at 0°C or at room temperature afforded a mixture of **2d** and **22**. Their m.p. and mixed m.p. with authentic samples of 5-(4-chlorobenzylidene)-3-methyl-2-thiohydantoin[27]

and 5-(4-chlorobenzylidene)-3-methylhydantoin[27], respectively, gave no depression. Nothing of the deprotected S-nucleosides could be detected by thin layer chromatography and this result showed the unstability of this type of nucleosides in alkaline medium.



22

EXPERIMENTAL

All melting points are uncorrected. Microanalyses were performed by microanalytical center at Cairo University. IR were recorded on Perkin-Elmer 1420 spectrophotometer using KBr Wafer Technique. The ^{1}H-NMR spectra were recorded using a Bruecker 250 MHz spectrophotometer using $CDC1_3$ and DMSO as solvents and TMS as internal standard. Chemical shift values are expressed in δ ppm units. ^{13}C-NMR spectra were recorded on a Bruecker 250 MHz spectrophotometer. TMS was used to determine the carbon chemical shifts and expressed in ppm. All analytical samples were homogeneous by thin-layer chromatography, which was performed on EM silica gel 60F sheet (0.2 mm) with $C_6H_6/CHC1_3$ (2:5, V/V) and in ether/benzene (2:1, V/V) as the developing solvents. The spots were detected with U.V. Model UVGL-58.

Reaction of 1 or 6 with Formaldehyde and Morpholine: General Procedure

A mixture of 5-benzylidene-2-thiohydantoin (**1**) or 5,5-dimethyl-2,4-dithiohydantoin (**6**) (0.01 mole), formaldeyde (1.0 ml, 40% solution) and morpholine (0.01 mole) in ethanol (30 ml) was stirred at room temperature for three hours and left overnight at room temperature. The solvent was evaporated to dryness under vacuum and the resulting residual solid was crystallized from aqueous ethanol to give the corresponding 5-benzylidene-3-morpholinomethyl-2-thiohydantoin (**2**) and 5,5-dimethyl-3-morpholinomethyl-2,4-dithiohydantoin (**7**), respectively.

For compound **2**; m.p.: 148°C, yield: 93%. Calc. for $C_{15}H_{17}N_3O_2S$: C, 59.41; H, 5.61; N, 13.86; S, 10.56; found: C, 59.40; H, 5.63; N, 13.85; S,

10.56. IR (cm^{-1}): 3100 (NH), 2950 (CH aliphatic), 1720 (CO of hydantoin); 1640 (C=C); 1315 (C=S). ^{1}H-NMR ($CDC1_3$): δ (ppm) = 2.71–2.75 (4H, t, 2C-CH_2-N); 3.62–3.65 (4H, t, 2C-CH_2-O); 4.83 (2H, s, N-CH_2-N); 6.74 (1H, s, Ph-CH=C); 7.41–7.46 (5H, m, aromatic protons); 9.37 (1H, s, N-1H). ^{13}C-NMR ($CDCl_3$): δ (ppm) = 51.36 (2 CH_2-N); 62.72 (N-CH_2-N); 66.73 (2CH_2-O); 132.62 (C-5 of hydantoin); 164.76 and 179.57 (C=O and C=S); 113.42, 129.61, 126.13, 129.30 and 129.07 (aromatic carbons).

For compound **7**; m.p.: 133°C, yield: 89%. Calc. for $C_{10}H_{17}N_3OS_2$: C, 46.33; H, 6.56; N, 16.22; S, 24.71; found: C, 46.40; H, 6.55; N, 16.20; S, 24.59. IR (cm^{-1}): 3100 (NH), 2950 (CH aliphatic), 1310 (C=S). ^{1}H-NMR ($CDC1_3$): δ (ppm) = 1.50 (6H, s, 2CH_3); 1.64 (2H, s, 2N-CH_2-N); 2.89 (4H, s, CH_2-N-CH_2); 3.70 (4H, s, CH_2-O-CH_2); 9.13 (1H, s, N-1H,). Ms, m/z.:259 (M^+, 16%, $C_{10}H_{17}N_3OS_2^+$), 160 (16%, $C_5H_8N_2S_2$), 100 (100%, $C_5H_{10}O^+$ or $C_4H_6NS^+$), 56 (9.5%, $C_3H_6N^+$), 57 (2%; C_3H_7N).

Action of Potassium Ethoxide on Compound 1

5-Bnezylidene-2-thiohydantoin (**1**) (0.01 mole) was added to a solution of potassium ethoxide (0.39 gm of potassium, 0.01 mole, in 20 ml absolute ethanol) in ice bath with vigorous stirring for 30 minutes. The starting material was dissolved and the potassium salt was separated. The solid product was filtered off, washed with ether to give 5-benzylidene-2-potssiothiohydantoin (**4**); m.p.: 287°C, yield: 55%. Calc. for $C_{10}H_7N_2OSK$: C, 49.50; H, 2.89; N, 11.55; S, 13.20; found: C, 49.33; H, 2.71; N, 11.43; S, 13.06.

Reaction of 5-Benzylidene-2-potassiothiohydantoin (4) with Ethyl Chloroformate or-Acetate

A mixture of compound (**4**) (0.01 mole) and ethyl chloroformate or chlroroacetate (5 ml) was heated under reflux in an oil bath at 90–100°C for 10 hours. The reaction mixture was filtered off while hot and the filtrate was triturated with ethanol to give a solid which on filtration and recrystallization from ethanol afforded the corresponding 5-benzylidene-2-carboethoxythiohydantoin (**5a**) and 5-benzylidene-2-carboethoxymethylthiohydantoin (**5b**), respectively.

For compound **5a**; m.p.: 229°C, yield: 65%. Calc. for $C_{13}H_{12}N_2O_3S$: C, 56.52; H, 4.85; N, 10.14; S, 11.59; found: C, 56.60; H, 4.80; N, 9.90; S, 11.81. IR (cm^{-1}): 3110 (NH), 2950 (CH aliphatic), 1760 (C=O, ester) 1720 (C=O of hydantoin), 1565 (C=N). ^{1}H-NMR ($CDC1_3$): δ (ppm) = 1.42–153 (3H, t, CH_3-C); 4.51-4.59 (2H, q, CH_2-C); 7.07 (1H, s, Ph-CH=C); 7.40–8.07 (5H, m, aromatic protons); 10.56 (1H, s, N-1H).

^{13}C-NMR ($CDC1_3$): δ (ppm) = 147.73, 169.95 and 133.41 (C-2, C-4 and C-5 of hydantoin); 125.10, 132.40, 128.18, 131.59 and 130.30 (aromatic carbons); 194.38, 65.17 and 13.95 (carboethoxy carbons). M.p. and mixed m.p. of **5b** with an authentic sample of 5-benzylidene-2-carboethoxymethylthiohydantoin gave no depression.[16]

Reaction of Compounds 2, 6 and 7 with Phenacyl Bromide: General Procedure

A mixture of **2**, **6** or **7** (0.01 mole) in aqueous potassium hydroxide (0.56 gm, 0.01 mole, in 10 ml water), ethanol (30 ml), and phenacyl bromide (2.2 gm, 0.011 mole) was stirred at room temperature for 1–2 hr. The reaction mixture was triturated with water. The solid product was filtered off and crystallized from ethanol to give 5-benzylidene-3-morpholinomethyl-2-benzoylmethylthiohydantoin (**3**), 5,5-dimethyl-3-morpholinomethyl-2-benzoylmethyIthio-4-thiohydantoin (**8**) and 5,5-dimethyl-2,4-dibenzoylmethylthiohydantoin (**9**).

For compound **3**; m.p.: 165°C, yield: 92%. Calc. for $C_{23}H_{23}N_3O_3S$: C, 65.56; H, 5.46; N, 9.98; S, 7.60; found: C, 65.61; H, 5.47; N, 9.95; S, 7.51. IR (cm^{-1}): 2950 (CH aliphatic), 1720 (C=O of hydantoin), 1690 (C=O of benzoyl), 1560 (C=N), 700 (C–S–). ^{1}H-NMR ($CDCl_3$): δ (ppm) = 2.64 (4H, s, 2 C-CH_2-O); 4.37 (2H, s, S-CH_2-CO); 4.78 (2H, s, N-CH_rN); 6.89 (1H, s, Ph–CH=C); 7.06–8.11 (10H, m, aromatic protons). ^{13}C-NMR ($CDC1_3$): δ (ppm) = 163.80, 169.90 and 137.59 (C-2, C-4 and C-5 of hydantoin); 62.55, 50.63 and 66.46 (morpholinomethyl carbons); 38.42, 191.96, 133.82, 128.17, 131.58 and 129.54 (benzoylmethyl carbons); 124.41, 135.55, 133.68 and 128.73 (benzylidene carbons).

For compound **8**; m.p.: 134°C, yield: 90%. Calc. for $C_{18}H_{23}N_3O_2S_3$: C, 57.29; H, 6.10; N, 11.14; S, 16.98; found: C, 57.30; H, 6.23; N, 11.10; S, 17.02. IR (Cm^{-1}): 2980 (CH aliphatic), 1690 (C=O of benzoyl), 1550 (C=N), 700 (C-S-C).

For compound **9**; m.p.: 110°C, yield: 85%. Calc. for $C_{21}H_{20}N_2O_2S_2$: C, 63.64; H, 5.05; N, 7.07; S, 16.16; found: C, 63.70; H, 5.21; N, 7.02; S, 15.96. IR (Cm^{-1}): 3000 (CH aliphatic), 1690 (C=O of benzoyl), 1550 (C=N), 700 (C–S–C). ^{1}H-NMR ($CDC1_3$): δ (ppm) = 1.36 (6H, s, 2 CH_3); 4.68 (2H, s, S-CH_2-CO at C-4); 4.78 (2H, s, S-CH_2-CO at C-2); 7.46–8.05 (1 OH, m, aromatic protons). ^{13}C-NMR ($CDCI_3$): δ (ppm) = 192.38, 169.63 and 82.60 (C-2, C-4 and C-5 of hydantoin); 24.90 (2 CH_3); 39.32, 202.51, 134.98, 128.47, 133.45 and 128.29 (benzoylmethyl carbons at C-2); 40.81, 193.47, 135.34, 128.64, 133.80 and 128.35 (benzoylmethyl carbons at C-4). Ms, m/z 396(M^+, 3%, $C_{21}H_{20}N_2O_2S_2$), 291 (3%, $C_{14}H_{15}N_2OS_2$), 268 (5%, C_{12} $H_{20}N_2OS_2$), 246 (5%, $C_{13}H_{14}N_2OS$), 106 (7%, Ph-CHO), 105 (100%, Ph-CO^+), 78 (4%; C_6H_6).

Reaction of Compound 5b with Phosphorous Pentasulfide

A mixture of compound **5b** (0.01 mole) and phosphorus pentasulfide (0.012 mole) was refluxed in anhydrous dioxane (50 ml) with vigorous stirring for one hr. To the reaction mixture, 2 gm of zinc dust and 1 gm of activated charcoal was added and heating was continued 5 minutes more. The hot solution was filtered off, evaporated to dryness and the residue was crystallized from ethanol to give the corresponding 4-benzylideneimidazo[2,l-b]thiazole-2-thione-5-one (**13**); m.p.: 165°C, yield: 86%. Calc. for $C_{12}H_8N_2OS_2$: C, 55.20; H, 3.00; N, 10.70; S, 24.90; found: C, 55.38; H, 3.08; N, 10.77; S, 24.60. IR (cm^{-1}): 3000 (CH aliphatic), 1720 (C=O of hydantoin), 1565 (C=N), 1320 (C=S), 710 (C-S-C). ^{1}H-NMR ($CDCl_3$): δ (ppm) = 4.03 (2H, s, S-CH_2); 5.77 (1H, s, Ph-CH=C); 7.36–7.46 (5H, m, aromatic protons). ^{13}C-NMR($CDC1_3$): δ (ppm) = 140.69, 169.17 and 137.73 (C-2, C-4 and C-5 of hydantoin); 161.21 and 194.80 (CH_2 and C=S, respectively); 120.70, 130.18, 127.40, 128.97 and 128.44 (benzylidene carbons). Ms, m/z (260, M^+, 18%, $C_{12}H_8N_2OS_2$), 220 (72%, $C_{10}H_8N_2S_2$), 219 (74%, $C_{10}H_7N_2S_2^+$), 160 (3%, $C_9H_6NS^+$), 117 (13.5%, C_8H_7N), 116 (12%, $C_8H_6N^+$).

Reaction of Compounds 2 and 1 with 2,3,4,6-Tetra-*O*-acetyl-α-*D*-gluco- or Galactopyranosyl Bromide and 2,3,4-Tri-*O*-acetyl-α-*D*-xylopyranosyl Bromide

General Procedure

To a solution of **2** and **7** (0.01 mole) in aqueous potassium hydroxide (0.56 gm, 0.01 mole, in 6 ml distilled water), a solution of (2,3,4,6-tetra-*O*-acetyl-α-*D*-gluco- or galacto -pyranosyl) bromide or (2,3,4-tri-*O*-acetyl-α-*D*-xylopyranosyl) bromide (0.011 mole) in acetone (30 ml) was added. The reaction mixture was stirred at room temperature until the starting material was consumed (TLC). The solvent was evaporated under reduced pressure at 40°C and the residue was washed with distilled water to remove the formed potassium bromide. The resulting solid was dried and crystallized from ethanol to give **14a–d**, **15**, **16a–f**, **17**, **18a–d** and **19**. The physical and analytical data are listed in Tables I–III.

Action of Mercuric Chloride on 5-Benzylidene-3-phenyl-2-thiohydantoin 2e

A mixture of **2e** (0.01 mole) and sodium hydroxide (0.4 gm, 0.01 mole) in 50% aqueous ethanol (20 ml) was added slowly to a stirred solution

TABLE I Experimental Data of Compounds **14–19**

Compd. No.	Time (hr)	M.P. (°C)	Yield (%)	Mol. Formula (Mol. Wt.)	Analysis (Calcd./Found)			
					C	H	N	S
14a	2	190	89	$C_{29}H_{35}N_3O_{11}S$	54.97	5.53	6.63	5.05
				(633.66)	55.10	5.60	6.70	4.90
14b	8	198	91	$C_{25}H_{28}N_2O_{10}S$	54.74	5.11	5.11	5.84
				(548.60)	54.81	5.21	4.88	5.80
14c	6	201	93	$C_{26}H_{3}oN_2O_{11}S$	53.87	5.19	4.84	5.53
				(578.59)	53.97	5.28	4.88	5.52
14d	4	219	87	$C_{25}H_{27}C1N_2O_{10}S$	51.50	4.63	4.80	4.59
				(583.01)	51.39	4.70	4.81	4.39
15	1	97	85	$C_{24}H_{35}N3O_{10}S_2$	48.89	5.94	7.13	10.86
				(589.67)	48.60	5.80	7.10	10.53
16a	2	95	93	$C_{29}H_{35}N_3O_{11}S$	54.97	5.53	6.63	5.05
				(633.67)	55.10	5.60	6.70	4.90
16b	15	135	93.5	$C_{25}H_{28}N_2O_{10}S$	54.74	5.11	5.11	5.84
				(548.60)	54.90	5.20	5.00	5.97
16c	20	160	94.5	$C_{26}H_{30}N_2O_{11}S$	53.97	5.19	4.84	5.53
				(578.59)	53.90	5.20	4.80	5.48
16d	20	149	89	$C_{25}H_{27}C1N_2O_{10}S$	51.50	4.63	4.80	5.49
				(583.01)	51.80	4.38	4.50	5.30
16e	12	130	84.5	$C_{30}H_{3}oN_2O_{10}S$	59.01	4.92	4.59	5.24
				(610.63)	58.50	5.00	4.40	5.11
16f	8	117	91	$C_{31}H_{32}N_2O_{11}S$	58.12	5.00	4.37	5.00
				(640.50)	58.12	5.05	4.40	4.80
17	1.5	84	87	$C_{24}H_{35}N_3O_{10}S_2$	48.89	5.94	7.13	10.86
				(589.67)	48.60	5.80	7.10	10.63
18a	1	107	83	$C_{26}H_{31}N_3O_9S$	55.61	5.52	7.48	5.70
				(561.61)	55.80	5.70	7.50	5.50
18b	5	170	87	$C_{22}H_{24}N_2O_8S$	55.46	5.04	5.88	6.72
				(476.50)	55.40	4.90	5.70	6.50
18e	4	133	85	$C_{23}H_{26}N_2O_9S$	54.54	5.14	5.53	6.32
				(506.52)	54.70	5.00	5.60	6.11
18d	2	194	86	$C_{27}H_{26}N_2O_8S$	60.22	4.83	5.20	5.94
				(538.57)	59.93	4.70	5.30	5.80
19	1	89	87	$C_{21}H_{3},N_3O_8S_2$	48.74	5.99	8.12	12.38
				(517.61)	48.90	6.10	8.30	12.20

of mercuric chloride (2.72 gm, 0.01 mole) in ethanol (30 ml) until the starting material was consumed (TLC). The solid formed was filtered off, washed with 25 ml distilled water and dried to give 5-benzylidene-3-phenyl-2-(chIoromercurithio)hydantoin **20**; m.p.: 291°C, yield: 95%. Calc. for $C_{16}H_{11}N_2OSHgCl$: C, 37.24; H, 2.14; N, 5.43; S, 6.21; CI, 6.89; found: C, 37.16; H, 2.11; N, 5.26; S, 6.05; Cl, 6.73.

TABLE II ^{1}H-NMR and ^{13}C-NMR Spectral Data of the Newly Prepared S-Nucleosides

^{1}H-NMR (δ ppm)	^{13}C-NMR (δ ppm)
14a; 1.73 (3H, s, CH_3-CO.at C-6′), 1.98 (3H, s, CH_3-CO at C-4′), 2.04 (6H, s, $2CH_3$-CO at C-2′ and C-3′), 2.47 (4H, s, 2C-CH_2-N), 3.34 (2H, s, N-CH_2-N), 3.55 (4H, s, 2C-CH_2-O), 4.04–4.12 (2H, m, H-6′ and H-6″ at C-6′), 4.14–4.24 (1H at C-4′, m), 5.02–5.09 (1H at C-2′, t), 5.33–5.40 (1H at C-3′, t), 5.63-5.67 (1H at C-5′, t), 5.94–5.98 (1H at C-1′, d, anomeric proton, J = 10.18 Hz), 6.99 (1H, s, Ph-CH═C), 7.48–8.32 (5H, m, aromatic).	**14a**; 80.36, 68.78, 72.96, 68.01, 75.25, 65.85 (C-1′, C-2′, C-3′, C-4′, C-5′ and C-′); 20.25, 20.34, 20.25, 20.13 ($4CH_3$ of acetoxy groups at C-2′, C-3′, C-4′ and C-6′); 169.50, 169.81, 169.34,169.25 (4C═O at C-2′, C-3′, C-4′ and C-6′); 161.98, 168.62, 137.61 (C-2, C-4 and C-5); 124.20, 133.86, 128.70, 132.09, 30.70 (benzylidene carbons); 50.27, 61.66, 62.12 ($4CH_2$, morpholinomethyl carbons).
14b; 1.79 (3H, s, CH_3-CO at C-6′), 2.50 (3H, s, CH_3-CO at C-4′), 2.07 (3H, s, CH_3-CO at C-2′), 2.08 (3H, s, CH_3-CO at C-3′), 3.13 (3H, s, N^3-CH_3), 3.46–3.97 (2H, m, H-6′ and H-6″ at C-6′), 4.15–4.28 (1H at C-4′, m), 5.11–5.19 (1H at C-2′, t), 5.33–5.47 (2H at C-3′ and C-5′, m), 5.85–5.89 (1H at C-1′, d, anomeric proton, J = 10.20 Hz), 7.02 (1H, s, Ph-CH═C), 7.42–8.14 (5H, m, aromatic).	**14b**; 80.97, 68.97, 76.90, 68.97, 76.95, 61.71 (C-l′, C-2′, C-3′, C-4′, C-5′ and C-6′); 20.24, 20.38, 20.41, 20.41 ($4CH_3$ of acetoxy groups at C-2′, C-3′, C-4′ and C-6′); 170.38, 169.35, 169.86, 169.35 (4C═O at C-2′, C-3′, C-4′ and C-6′); 161.24, 169.25, 137.84 (C-2, C-4 and C-5); 125.34, 134.05, 128.54, 131.86, 130.03, (benzylidene carbons); 26.49 (N-CH_3).
15; 1.50 (6H, s, $2CH_3$ at C-5), 1.91 (3H, s, CH_3-CO at C-6′), 1.98 (3H, s, CH_3-CO at C-4′), 2.06 (3H, s, CH_3-CO at C-2′), 2.12 (3H, s, CH_3-CO at C-3′), 2.89 (2H, s, N-CH_2-N), 3.68 (4H, s, 2C-CH_2-N), 3.89 (4H, s, 2C-CH_2-O), 4.19–4.45 (2H, m, H-6′ and H-6″ at C-6′), 5.24–5.27 (1H at C-4′, m), 4.34–4.38 (1H at C-2′, t), 6.33–6.34 (1H at C-3′, t), 4.46–4.47 (1H at C-5′, t), 6.63–6.64 (1H at C-1′, d, anomeric proton, J = 10.17 Hz).	**14d**; 80.03, 68.84, 72.68, 67.93, 75.22, 61.70 (C-1′, C-2′, C-3′, C-4′, C-5′ and C-6′); 20.04, 20.24, 20.04, 20.24 ($4CH_3$ of acetoxy groups at C-2′, C-3′, C-4′ and C-6′); 169.36, 169.74, 169.36, 169.74 (4C═O at C-2′, C-3′, C-4^1 and C-6′); 162.41, 168.26, 138.16 (C-2, C-4 and C-5); 122.14, 134.49, 128.70, 133.58, 132.85 (benzylidene carbons); 26.41 (N-CH_3).
16d; 1.63 (3H, s, CH_3-CO at C-6′), 1.98 (3H, s, CH_3-CO at C-4′), 2.09 (3H, s, CH_3-COatC-2′), 2.15 (3H, s, CH_3-COatC-3′), 3.07 (3H, s, N^3-CH_3), 4.01–4.08 (2H, m, H-6′ and H-6″ at C-6′), 4.56 (1H at C-4′, m), 5.21–5.28 (1H at C-2′, t), 5.43 (1H at C-3′, t), 5.59–5.62 (1H at C-5′, t), 6.04–6.08 (1H at C-1′, d, anomeric proton, J = 10.34 Hz), 6.99 (1H, s, Ph-CH═C), 7.51–7.54 (2H, d, aromatic), 8.31–8.34 (2H, d, aromatic).	**16d**; 80.56, 67.68, 70.62, 66.37, 74.86, 61.69 (C-1′, C-2′, C-3′, C-4′, C-5′ and C-6′); 20.23, 20.29, 20.18, 19.91 ($4CH_3$ of acetoxy groups at C-2′, C-3′, C-4′ and C-6′); 169.63, 169.86, 169.58, 169.28 (4C═O at C-2′, C-3′, C-4′ and C-6′); 162.58, 168.29, 138.13 (C-2, C-4 and C-5); 122.10, 134.40, 128.66, 133.59, 132.79 (benzylidene carbons); 26.37 (N-CH_3).

(Continued on next page)

TABLE II (Continued)

^{1}H-NMR δ ppm	^{13}C-NMR (δ ppm)
17; 1.18–1.30 (4H, t, 2C-CH_2-N), 1.35–1.40 (4H, t, 2C-CH_2-0), 1.34 (6H, s, 2CH_3 at C-5), 1.98 (3H, s, CH_3-CO at C-6′), 1.99 (3H, s, CH_3-CO at C-4′), 2.00 (3H, s, CH_3-CO at C-2′), 2.01 (3H, s, CH_3-CO at C-3′), 3.32 (2H, s, N-CH_2-N), 4.36–4.43 (lH, m, at C-4′), 5.11–5.19 (1H at C-2′, t), 5.23–5.42 (IH at C-3′, t), 5.74–5.78 (1H at C-5′, t), 6.30–6.38 (1H, d, anomeric proton, J = 10.34).	
18a; 2.06 (9H, s, 3CH_3-CO at C-2′, C-3′ and C-4′), 2.48 (2H, s, N-CH_2-N), 3.22 (4H, s, 2C-CH_2-N), 3.55 (4H, s, 2C-CH_2-0), 3.79-3.82 (1H at C-2′, t), 4.15–4.26 (1H at C-4′, m), 4.95–4.97 (1H at C-3′, m), 5.21–5.27 (1H at C-5′, t, J = 7.82, diequatorial orientation between H-5′$_e$ and H-4′), 5.40–5.49 (1H at C-5′, t, J = 7.52, diaxial orientation between H-5′. and H-4′), 6.06–6.09 (1H at C-1′, d, anomeric proton, J = 7.52 Hz), 6.97 (1H, s, Ph-CH═C), 7.47–8.26 (5H, m, aromatic).	**18a**; 80.80, 65.84, 68.66, 67.62, 70.59 (C-1′ C-2′, C-3′, C-4′ and C-5′); 20.30, 20.43, 20.30 (3CH_3 of acetoxy groups at C-2′, C-3′ and C-4′); 169.16, 169.16, 169.44 (SCO at C-2′, C-3′ and C-4′); 162.49, 168.73, 137.45 (C-2, C-4 and C-5); 124.04, 133.78, 128.69, 131.90, 130.06 (benzylidene carbons); 50.26, 62.03, 64.55 (4CH_2, morpholinomethyl carbons).
18c; 2.10 (9H, s, 3CH_3-CO at C-2′, C-3′ and C-4′), 3.12 (3H, s, N^3-CH_3). 3.86 (3H, s, Ar-OCH_3), 3.60–3.67 (1H at C-4′, t), 5.01–5.18 (1H at C-3′, m), 4.27–4.32 (IH at C-2′, m), 5.21–5.24 (IH at C-5′, t, J = 7.56 Hz. diequatorial orientation between H-5′$_e$ and H-4′), 5.29–5.35 (1H at C-5′, t, J = 7.56 Hz, diaxial orientation between H-5′, and H-4d), 6.05–6.08 (1H at C-1′, d, anomeric proton, J = 7.73 Hz), 6.93 (1H, s, Ph—CH═C), 6.96–6.98 (2H, d, aromatic), 8.06–8.09 (2H, d, aromatic).	**18c**; 81.26, 65.45, 68.88, 67.87, 70.87 (C-1′, C-2′, C-3′, C-4′ and C-5′); 20.55, 20.61, 20.54 (3CH_3 of acetoxy groups at C-2′, C-3′ and C-4′); 169.43, 169.55, 169.49 (3C═O at C-2′, C-3′ and C-4′); 161.19. 169.30, 135.98 (C-2, C-4 and C-5); 141.14, 135.86, 125.86, 130.99, 129.94 (benzylidene carbons); 26.48, 55.24 (N-CH_3, Ar-OCH_3).
18d; 1.98 (3H, s, CH_3-CO at C-4′), 2.05 (6H, s, 2CH_3-CO at C-2′, C-3′), 3.77–3.84 (1H, t, at C-2′), 4.12–4.15 (1H at C-4′, m), 4.95 (1H at C-3′, m), 5.18–5.24 (IH at C-5′, t, J = 7.20 Hz, diequatorial orientation between H-5′$_e$ and H-4′), 5.42–5.48 (1H at C-5′, t, J = 7.15 Hz, diaxial orientation between H-5″, and H-4′), 6.13–6.16 (1H at C-1′, d, anomeric proton, J = 7.51 Hz), 7.07 (1H, s, Ph—CH═C), 7.42–8.33 (5H, m, aromatic).	**18d**; 80.65, 64.61, 68.59, 67.61, 70.73 (C-l′, C-2′, C-3′, C-4′ and C-5′); 20.24, 20.26, 20.42 (3CH_3 of acetoxy groups at C-2′, C-3′ and C-4′); 169.08, 169.43, 169.16 (3C═0 at C-2′, C-3′ and C-4′); 161.30, 167.67, 137.24 (C-2, C-4 and C-5); 124.39, 133.81, 127.62, 131.96, 128.75 (benzylidene carbons); 124.39, 130.89, 128.56 (N-C_6H_5)

Reaction of Compound 20 with 2,3,4,6-Tetra-*O*-acetyl-α-*D*-galactopyranosyl Bromide

A suspension of **20** (4.39 gm, 0.01 mole) in xylene (150 ml) was distilled until 50 ml of the distillate was collected, cooled and added

TABLE III Mass Spectral Data of the Newly Prepared S-Nucleosides

Comp. no.	Mass spectral data
14b	M^+ 548 (0.5%, $C_{25}H_{28}N_2O_{10}S$), m/z 332 (4%, $C_{14}H_{20}O_9$), 331 (18%, $C_{14}H_{19}O_9^+$), 218 (41%, $C_{11}H_{10}N_2OS$), 169 (33%, $C_8H_9O_4^+$), 145 (5%, C_9H_7NO), 144 (6%, $C_9H_6NO^+$), 127 (9%, $C_6H_7O_3^+$), 117 (29%, C_8H_7N), 116 (7%, $C_8H_6N^+$), 109 (17%, $C_6H_50_2^+$), 81 (5%, $C_5H_5O_5^+$), 73 (3%, CH_3NCS), 43 (100%, CH_3CO).
14c	M^+ 578 (2%, $C_{26}H_{30}N_2O_{11}S$), m/z 332 (2%, $C_{14}H_{20}O_9$), 331 (10%, $C_{14}H_{19}O_9^+$), 248 (7%, $C_{I2}H_{12}N_2O_2S$), 247(1.5%, $C_{12}H_{11}N_2O_2S^+$), 174 (4%, $C_{10}H_8NO_2^+$), 169 (38%, $C_8H_9O_4^+$), 147 (4%, C_9H_9NO), 132 (3%, $C_8H_6NO^+$), 127 (9%, $C_6H_7O_3^+$), 109 (33%, $C_6H_5O_2$), 73 (1%, CH_3NCS^+), 43 (100%, CH_3CO).
15	M^+ 589 (1.5%, $C_{24}H3_5N_3O_{10}$ S_2), m/z 331 (1%, $C_{14}H_{19}O_9^+$), 169 (7%, $C_8H_9O_4^+$), 160 (20%, $C_5H_8N_2S_2^+$), 159 (7%, $C_5H_7N_20_2S_2^+$), 145 (3%, $C_4H_5N_2S_2^+$), 127 (4%, $C_6H_7O_3^+$), 109 (8%, $C_6H_5O_2^+$), 101 (6%, $C_5H_{11}NO$), 100 (62%, $C_5H_{10}NO^+$), 86 (13%, $C_3H_4NS^+$), 43 (100%, CH_3CO).
16a	M^+ 534 (0.9%, $C_{24}H_{26}N_2O_{10}S$), m/z 332 (2%, $C_{14}H_{20}O_9$), 331 (9%, $C_{14}H_{19}O_9^+$), 204 (7%, $C_{10}H_8N_2OS$), 169 (10%, $C_8H_9O_4^+$), 145 (3%, C_9H_7NO), 127 (5%, $C_6H_70_3^+$), 117 (7%, C_9H_7N), 109(8.5%, $C_6H_5O_2^+$), 101 (5.5%, $C_5H_{11}NO$), 100 (84%, $C_5H_{10}NO$), 81 (3.5%, $C_5H_5O^+$), 59 (2.5%, HCNS), 43 (100%, CH_3CO).
16c	M^+ 578 (6%, $C_{26}H3oN_2O_{11}S$), m/z 332 (4%, $C_{14}H_{20}0_9$), 331 (26%, $C_{14}H_{19}O_9^+$), 248 (23%, $C_{12}H_{12}N_2O_2S$), 247 (2%, $C_{12}H_{11}N_2O_2S^+$), 174 (4%, C_{10} $H_8NO_2^+$), 169 (4%, $C_8H_9O_4^+$), 147 (9%, C_9H_9NO), 146 (4%, $C_9H_8NO^+$), 132 (5%, $C_8H_6NO^+$), 127 (9%, $C_6H_7O_3^+$), 109 (19%, $C_6H_5O_2^+$), 81 (5%, $C_5H_5O^+$), 73 (2%, CH_3NCS), 43 (100%, CH_3CO).
16e	M^+ 610 (0.6%, $C_3oH_3oN_2O_1oS$), m/z 332 (3.5%, $C_{14}H_{20}O_9$), 331 (12%, $C_{14}H_{19}O_9^+$), 280 (12%, $C_{16}H_{12}N_2O_2S$), 279 (6.5%, $C_{16}H_{11}N_2O_2S^+$), 169 (22%; $C_8H_9O_4^+$), 145 (2%, C_9H_7NO), 144 (2%, $C_9H_6NO^+$), 127 (7%, $C_6H_70_3^+$), 117 (19%, C_8H_7N), 116 (7%, $C_8H_6N^+$), 109 (17%, $C_6H_5O_2^+$), 81 (5%, $C_5H_5O^+$), 43 (100%, CH_3CO).
18b	M^+ 476 (0.2%, $C_{22}H_{24}N_2O_8S$), m/z 259 (3%, $C_{11}H_{15}O_7^+$), 218 (13%, $C_{11}H_{10}N_2OS$), 199 (2%, $C_9H_{11}O_3^+$), 157 (5%, C_7H, O_4^+), 144 (2.5%, $C_9H_6NO^+$), 139 (10%, $C_7H_7O_3^+$), 117 (7%, C_8H_7N), 116 (5%, $C_8H_6N^+$), 97 (18%, $C_5H_5O_2^+$); 73 (2%, CH_3NCS), 69 (4.5%, $C_4H_5O^+$), 43 (100%, CH_3CO).
18c	M^+ 506 (2%, $C_{23}H_{26}N_2O_9S$), m/z 259 (4.5%, $C_{11}H_{15}O_7^+$), 248 (10%, $C_{12}H_{12}N_2O_2S$), 199 (4%, $C_9H_{11}O_5^+$), 174 (3.5%, $C_{10}H_8N0_2^+$), 157 (12%, $C_7H_9O_4^+$), 147 (7.5%, C_9H_9NO), 146 (4%, $C_8H_8NO^+$), 139 (16%, $C_7H_7O_3$), 132 (5.5%, $C_8H_6NO^+$), 97 (27%, $C_5H_5O_2^+$), 73 (4%, C_2H_3NS), 69 (5%, $C_4H_5O^+$), 43 (100%, CH_3CO).

to a powdered (2,3,4,6-tetra-*O*-acetyl-α-*D*-galactopyranosyl) bromide (4.52 gm, 0.011 mole). The mixture was heated under reflux (moisture excluded) for two hours and filtered off. The residue was washed with hot xylene and evaporated under vaccum and cooled. The residual solid product was extracted with chloroform (200 ml). Thevsolvent

was evaporated to dryness and the solid residue was crystallized from ethanol to give 5-benzylidene-3-phenyl-2-(2′,3′,4′,6′-tetra-*O*-acetyl-β-*D*-thiogalactopyranosyl)hydantoin; mp.: 130°C, yield 86%. The product showed no depression of m.p. and m.m.p. when admixed with **16e**.

Attempted Deprotection of 5-(4-Chlorobenzylidene)-3-methyl-2-(2′,3′,4′,6′-tetra-*O*-acetyl-β-*D*-thioglucopyranosyl)hydantoin (14d)

a) By Using NH_3/MeOH

To a suspension of the S-glucoside **14d** (0.01 mole) in absolute methanol (25 ml), a saturated solution of ammonia in absolute methanol (25 ml) was added. The reaction mixture was stirred at room temperature for 24 hrs until the starting material was consumed (TLC). The reaction mixture was evaporated to dryness under vacuum and the resulting solid was crystallized from methanol to give 0.79 gm (35% of the yield; m.p.: 202–204°C). Its mixed m.p. with an authentic sample of 5-(4-chlorobenzylidene)-3-methyl-2-thiohydantoin (**2d**)[27] gave no depression. The filtrate was evaporated to dryness to give a solid product (1.47 gm, 65% of th. Yield); m.p. 261°C. Its mixed m.p. with an authentic sample of 5-(4-chlorobenzylidene)-3-methylhydantoin (**22**) gave no depression.[27]

b) By Using NaOEt/EtOH or NaOMe/MeOH

A suspension of equimolecular amounts of 14d and sodium ethoxide in ethanol (25 ml) was stirred at room temperature for 30 min. The reaction mixture was evaporated to dryness. The residual solid was dissolved in water (10 ml) and acidified with HC1. After standing at room temperature for some hours, a solid precipitated which was collected by filtration, washed with water, dried and crystallized to give **2d** (44% of th. yield) and **22** (56% of th. yield). Their m.p. and mixed m.p. gave no depression.[27]

REFERENCES

[1] A. Sinks and W. S. Waring, *Prog. Med. Chem.*, **3,** 313 (1963).
[2] A. A. El-Barbary, A. I. Khodair, E. B. Pedersen, and C. Nielsen, *Monatsh. Chem.*, **125,** 593 (1994).
[3] R. J. Remy and J. A. Secrist, *Nucleosides Nucleotides*, **4,** 411 (1985).
[4] E. De. Clercq, *Pure Appl. Chem.*, **33,** 623 (1983).
[5] A. I. Khodair, *Carbohydrate Research*, **331,** 445 (2001).
[6] A. I. Khodair and E. E. Ibrahim, *Nucleosides, Nucleotides*, **15,** 1927 (1996).
[7] A. M. Al-Obaid, H. I. El-Subbah, A. I. Khodair, and M. M. A. El-Zamer, *Anti-Cancer Drugs*, **7,** 873 (1996).

[8] A. I. Khodair, *Phosphorus, Sulphur and Silicon*, **122,** 9 (1997).
[9] A. I. Kohdair and P. Bertrand, *Tetrahedron*, **54,** 4859 (1998).
[10] A. I. Kohdair, A. A. El-Barbary, Y. A. El-Hmaady, and D. R. Imam, *Phosphours, Sulphur and Silicon*, **170,** 261 (2001).
[11] A. I. Kohdair, H. I. El-Subbagh, and A. A. El-Emam, *Bull. Chem. Farm. Ann*., **136,** 561 (1997).
[12] A. K. Kohdair and J. P. Gesson, *Phosphorus, Sulphur and Silicon*, **142,** 167 (1998).
[13] A. A. El-Barbary, A. I. Khodair, E. B. Pederesen, and C. Nielsen, *J. Med. Chem*., 37 (1994).
[14] A. A. El-Barbary, A. I. Khodair, and E. B. Pedersen, *J. Org. Chem.*, **58,** 5994 (1993).
[15] A. A. El-Barbary, A. I. Khodair, E. B. Pedersen, and C. Nielsen, *Nucleosides Nucleotides*, **13,** 707 (1994).
[16] A. F. A. Shalaby, H. A. Daboun, and M. A. Abd-Elaziz, *Z. Naturforsch*, **31b,** 111 (1976).
[17] D. Brillon, *Synthetic Comm.*, **20,** 3085 (1990).
[18] A. A. El-Barbary, K. Clausen, and S. O. Lawesson, *Tetrahedron*, **36,** 3309 (1990).
[19] A. A. El-Barbary, H. A. Hammouda, and M. El-Borai, *Ind. J. Chem*., **23B,** 770 (1984).
[20] W. A. Bonner, *J. Amer. Chem. Soc*., **81,** 1448 (1959).
[21] P. Nanasi, E. N. Nanasi, and E. Corletti, *Gazz. Chim. Ital*., **95,** 966 (1965).
[22] J. A. Philip Gorin and M. Mylosk, *Can. J. Chem*., **53,** 1212 (1975).
[23] J. P. Fisher and E. P. Paradoules, *J. Heterocycl. Chem*., **19,** 123 (1982).
[24] G. Wagner and B. Dietzsch, *Pharmazie*, **31,** 153 (1976).
[25] F. M. Abdel-Megeid, M. A. El-Kaschef, and H. A. Abdel-Bary, *Carbohydr. Res*., **59,** 95 (1977).
[26] G. TRogers, R. S. Shabolt, and T. L. V. Ulbrich, *J. Chem. Soc.* ©, **203** (1969).
[27] J. T. Edward and S. Nielsen, *J. Chem. Soc*., 5084 (1957).
[28] P. A. Firan and C. D. Warren, *J. Chem. Soc*., 2823 (1962).
[29] P. G. Scheurer and F. Smith, *J. Amer. Chem. Soc*., **76,** 3244 (1954).