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Note

Exceptional oxidation, with copper ion, of the bis-[(*o*-chlorophenyl)hydrazone] of L-*threo*-2,3-hexodiulosono-1,4-lactone*

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The insecticidal properties[1] of 2-(*m*-chlorophenyl)- and 2-(*p*-chlorophenyl)-1,2,3-triazoles have attracted the attention of the synthetic organic chemist to the synthesis of the *o*-chlorophenyl analogs. The *m*- and *p*-chlorophenyltriazoles[2] could be prepared by cyclizing the corresponding bis[2-(chlorophenyl)hydrazone] with an oxidant such as copper sulfate. However, an attempt at such a conversion with the bis[2-(*o*-chlorophenyl)hydrazone] is of special interest, as a hydrogen atom replaced the chlorine atom, and the phenyltriazole was obtained[3–5]. It was assumed[6] that the *ortho* chlorine atom and the hydrazone residue form a complex[6] that facilitates the removal of the *ortho* halogen, and such a complex explains why the *meta* and *para* substituents do not undergo such a reaction. The only halogen in the *ortho* position that is retained in the molecule under these conditions is the fluorine atom; this was attributed[6] to the fact that the fluorine is more strongly bound than the other halogen atoms.

It was interesting, as a continuation of our work[7,8], to apply such an oxidation reaction to L-*threo*-2,3-hexodiulosono-1,4-lactone 2,3-bis[2-(*o*-chlorophenyl)-hydrazone] (**1**), which was synthesized by the condensation of one molecular proportion of L-*threo*-2,3-hexodiulosono-1,4-lactone with two equivalents of (*o*-chlorophenyl)hydrazine. It was expected that, during its reaction with cupric chloride, compound **1** would lose its chlorine atoms, to give the known 3,6-anhydro-3-(2-phenylazo)-L-*xylo*-2-hexulosono-1,4-lactone 2-(2-phenylhydrazone), but it was found that the chlorine is retained on the ring, giving the new 3,6-anhydro-3-[2-(*o*-chlorophenyl)azo]-2-hexulosono-1,4-lactone 2-[(2-chlorophenyl)hydrazone] (**2**), probably because of the mild conditions employed.

The only reported[9] synthesis of the 2-(*o*-chlorophenyl)-4,5-diphenyl-1,2,3-triazoles was through chloropalladation of the parent 2-phenyl analog with Li_2PdCl_4, followed by cleavage of the carbon–palladium bond in the metallated 2-phenyl-1,2,3-

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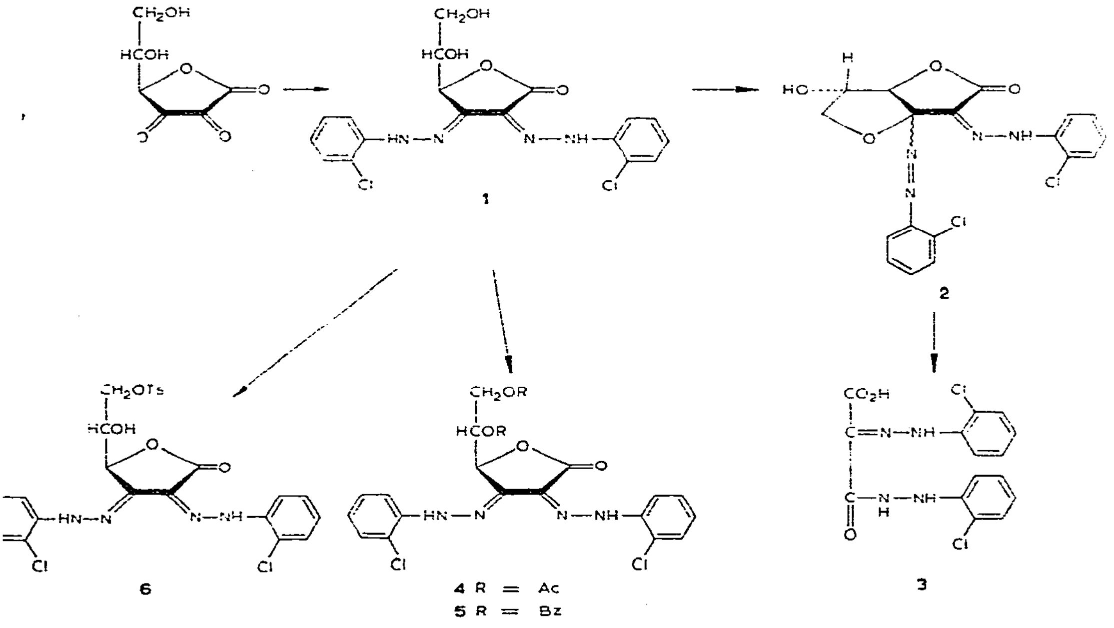
*Heterocycles from Carbohydrate Precursors. Part III. For Part II, see E. S. H. El Ashry, *Carbohydr. Res.*, 52 (1976) 69–77.

triazole by chlorination. Other electrophilic substitutions[2] of 2-phenyl-1,2,3-triazoles gave mainly the *p*-chloro derivative. The infrared (i.r.) absorption spectra of **1** and **2** showed their carbonyl lactone bands at 1720 and 1740 cm^{-1}, and the hydroxyl absorptions at 3480 and 3575 cm^{-1}, respectively.

Degradation of **2** with sodium hydroxide afforded a product formulated as mesoxalic acid 1-[2-(*o*-chlorophenyl)hydrazide] 2-[2-(*o*-chlorophenyl)hydrazone] (**3**), similar to the previously established structure[10] of the phenyl analog. Its i.r. spectrum showed a carbonyl band at 1700 cm^{-1}.

Acetylation of **1** with boiling acetic anhydride afforded the corresponding di-*O*-acetyl derivative (**4**); similarly, benzoylation afforded the di-*O*-benzoyl derivative (**5**). Their i.r. absorption spectra showed unresolved carbonyl absorption at 1740 and 1720 cm^{-1} due to the lactone and the ester groups.

The 6-*p*-toluenesulfonate of L-*threo*-2,3-hexodiulosono-1,4-lactone 2,3-bis(2-phenylhydrazone) had proved a useful precursor for the synthesis of the diazine derivative[7]. Partial *p*-toluenesulfonylation of **1** afforded the 6-*p*-toluenesulfonate (**6**).



Ts = $SO_2C_6H_4Me$-*p*

EXPERIMENTAL

General methods. — Melting points were determined with a Kofler block apparatus and are uncorrected. I.r. spectra were recorded with a Unicam SP-200 spectrometer. Microanalyses were performed in the Chemistry Department, Faculty of Science, Cairo University, Cairo, Egypt.

TABLE I

MICROANALYTICAL AND INFRARED ABSORPTION DATA FOR COMPOUNDS 1–6

Compound	*M.p. (degrees)*	*Formula*	*Calculated (%)*				*Found (%)*				ν_{max}^{Nujol} *(cm^{-1})*
			C	*H*	*Cl*	*N*	*C*	*H*	*Cl*	*N*	
1	226	$C_{18}H_{16}Cl_2N_4O_4$	51.1	3.8	16.9	13.2	51.6	3.7	16.6	13.1	3480, 1720
2	165–166	$C_{18}H_{14}Cl_2N_4O_4$	51.3	3.4	16.8	13.3	51.6	3.6	16.5	13.1	3575, 3275, 1740
3	184–186	$C_{15}H_{12}Cl_2N_4O_3$	49.2	3.3	19.1	15.3				14.8	3350, 3300, 1700
4	147–148	$C_{22}H_{20}Cl_2N_4O_6$	52.1	4.0	14.0	11.0	52.3	4.3	13.7	10.6	1740
5	200–201	$C_{32}H_{24}Cl_2N_4O_6$	60.9	3.8	11.2	8.9	60.6	4.2		8.6	1720
6	224–225	$C_{25}H_{22}Cl_2N_4O_6S$	52.1	3.8	12.1	9.7	52.4	4.3	12.4	9.6	3450, 1740

L-threo-*2,3-Hexodiulosono-1,4-lactone 2,3-bis*[*2-*(o-*chlorophenyl*)*hydrazone*] (**1**). — A solution of dehydro-L-ascorbic acid (1.8 g) in water (20 ml) was treated with (*o*-chlorophenyl)hydrazine (2.9 g) and few drops of glacial acetic acid. The mixture was heated on a boiling-water bath for 30 min, and cooled, and the bishydrazone that separated was filtered off, and washed with water, ethanol, and ether. The red bis(arylhydrazone) was recrystallized from ethanol.

3,6-Anhydro-3-[*2-*(o-*chlorophenyl*)*azo*]*-2-hexulosono-1,4-lactone* [*2-*(o-*chlorophenyl*)*hydrazone*] (**2**). — A suspension of compound **1** (1 g) in a solution of cupric chloride (2 g) in ethanol (50 ml) was boiled for 5 min under reflux. Hot water was added to incipient turbidity, and the product that separated on cooling was filtered off, washed with water, and recrystallized from ethanol to give yellow needles.

Mesoxalic acid 1-[(*2-*(o-*chlorophenyl*)*hydrazide*] *2-*[*2-*(o-*chlorophenyl*)*hydrazone*] (**3**). — A suspension of compound **2** (0.5 g) in water (100 ml) was heated with 2M sodium hydroxide solution (10 ml) at 70–80° until dissolution occurred. The solution was then cooled, and acidified with glacial acetic acid, and the yellow product that separated was filtered off, and recrystallized from ethanol.

*5,6-Di-*O*-acetyl-*L-threo-*2,3-hexodiulosono-1,4-lactone 2,3-bis*[*2-*(o-*chlorophenyl*) *hydrazone*] (**4**). — The bishydrazone **1** (0.5 g) in acetic anhydride (10 ml) was boiled under reflux for 30 min. The mixture was then poured onto crushed ice, and the solid that separated was filtered off, washed with water, and dried. The acetate crystallized from chloroform–ethanol in red needles.

*5,6-Di-*O*-benzoyl-*L-threo-*2,3-hexodiulosono-1,4-lactone 2,3-bis*[*2-*(o-*chlorophenyl*)*hydrazone*] (**5**). — A solution of the bishydrazone **1** (1 g) in dry pyridine (10 ml) was treated with benzoyl chloride (4 ml) and kept overnight at room temperature. The mixture was poured onto crushed ice, and the benzoate that separated was filtered off, washed repeatedly with water, and recrystallized from chloroform–ethanol in red needles.

*6-*O*-*p*-Tolylsulfonyl-*L-threo-*2,3-hexodiulosono-1,4-lactone 2,3-bis*[*2-*(o-*chlorophenyl*)*hydrazone*] (**6**). — A solution of the bishydrazone **1** (1 g) in dry pyridine (20 ml) was treated with *p*-toluenesulfonyl chloride (1.5 g), and kept overnight at room temperature. The mixture was poured onto crushed ice, and the solid that separated was filtered off, and recrystallized from chloroform–ethanol.

REFERENCES

1 H. S. El Khadem, A. M. Kolkaila, and M. H. Meshreki, *J. Chem. Soc.*, (1963) 3531–3535.
2 B. B. Bishay, H. S. El Khadem, Z. M. El-Shafei, and M. H. Meshreki, *J. Chem. Soc.*, (1962) 3154–3158.
3 H. S. El Khadem, Z. M. El-Shafei, and Y. S. Mohamed, *J. Chem. Soc.*, (1960) 3993–3997.
4 H. S. El Khadem, Z. M. El-Shafei, and M. H. Meshreki, *J. Chem. Soc.*, (1961) 2957–2961.
5 G. Henseke and Z. Müller, *J. Prakt. Chem.*, 18 (1962) 47.
6 H. S. El Khadem and D. L. Swartz, *Carbohydr. Res.*, 30 (1973) 400–404.
7 H. S. El Khadem and E. S. H. El Ashry, *Carbohydr. Res.*, 7 (1968) 501–502, 507–509; 13 (1970) 57–61; 21 (1972) 430–439; *J. Chem. Soc.*, (1968) 2247–2248, 2248–2250, 2250–2253.
8 E. S. H. El Ashry and Y. El Ashry, *Chem. Ind.* (*London*), (1976) 372–373.
9 J. A. C. Allison, H. S. El Khadem, and C. A. Wilson, *J. Heterocycl. Chem.*, 12 (1975) 1275–1277.
10 H. S. El Khadem and E. S. H. El Ashry, *J. Heterocycl. Chem.*, 10 (1973) 1051–1053.