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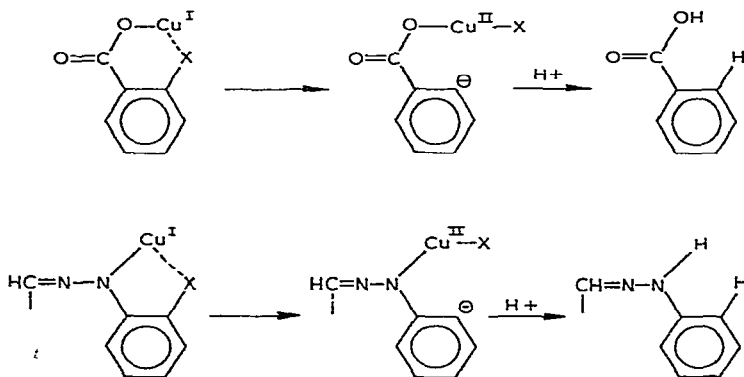
Saccharide *o*-halogenophenyl osotriazoles: fluoro derivatives

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Periodate oxidation of saccharide *m*- and *p*-halogenophenyl osotriazoles yields 4-formyl-2-(halogenophenyl)-1,2,3-triazoles that possess insecticidal properties¹. However, the *o*-halogenophenyl osotriazoles of sugars are not known, because, during the conversion of the *o*-halogenophenyl osazones into the corresponding osotriazoles with copper sulfate, the *o*-halogen atom is replaced by hydrogen, and the phenyl osotriazole is obtained². Similarly, when treated with reduced copper powder in aqueous or nonaqueous media, *o*-halogenobenzoic acids yield benzoic acid^{2,3}. Unlike the (more common) hydrolysis of the halogenobenzenes to phenols, the halogen atom in these substituted benzoic acids and triazoles is replaced by hydrogen. Although no mechanism for this reaction has been put forward, it is reasonable to assume that the *ortho*-halogen atom and the carboxylic group or hydrazone residue form with the reduced copper a complex that facilitates the removal of the *ortho*-halogen atom. Formation of such a complex would explain why the *meta*- and *para*-substituted compounds do not undergo such a reaction. Under the influence of heat, the complex would break down, giving the mixed copper(II) halide carboxylate, while the halogen atom would be replaced with a negative charge, which would be occupied by a proton.



The lability of the halogen atom in 4-formyl-2-(halogenophenyl)-1,2,3-triazoles may prove of use in formation of biodegradable insecticides which would cause no permanent damage to the ecology. The aim of this work (and of subsequent papers in this series) is the synthesis of various saccharide *o*-halogenophenyl triazoles, and their conversion into 4-formyl-2-(*o*-halogenophenyl)-1,2,3-triazoles for screening as insecticides. As the *o*-bromo-, *o*-chloro-, and *o*-iodo-phenylosazones all undergo dehalogenation during triazole formation, we have attempted to perform the reaction with compounds containing a more strongly bound halogen, namely, the *o*-fluorophenyl osazones. We anticipated that chelation would render the *o*-fluorine atom sufficiently labile to allow degradation over a long period of time, but stable enough to be retained in the ring during osotriazole formation. This possibility was supported by the fact that, when *o*-fluorobenzoic acid was refluxed with reduced copper powder, it did not lose its fluorine atom, suggesting that the copper precipitated during triazole formation might not affect the *o*-fluorine atom.

Accordingly, D-glucose and D-arabinose were treated with (*o*-fluorophenyl)-hydrazine (recently become available commercially), and crystalline osazones were obtained. As anticipated, treatment of the D-glucose derivative **1** with copper(II) sulfate did not result in the elimination of the fluorine atom during triazole formation, and D-arabinohexulose (*o*-fluorophenyl)triazole (**2**) was obtained. The mass spectra of

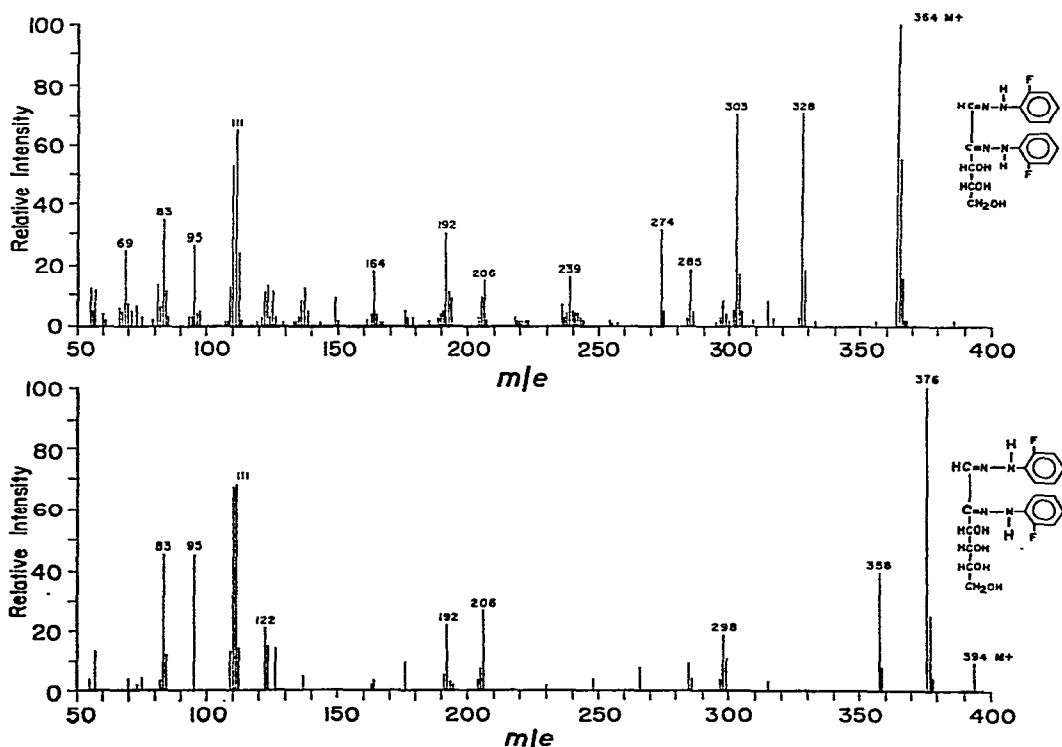


Fig. 1. Mass spectra of *o*-fluorophenyl osazones.

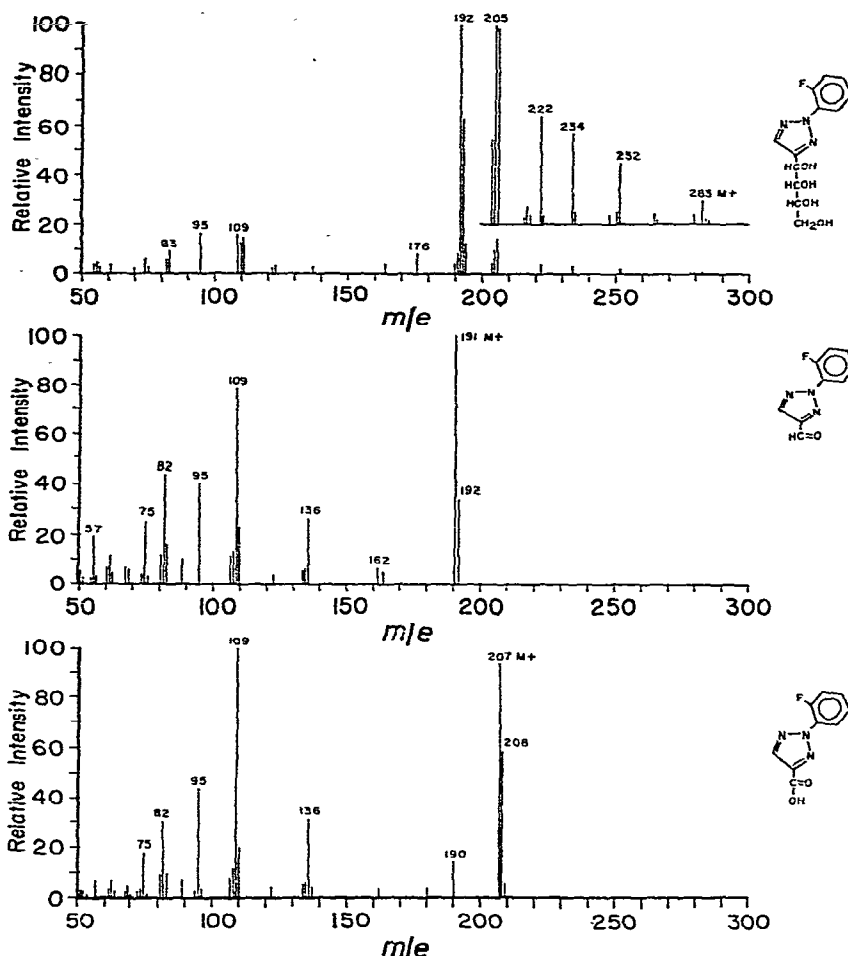
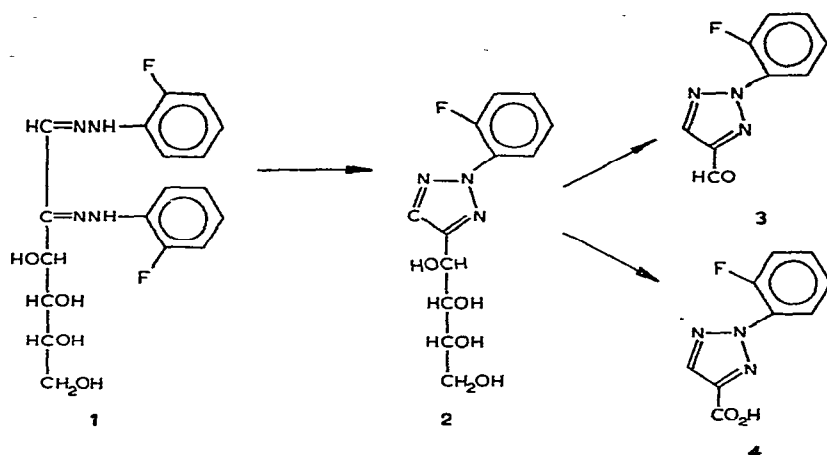


Fig. 2. Mass spectra of *o*-fluorophenyl triazoles.

the osazones (see Fig. 1) and the osotriazoles (see Fig. 2) showed typical, hydroxyalkyl fragmentation, with stepwise loss of H_2O and $CHOH$. All the fragments containing phenyl rings retained the fluorine atom in the ring, confirming the stability of the C-F bond.

Upon periodate oxidation, triazole **2** yielded 4-formyl-2-(*o*-fluorophenyl)-1,2,3-triazole (**3**), which is being screened for insecticidal properties. The corresponding carboxylic acid, 2-(*o*-fluorophenyl)-1,2,3-triazole-4-carboxylic acid (**4**) was prepared by permanganate oxidation of triazole **2**. The mass spectra of compounds **3** and **4** (see Fig. 2) were quite similar, showing strong molecular peaks. In the case of the formyl derivative, an $M^+ - CHO$ peak was observed at m/e 162, and for acid **4**, $M^+ - OH$ (190) and $M^+ - COOH$ (162) peaks were observed. The two spectra showed peaks corresponding to $M^+ - HCN$ and *N*-(*o*-fluorophenyl)azirine (136) resulting



from the loss both of HCN and the formyl or carboxylic group. The peaks at m/e 109/95 were assigned to *o*-F-PhN and *o*-F-Ph.

EXPERIMENTAL

General methods. — Melting points were determined with a Kofler block and are uncorrected. U.v. spectra were recorded with a Beckman DB-G spectrometer. I.r. spectra were recorded, for potassium bromide discs, with a Perkin-Elmer 621 spectrophotometer. Mass spectra were recorded and measured by Mr. M. P. Gilles, Department of Chemistry and Chemical Engineering, Michigan Technological University, on a Varian M66 instrument. Microanalyses were performed by W. Spang, Ann Arbor, Michigan.

D-arabino-Hexulose (o-fluorophenyl)osazone (1). — D-Glucose (4 g) and (o-fluorophenyl)hydrazine* (8 g) in water (75 ml) were heated for 2 h on a steam bath. The crystals formed were filtered off, and recrystallized from ethanol-water. Yield before recrystallization, 2.0 g; m.p. 216°; $\lambda_{\text{max}}^{\text{EtOH}}$ 382, 323, and 253 nm (log ϵ 4.45, 4.00, and 4.26); $\lambda_{\text{min}}^{\text{EtOH}}$ 340, 275, and 216 (log ϵ 3.92, 3.72, and 3.96).

Anal. Calc. for C₁₈H₂₀F₂N₄O₄: C, 54.82; H, 5.11; N, 14.21. Found: C, 54.75; H, 5.14; N, 14.29.

D-erythro-Pentulose (o-fluorophenyl)osazone. — D-Arabinose (4 g) and (o-fluorophenyl)hydrazine (8 g) in water (75 ml) were heated for 2 h on a steam bath. The crystals formed were filtered off, and recrystallized from ethanol-water. Yield before recrystallization, 2.0 g, m.p. 145°.

Anal. Calc. for C₁₇H₁₈F₂N₄O₃·H₂O: C, 53.40; H, 5.27; N, 14.65. Found: C, 53.63; H, 5.27; N, 14.79.

D-arabino-Hexulose (o-fluorophenyl)osotriazole (2). — D-arabino-Hexulose

*Aldrich Chemical Co., Inc., Milwaukee, Wisconsin 53233, U. S. A.

(*o*-fluorophenyl)osazone (**1**; 1 g) and copper(II) sulfate (1 g) in water (100 ml) were refluxed for 3 h, and then an excess of hydrogen sulfide was added, and the suspension was filtered. An excess of barium carbonate was added to the filtrate, and the mixture was filtered. The filtrate was concentrated to 10 ml, and **2** crystallized out; it was recrystallized from water; yield, 0.5 g, m.p. 173°; $\lambda_{\text{max}}^{\text{EtOH}}$ 253 nm ($\log \epsilon$ 4.16), $\lambda_{\text{min}}^{\text{EtOH}}$ 220 nm ($\log \epsilon$ 2.795).

Anal. Calc. for $\text{C}_{12}\text{H}_{14}\text{FN}_3\text{O}_4$: C, 50.88; H, 4.98; N, 14.83. Found: C, 50.95; H, 4.98; N, 14.81.

2-(o-Fluorophenyl)-4-formyl-1,2,3-triazole (3). — *D-arabino*-Hexulose (*o*-fluorophenyl)osotriazole (1 g) and sodium *meta*-periodate (2.5 g) in water (30 ml) were kept for 24 h at room temperature, and the mixture was filtered. The formyltriazole (yield 0.29) was recrystallized from water, to give needles, m.p. 50°.

Anal. Calc. for $\text{C}_9\text{H}_6\text{FN}_3\text{O}$: C, 56.55; H, 3.16; N, 21.98. Found: C, 56.46; H, 3.23; N, 21.88.

2-(o-Fluorophenyl)-1,2,3-triazole-4-carboxylic acid (4). — *D-arabino*-Hexulose (*o*-fluorophenyl)osotriazole (1 g) and potassium permanganate (2.5 g) in water (30 ml) were boiled for 30 min; the suspension was filtered hot, and the filtrate was treated with enough sodium bisulfite to decolorize it. The acid **4** crystallized out upon acidification; yield, 0.5 g. It was recrystallized from water, m.p. 144°; $\lambda_{\text{max}}^{\text{EtOH}}$ 255 nm ($\log \epsilon$ 4.11), $\lambda_{\text{min}}^{\text{EtOH}}$ 223 nm ($\log \epsilon$ 3.32).

Anal. Calc. for $\text{C}_9\text{H}_6\text{FN}_3\text{O}_2$: C, 52.18; H, 2.92; N, 20.28. Found: C, 52.20; H, 3.02; N, 20.25.

REFERENCES

- 1 H. EL KHADEM, A. M. KOLKAILA, AND M. H. MESHREKI, *J. Chem. Soc.*, (1963) 3531.
- 2 H. EL KHADEM, Z. M. EL-SHAFEI, AND M. H. MESHREKI, *J. Chem. Soc.*, (1961) 2957.
- 3 W. R. H. HURTLEY, *J. Chem. Soc.*, (1929) 1870.