

PHOTOREARRANGEMENT OF PHENYL SELENIDE DERIVATIVES.  
ACCESS TO SELENIUM SUBSTITUTED C-NUCLEOSIDES

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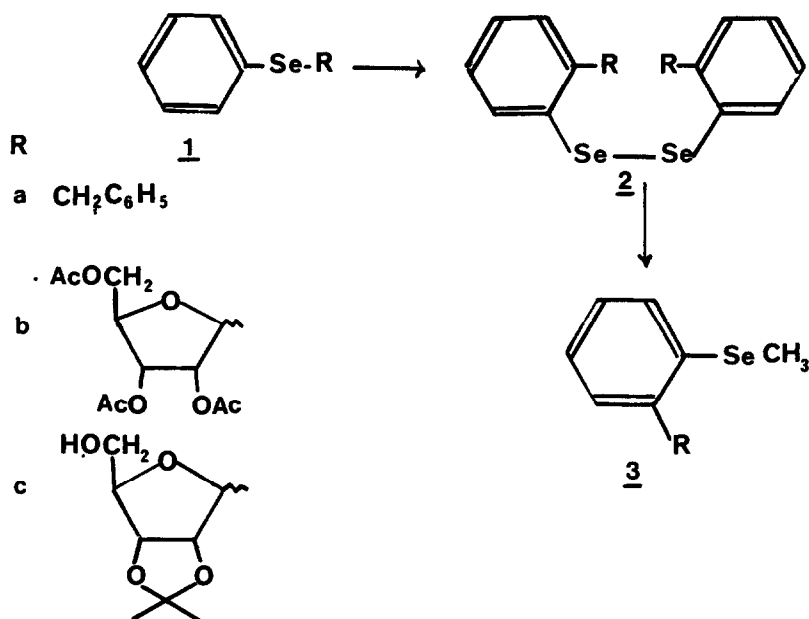
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Summary : The photorearrangements of benzyl phenyl selenide and phenyl ribosyl selenide derivatives afford 2-benzyl phenylselenol and 2-ribosyl phenylselenol, respectively which can be isolated as their methyl derivatives.

Pseudonucleosides (or C-nucleosides) are biologically important carbohydrate derivatives in which an heterocycle is linked at the anomeric position of a ribose moiety by a carbon-carbon bond<sup>1,2</sup>.

Our recent observation on the photorearrangement of a number of thionucleosides (ribosylthiopyrimidine<sup>3</sup> and ribosylthiopyridine<sup>4</sup>) yielding pseudonucleosides prompted us to investigate the behaviour of their seleno analogues. In a preliminary experiment we have established that benzyl phenyl selenide 1a undergoes a photorearrangement to give 2-benzyl phenylselenol. This result lead us to prepare the phenylribosylselenide 1b in order to study its photoreactivity.

Irradiation<sup>5</sup> of a solution of benzyl phenylselenide 1a gave after work up diphenyl diselenide and the diselenide 2a (Yield 50%), clearly an oxidation product of 2-benzyl phenylselenol. Structure 2a is based on the interpretation of the spectral data (ms, UV, NMR) and on the chemical transformation into 3a. Both the compounds 1a and 2a have very similar NMR spectra ; in the case of 2a the resonance for the methylene protons occurs at 4.02 ppm instead of 3.88 ppm for 1a. Sodium borohydride treatment of 2a followed by methylation with methyl iodide gave 3a. As expected, the NMR spectrum of this compound exhibited a methylseleno signal at 2.32 ppm.



TABLE

NMR DATA ( $\delta$ ppm)							
	Aromatic protons	H-1	H-2	H-3	H-4	H-5	Me and/or MeCO
$\alpha$ - <u>1b</u>	7.8-7.2 (5,m)	6.08 (1,d) J=5Hz	5.5 - 5.1 (2,m)	4.5 - 4.20 (3,m)			2.05 2.02 1.97 3 x (3,s)
$\beta$ - <u>1b</u>	7.8-7.2 (5,m)	5.53 (1,d) J=4Hz	5.5 - 5.1 (2,m)	4.4 - 4.15 (3,m)			2.03 (9,s)
$\alpha$ - <u>3c</u>	7.6-7.1 (5,m)	5.39 (1,d) J=4Hz	5.01-4.73 (2,m)	4.37 3.74 (1,t)			2.32 1.39 1.27 3 x (3,s)
$\beta$ - <u>3c</u>	7.4-7.12 (5,m)	5.16 (1,d) J=5Hz	4.75 (2,m)	4.13 3.97 (1,q) 3.84			2.25 1.63 1.35 3 x (3s)

To prepare the phenylselenide 1b we devised the following procedure : zinc-acetic acid reduction of diphenyl diselenide under a nitrogen atmosphere gave, after evaporation of the solvent, the corresponding phenylselenate as a viscous residue. To a dichloroethane solution of the latter was added a 0.8 molar equivalent of tetra-O-acetylribose in the same solvent containing 10%  $\text{BF}_3 \cdot \text{Et}_2\text{O}$  giving immediately the phenylselenide derivative 1b in 78% yield (from tetra-O-acetylribose) after purification by silicagel column chromatography.

Compound 1b was irradiated<sup>5</sup> in tert-butanol solution ; after 30% conversion of the starting material the reaction products were isolated by silicagel column chromatography to give diphenyl diselenide, unreacted starting material 1b and a mixture of diselenides.

Inspection of the NMR spectrum of the unreacted material showed the presence of an additional signal at 6.08 ppm integrating for 0.2 proton. This new peak may be attributed to the H-1 proton of 1- $\alpha$ -phenyl selenyl-2,3,5-tri-O-acetylribose  $\alpha$ -1b ; this observation indicates that 1b underwent partial anomerization in the presence of light. Indeed, in most ribosyl derivatives the H-1 signal is observed at a lower field position for the  $\alpha$ - than for the  $\beta$ -anomer<sup>6</sup> (Table). Careful chromatography led to partial separation of this new derivative which was obtained with 80% purity ; this was sufficient to enable a comparison of its NMR spectrum with that of selenide 1b which had been isolated as a single anomer from tetra-O-acetylribose. On the basis of the H-1 chemical shifts we suggest that the latter was obtained as a  $\beta$ -anomer.

The mixture containing the others photoproducts (isolated as diselenides 2b) was treated with sodium borohydride and the resulting selenols methylated with methyl iodide to provide an anomeric pair of methylselenides 3b (20% yield from  $\beta$ -1b). These compounds were deoxyacetylated and treatment of the resulting C-nucleosides with 2,2-dimethoxypropane led to the separation of two acetonides derivatives 3c [ $(\text{C}_{15}\text{H}_{20}\text{O}_4\text{Se}) \text{M}^+$ . Found 344.052<sup>7</sup>] in the 3:1 ratio.

Structure assignment was made essentially on the basis of NMR spectral analysis. The  $\beta$ -configuration for the more abundant anomer followed

from a previously discussed<sup>4</sup> interpretation of NMR data for ascertaining the anomeric configuration of similar derivatives. Thus the NMR spectra of compounds 3c showed a methylseleno signal at ~ 2.30 ppm. The chemical shift differences ( $\Delta\delta$  CH<sub>3</sub>) of the two acetonide methyls were 0.28 and 0.12 ppm for the  $\beta$ -3c and the  $\alpha$ -3c anomers, respectively. As expected, the H-1<sup>8</sup> signal for the  $\alpha$ -anomer 3c was found at a lower field than for the  $\beta$ -anomer. Finally, the H-4 signal appeared as a triplet in the case of the  $\alpha$ -derivative and a quartet in the other.

In conclusion this work demonstrates that the photorearrangement which was observed with ribosylthiopyrimidine and ribosylthiopyridine nucleosides can be extended to a ribosylseleno derivative. This reaction provides an access to selenium containing pseudonucleosides which have been obtained for the first time. It is noteworthy that photoanomerization of the starting material takes place and this might explain the formation of the two anomers 3c. In the case of the thioderivatives<sup>3,4</sup> this phenomenon was not observed.

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- 4 J.L. FOURREY and P. JOUIN, J. Org. Chem., 44, 1892 (1979).
- 5 A 100 ml tert butanol solution containing one mmol of 1a (or  $\beta$ -1b) was irradiated at room temperature under nitrogen during 1 hour in a quartz vessel with a Hanau TW 150 lamp. The reaction products were separated on a column of silicagel which was eluted with a hexane-ethyl acetate gradient. Compounds 1b and 2b were eluted with hexane-ethylacetate (8:2) and (6:4), respectively
- 6 J.D. STEVENS and H.G. FLETCHER, Jr., J. Org. Chem., 33, 1799 (1968)
- 7 Based on the most abundant selenium isotope.
- 8 Although ribose numbering is formally incorrect in this case, we use it for convenience.