

The Beta to Alpha Transformation of Fully Acetylated Glycosides by Alkali

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The mutarotation of sugars is known to be catalyzed both by acids and bases, but the analogous transglycosidation reaction has only been accomplished with the aid of acid catalysts. Wolfrom and Husted¹, however, have proved that fully acetylated sugars can be transformed from the β - to α -form, using alkali as catalyst. The acetylated sugar was dissolved in an inert solvent, preferably a mixture of dioxane and ether, and shaken with solid sodium hydroxide and a drying agent. Wolfrom and Husted believed that the active agent was a very mild alkalinity, but the present author considers it more probable that the reaction is an example of heterogenous catalysis, for when a mixture of solid sodium hydroxide and Drierite was shaken in dioxane-ether for ten hours and then filtered, no trace of alkalinity and no catalytic activity could be detected in the solution. The glycosides which would most closely resemble sugar acetates are the phenylglycosides, phenols being fairly strong acids. Therefore the effect of alkali in inert solvents on some phenyl glucosides has been investigated in this laboratory.

First the method of Wolfrom and Husted was improved. Instead of crushed solid sodium hydroxid, Ascarite was used. In this way more reproducible results could be obtained. Finally it was found that anhydrous pyridine was a more effective solvent than ether-dioxane. In this solvent the reactions were about 6—7 times faster than in ether-dioxane.

The β -glucoside of a very acid phenol, 2,4-dinitrophenol, was transformed into the α -form by this method. The α -glucoside tetraacetate melted at 182—182.5° and had a specific rotation of + 212° in chloroform. When morpholine was used as a solvent, no transglycosidation was observed but the glycosidic bond was broken and 2,4-dinitrophenyl-morpholine was formed.

Attempts to transform the β -glucosides of phenol, *o*-nitrophenol, and *p*-nitrophenol by this method were not successful. Other bases and more suitable solvents may, however, be found so that these glycosides also might be transformed. This would be of value not only from a theoretical but also from a synthetical point of view, as methods to transform phenyl β -glycosides into the α -glycosides are not known*.

EXPERIMENTAL

Transformation of β -glucose pentaacetate

A mixture of Drierite (10 g), Ascarite (3 g) and anhydrous pyridine (25 ml) was shaken mechanically in order to remove all traces of moisture. After one hour β -glucose pentaacetate (3 g) was added and the shaking continued for 45 minutes. The brown solution was filtered through a layer of kieselguhr into acetic acid (2 ml). The filter was washed with anhydrous dioxane (20 ml) and the filtrate poured into water (200 ml). White crystals slowly precipitated, which were collected and dried. Yield 1.6 g. M. p. 108–109^{***}. $[\alpha]_D^{20} + 101^\circ$. Recrystallization from methanol yielded pure α -glucose pentaacetate.

Using a shorter reaction time, equilibrium was not established, while a longer reaction time lowered the yield.

2,4-Dinitrophenyl α -glucoside tetraacetate

A mixture of Drierite (6 g), Ascarite (2 g) and anhydrous pyridine (20 ml) was shaken mechanically for one hour. Then 2,4-dinitrophenyl β -glucoside tetraacetate (2 g) was added and the shaking continued for three hours. The mixture was filtered through a layer of kieselguhr into a small amount of acetic acid, the filter washed with dioxane (20 ml), and the filtrate poured into water (200 ml). The yellow precipitate was collected and recrystallized from methanol, yielding 0.55 g of white crystals, melting at 181–181.5°. From the mother liquor a second crop of 0.1 g could be obtained. One further recrystallization from methanol yielded the pure substance. M. p. 182–182.5°. $[\alpha]_D^{20} + 212^\circ$.

$C_{20}H_{22}O_{14}N_2$ (514.4) Calc. N 5.45 Found N 5.47

2,4-Dinitrophenyl morpholine

When the above experiment was repeated using morpholine as solvent, a substance which crystallized from methanol in long yellow needles and melted at 118–119° was obtained. As the same product could be obtained by treating morpholine with 2,4-dinitrochlorbenzene, the substance evidently was 2,4-dinitrophenyl morpholine.

$C_4H_8ON-C_6H_3O_4N_2$ (253.2) Calc. N 16.6 Found N 16.4

* One rearrangement of this kind is reported. Montgomery, Richtmeyer and Hudson² have treated phenyl β -glucoside tetraacetate with anhydrous zinc chloride in phenol and obtained the α -glucoside. This method is of practical value only if the rearrangement is intramolecular, which, however, seems rather improbable.

** All melting points uncorrected. All specific rotations in chloroform, $c = 2$.

SUMMARY

A phenyl β -glycoside, 2,4-dinitrophenyl β -glucoside tetraacetate has been transformed into the corresponding α -glucoside with the aid of sodium hydroxide in absolute pyridine.

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REFERENCES

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2. Montgomery, E. M., Richtmeyer, N. K., and Hudson, C. S. *J. Am. Chem. Soc.* **64** (1942) 690.

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