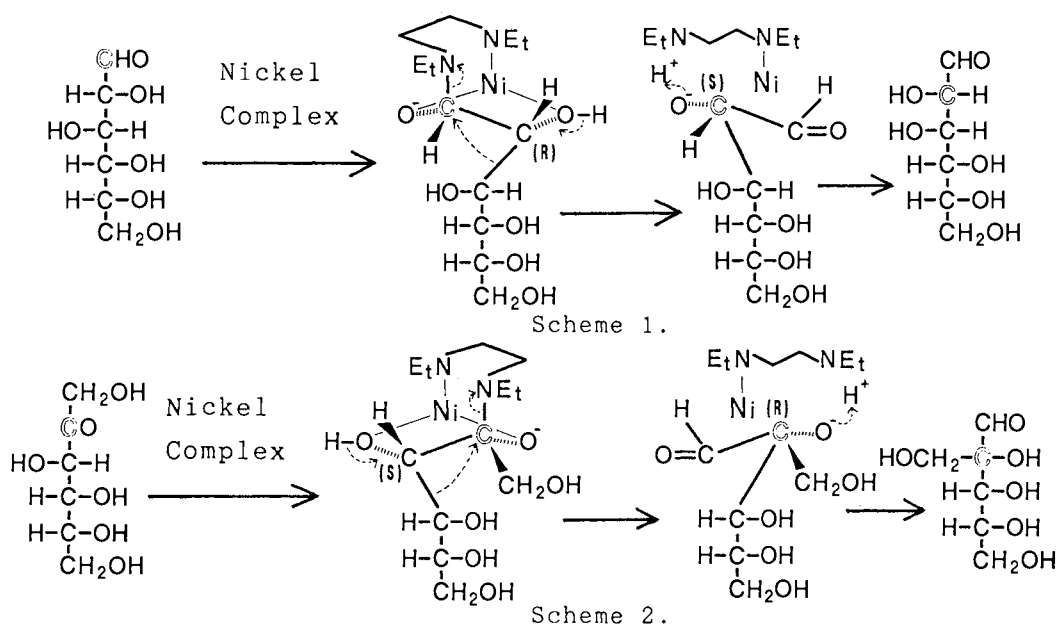


Novel Branching of a Ketose Promoted by the Nickel(II) - Diamine Complex.
The Isomerization of D-Fructose into D-Hamamelose

Ryoji YANAGIHARA,* Shuichi OSANAI,* and Sadao YOSHIKAWA
Department of Applied Chemistry, Faculty of Science
and Technology, Keio University, Yokohama 223

D-Fructose was converted into 2-C-(hydroxymethyl)-D-ribose in a methanolic solution containing a nickel(II) - N,N'-diethylethylenediamine complex.

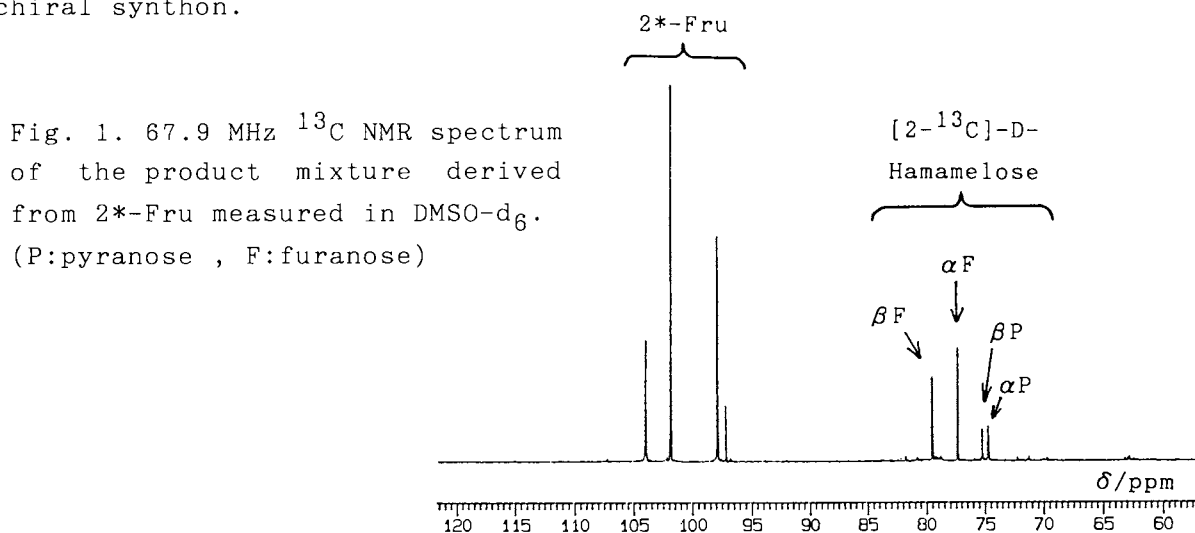
Branched chain sugars, which are rare in natural sources, are important materials as the moiety of antibiotics. The synthesis of branched chain sugars by means of stereoselective and stereospecific reactions has been investigated. Recently, we reported C-2 epimerization of various aldoses catalyzed by the nickel complexes under various conditions.¹⁾ Scheme 1 shows the mechanism of the reaction. If a ketose was particularly adapted to the mechanism as a substrate, the formation of 2-C-(hydroxymethyl)aldose was expected (Scheme 2). In this study, [2-¹³C]-D-fructose (2*-Fru)²⁾ was used as a substrate to confirm our proposal on the branching mechanism.



Nickel chloride hexahydrate (1.0 mmol) and N,N'-diethylethylenediamine (2.0 mmol) were added to methanol (15 ml), and refluxed for 5 min with stirring. D-Fructose (1.0 mmol) was added to the solution, and kept at 50 °C for 15 min with stirring. Then the solution was cooled in an ice bath. Deionization and gas chromatography were carried out in a similar manner reported previously.³⁾

Figure 1 shows the ^{13}C NMR spectrum of the product mixture derived from 2*-Fru. Four characteristic peaks were observed except the peaks of the substrate. Their chemical shifts agreed with an authentic data of C-2 of 2-C-(hydroxymethyl)-D-ribose (D-hamamelose).⁴⁾ On the gas chromatogram of the resulting sugars, the retention times of newly observed four peaks agreed with those of D-hamamelose that was prepared according to the Ho's method.⁵⁾ The product was composed of 29% of D-hamamelose and 71% of remaining D-fructose. No other sugars were detected.

The nickel complex that catalyzed epimerization of aldoses was able to convert D-fructose into D-hamamelose. Such a reaction system could be a new method for preparation of a branched chain sugar derivative as a chiral synthon.



References

- 1) T. Tanase, F. Shimizu, M. Kuse, S. Yano, S. Yoshikawa, and M. Hidai, *J. Chem. Soc., Chem. Commun.*, **1987**, 659; K. Fukushima, M. Takahashi, H. Nagano, S. Osanai, and S. Yoshikawa, *Nippon Kagaku Kaishi*, **1988**, 585; T. Yamauchi, K. Fukushima, R. Yanagihara, S. Osanai, and S. Yoshikawa, *Carbohydr. Res.*, **204**, 233 (1990).
- 2) 2*-Fru was obtained commercially from Cambridge Isotope Laboratories.
- 3) R. Yanagihara, S. Osanai, and S. Yoshikawa, *Chem. Lett.*, **1990**, 2273.
- 4) G. Schilling and A. Keller, *Justus Liebig's Ann. Chem.*, **1977**, 1475.
- 5) P.-T. Ho, *Tetrahedron Lett.*, **1978**, 1623.

(Received October 19, 1991)