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Off-Pathway Intermediates in the Conversion of Sugars to Plastic

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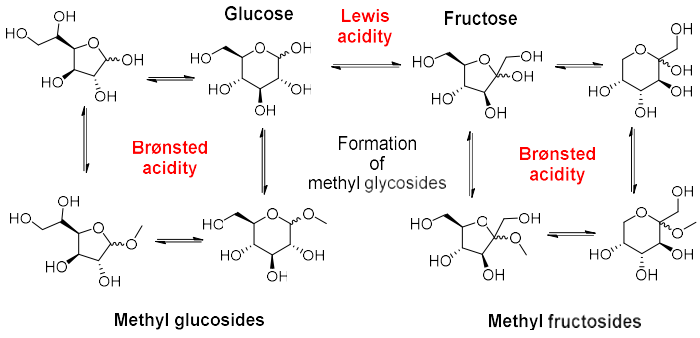
Carbohydrates are the most abundant compounds forming biomass and their conversion into chemicals is a central topic in the research of alternative resources for replacing the use of fossil feedstock. Using heterogeneous catalysts, simple sugars can be converted into chemicals and fuels. Recently, Lewis acidic zeolites have received much attention for their ability to bind and convert sugars. Particularly Sn-beta zeolite has been studied as catalyst for the production of methyl lactate and other monomers for bio-based polymeric materials.[1] The process is carried out in short-chain alcohol, normally methanol, because the catalyst shows higher stability in alcohol than in water.[2] Under these conditions, the sugar molecules react with the solvent to form methyl glycosides, resulting in complex reaction mixtures of isomeric glycosides (pyrano-furano and α-β forms) (Scheme 1). We use 2D ^{1}H-^{13}C HSQC to identify and quantify all different forms of sugars as off-pathway intermediates in the conversion of sugars to plastic (Figure 1).



Scheme 1. . Equilibrium between glucose and fructose in methanol using Sn-beta as catalyst the presence of Lewis acidity catalyzes the isomerization while the Brønsted acidity promotes the formation of methyl glycosides.

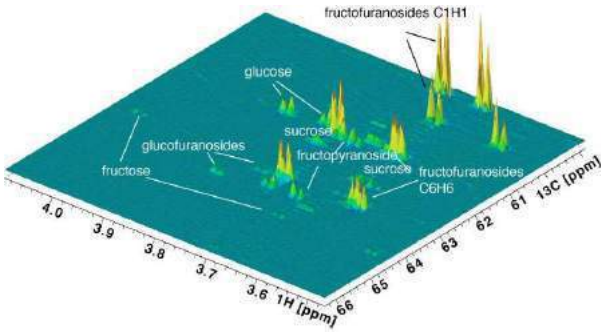


Figure 1. In the ^{1}H-^{13}C HSQC spectra of the reaction mixtures it is possible to identify and quantify sugars and their methyl glycosides in their pyrano-furano and alfa-beta forms.

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