

Exploitation of Inulin-type Fructans (ItF) from Chicory Roots for the Production of Platform Chemicals

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Around 76,042 tons of Inulin-type Fructans (ItF) can be provided annually in Europe by cultivating of Chicory (*Cichorium intybus* L.) roots with 15-20 g⁻¹ ItF fresh weight. In a bio-economical approach, roots of a poor quality and roots after the Chicory salad production can be used for the production of the platform chemicals under hydrothermal conditions [1].

Among the group of platform chemicals the furfurals, which are listed under the top 10 of added value bio-based chemicals by the US Department of Energy, are very important for the replacement of chemical building blocks from fossil carbon sources [2]. One representative is 5-Hydroxymethylfurfural (5-HMF) which is an attractive platform compound for various chemical transformations due to its two different functional groups.

Promising experiments in 15 ml batch reactors with model ItF with a DP of a maximum of 36 (Sigma-Aldrich Co. LLC.) and further ItF with lower DP (BENEO GmbH) in three mineral acids at reaction temperatures between 100 and 160 °C for 3, 20 and 60 minutes were conducted. It was proved that ItF can easily be hydrolysed into its fructose monomers by acid catalysts which will also promote dehydration step to 5-HMF. Diluted nitric acid as reaction medium showed the best results for conversion of D(-)-Fructose (41 mol% 5-HMF) and ItF with a DP of 2-8 (38 mol% 5-HMF) at 160 °C for 3 minutes (HPLC; column: Li Chrospher 100 RP-18; mobile phase: 90 : 10 water : acetonitrile at 20 °C) but type of mineral acid is not influencing molar yields of 5-HMF heavily.

Low-temperature storing after harvesting up to the mid of October and subsequent forcing of the roots for Chicory salad production, which is accompanied by further breakdown, mainly of the larger ItF, are assumed to be advantageous for higher yields of 5-HMF.

For this reason, further experimental studies in a half-continuous lab-scale plant have to be conducted to find out which is the critical reaction during hydrothermal treatment of ItF – hydrolysis or dehydration – as well as to provide a data basis for modeling the process.

References

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