Developing new methods to produce bioderived molecules from carbohydrates and biomass

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Bioplatform molecules have been identified as versatile molecules that can be produced from biomass, such as wood and algae, and be further converted into various useful, high-value products. The use of bioplatform molecules is anticipated to provide a renewable alternative for many petroleum-based products, including fuels, specialty chemicals and monomers. One of the most widely studied bioplatform molecules is 5-hydroxymethylfurfural (HMF) due to the versatility of its hydroxyl, aldehyde and furan ring functionalities that can be utilized for further conversion. There are, however, challenges that have emerged with the use of HMF. For example, HMF is easily converted into humins, an unwanted polymeric side-product, during its production and storage. Additionally, HMF can be difficult to isolate due to its high polarity. With these challenges in mind, this work has studied alternative routes to produce similar bioplatform molecules to HMF and bioproducts produced from HMF.

5-chloromethylfurfural (CMF), a structurally and functionally similar molecule to HMF, has been proposed by Mascal[1] as an alternative to HMF. A new method for the production of CMF using a semi-batch flow system was developed, where toluene and cyclopentyl methyl ether were explored as alternatives to the chlorinated solvents currently used in obtaining high yields of CMF. Compared to a batch system, the semi-batch flow system allowed for improved yields of CMF while using these alternative solvents. To investigate the benefits or drawbacks of CMF compared to HMF, CMF was studied as a substrate in a variety of reactions to produce biofuel precursors and monomers. Lastly, alternative one-pot reaction methods for synthesizing select bioproducts have been studied to produce and use HMF *in-situ* without requiring its isolation. These methods are advantageous and could provide a less environmentally and economically costly route to produce desired chemicals directly from biomass.

[1] M. Mascal, E. B. Nikitin, *ChemSusChem* **2009**, *2*, 859–861.