DEHYDRATION OF PLANT DERIVED SUGARS UTILIZING IRON (III) AND MOLYBDENUM (V) CATALYSTS IN A BIPHASIC REACTION MEDIUM

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Many valuable organic compounds and fuels are currently derived from a finite source of fossil derived oil. However, by using plant material these compounds can be derived from a renewable carbon resource. The plant cell wall is composed of three major polymers, lignin, cellulose, and hemicellulose. These polymers have the potential to yield basic building blocks in the form of phenolic compounds (lignin) and simple sugars (cellulose, hemicellulose). Sugars, like glucose, mannose, and xylose, can be dehydrated to form desirable platform chemicals. Transition metal salts can be used to isomerize glucose into fructose and then facilitate the subsequent dehydration to compounds such as 5-hydroxymethylfurfural (HMF) or levulinic acid (LA). Prior work has shown successful sugar transformation with chromium salts, however the high toxicity of Cr makes it an undesirable choice. Inexpensiveness, abundance, and minimal toxicity make metals like Fe and Mo attractive alternatives to Cr. By using a biphasic reaction medium, products can be extracted into the organic layer (2-methyltetrahydrofuran) away from the aqueous catalyst to prevent unwanted decomposition. Microwave heating techniques allow for increased reaction reactivity and selectivity. In addition to Lewis Acid metal salts, addition of Brønsted Acids can also enhance reactivity. Metal salts, such as $FeCl_3 \bullet 6H_2O$ and $MoCl_5$, each have an affinity for the conversion of fructose and glucose into dehydrated products and have produced HMF, LA, and formic acid (FA) as major products. Reaction conditions can also be manipulated to favor HMF or LA as the major product formed. Through the use of readily available metal catalysts and green reaction solvents, optimized reaction conditions for simple sugars can soon be applied to raw biomass material.