

Conversion of Food Waste to Levulinic Acid Utilising a Catalytic Membrane Reactor

¹Zhexi Zhu, ¹Xianghong Qian, ²S. Ranil Wickramasinghe and ³Davar Sasongko

¹*Department of Biomedical Engineering, University of Arkansas, USA*

²*Department of Chemical Engineering, University of Arkansas, USA*

³*SIEV Technologies LLC, Arkansas, USA*

Abstract

Food waste is a growing environmental and societal concern, especially as population growth and urbanisation continues to increase. However, food waste represents an abundant material that can be used as biomass feedstock for the synthesis of valuable bio-based chemical intermediates. One such chemical is levulinic acid (LA). LA is a C5 chemical intermediate that holds tremendous potential as a building block chemical for the synthesis of a wide number of compounds including plastics, polymers, agrochemicals, and biofuels. Here, food waste from vegetables and other starch-based food groups have been investigated for its conversion to LA using a unique solid acid catalyst immobilised on a membrane substrate. This one-pot conversion process using a novel enzyme-mimic catalyst offers many benefits over other technologies that rely on corrosive homogenous acids or toxic metal-based catalysts. Additionally, the porous membrane enables the immediate separation of the LA product from the feed stream, driving the reaction to completion and improving the yield. Lastly, hot water extraction as a pre-processing step was found to be effective in removing some of the proteins that can adversely affect the conversion reaction. For starch-based food waste such as rice and noodles, over 90% levulinic acid yield was obtained. For more recalcitrant cellulosic vegetables, 50% levulinic acid yield was achieved, indicating the promising potential of the technology for food waste utilisation.

Keywords: catalytic membrane reactor, biomass conversion, food waste, levulinic acid