

Catalytic Strategy for Conversion of Triacetic Acid Lactone to Potassium Sorbate

Background/Objective

The increasing demand for fuels and chemicals produced from sustainable carbon sources has led to a growing interest in using biomass as a renewable feedstock. In particular, 4-hydroxy-6-methyl-2-pyrone (also denoted as triacetic acid lactone or TAL) is a platform chemical that can be converted into a wide range of molecules typically derived from petrochemicals. Sorbic acid and its salt potassium sorbate (KS) are commercially valuable end products that are widely used as antimicrobial preservatives in the food industry. The commercial manufacturing process for KS currently uses sorbic acid as an intermediate. Here, we propose a new approach for producing KS directly from TAL without sorbic acid as an intermediate.

Approach

- Developed a three-step process: hydrogenation of TAL into 4-hydroxy-6-methyltetrahydro-2-pyrone (HMP), dehydration of HMP to parasorbic acid (PSA), and ring-opening and hydrolysis of PSA to KS.
- Developed a three-step reaction kinetics model for dehydration of HMP into PSA.
- Utilized tetrahydrofuran (THF) for the purification of the TAL-derived KS (TAL-KS).

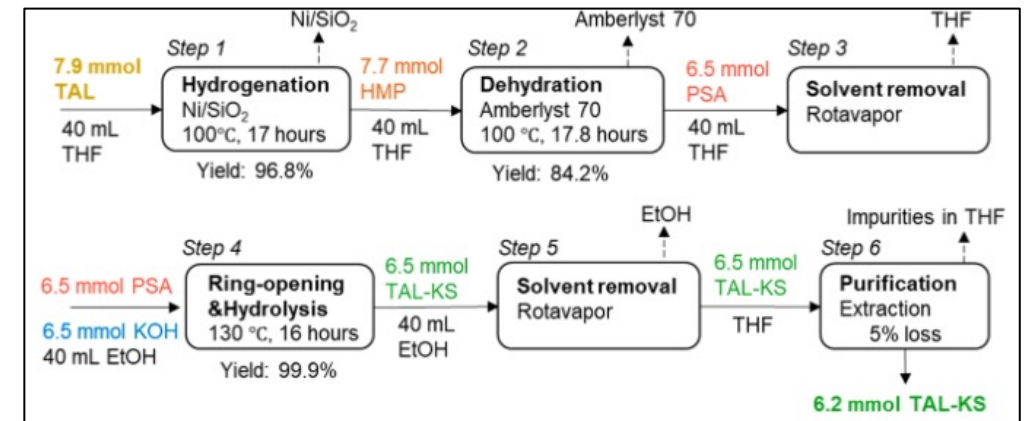
Results

- The reaction kinetics model for HMP dehydration showed the highest PSA yield at low temperatures.
- Experimentally obtained an 84.2% PSA yield with respect to TAL, which aligned with the model prediction, and subsequently obtained a >99.9% yield of KS from PSA.
- TAL-KS had a purity of 95.5% and an overall yield of 77.3% with respect to TAL, and it showed similar antimicrobial activities as commercial KS.

Significance/Impacts

This is the first known study to synthesize KS directly from TAL, providing an alternative and more efficient route for production and could contribute to the development of biobased food preservatives.

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Overall process of TAL-derived potassium sorbate.