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Green Chemical Methods for Reduction of Levulinic Acid

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ABSTRACT

This paper reports the production of ethyl 4-hydroxy valeric acid by Green synthetic routes by using two ecofriendly techniques of biocatalytic and electrochemical reduction of levulinic acid. For bicatalytic reduction Baker's Yeast was used. Conditions for electrochemical reduction were explored by the use of cyclic voltammetric investigation in different pH and scan rates. Electrochemical reduction was carried out by electrolysis method using stainless steel (SS-316) electrodes galvanostatically. The reduction products were isolated and purified by chromatographic techniques and characterized on the basis of spectral analysis.

Key words*: Levulinic acid, Baker's yeast (BY), Biocatalytic reduction, Cyclic voltammetry, Galvanostatically, Stainless steel Electrode (SS-316).*

Introduction

Unforeseeable resources of fossil fuels and their rising demands have directed researchers towards the search of alternative feed stocks for chemical industry and fuels. In recent years, use of renewable biomass for production of chemicals and fuels has attracted much attention. The biomass based chemical production is considered as sustainable and environmentally benign process. In this regard, transformation of lignocelluloses into platform molecules, which can be then further, converted into a variety of valuable chemicals or fuels under desirable mild conditions. Researchers, from past many years are working for production of glucose and levulinic acid through hydrolysis of cellulose in aqueous medium.

Levulinic acid on reuction gives ã-hydroxy valeric acid which is a versatile building block with high chemical reactivity and can be catalytically converted into valuable chemicals and fuels like α-valerolactone (GVL), 5-aminolevulinate, diphenolic acid etc that can be used in flavoring, fragrance industries and addictives in diesel and biodiesel. Among them γ-valerolactone is promising C5-building block has variety of applications like as a fuel addictive, lighter fluid as solvent etc. Thus production of GVL from lignocelluloses biomass is in much interest in recent years. Generally, GVL can be produced through selective hydrogenation of biomass derived levulinate esters on either homogenous or heterogeneous catalysts. Use of homogeneous catalysts has drawbacks of catalyst synthesis, recovery and recycling. While use of heterogeneous catalysts like supported hydrogenation based on noble metals like ruthenium, palladium and gold have disadvantages like high cost, hard manufacture and vulnerability to poison. Thus, search of environmental friendly green methods is very essential.

Thus, present study focuses on most active areas of Green Chemistry research and development i.e. application of biocatalysts and electro analytical methodology developments in conventional organic