

SHORT ABSTRACT

The current study focuses on physico-chemical characterization and pretreatment of three commonly available lignocellulosic biomasses of North-East India such as Castor (*Ricinus communis*), Jatropha (*Jatropha curcas*), and Miscanthus (*Miscanthus Sinensis*) for second generation biofuels production. It was found that the cellulose content of three biomasses varied from 40% to 44%, hemicellulose content from 8% to 14% and lignin content varied from 21% to 30%. Chemical structure of lignocellulose is studied through FTIR. The crystallinity index of Castor and Jatropha was similar, i.e., 69%, whereas crystallinity index of Miscanthus was 72%. Due to the presence of higher carbon and cellulose content along with less moisture (10%–12%), ash (5%–10%), sulphur (0.1%–0.8%), and extractives (12%–20%) makes them very good feedstock for the production of alcoholic fuels through biochemical route. Thermogravimetric analysis of these three lignocellulosic biomass under high purity nitrogen atmosphere were carried out over a temperature range of 25 °C–900 °C at three different heating rates of 10, 15, 20 °C min⁻¹. The activation energy and pre-exponential factors were calculated by applying two model-free methods and compared. The kinetic parameters obtained from Kissinger and Ozawa methods were in good agreement with the experimental results. The value of kinetic parameters explained the thermal stability of the biomass. The thermal analysis could not infer the composition and chemical structure of lignocellulosic biomass; hence FTIR spectroscopic analysis has been carried out.

Bioethanol production from lignocellulosic feedstock is considered one of the most promising as it is abundant, cheap and renewable resource. The maximum yield of glucose from biomass requires efficient pretreatment and process optimization is needed to locate the best operational conditions. The efficiency of pretreatment is evaluated in terms of sugars yield, biomass structure alteration and ethanol yield. In the present study, optimization of dilute sulphuric acid pretreatment of Miscanthus followed by enzymatic hydrolysis and fermentation for production of bioethanol was carried out. Response surface methodology was employed for the simultaneous analysis of pretreatment conditions such as substrate loading, acid loading and pretreatment time on crystallinity (CrI %) of solid fraction and amount of xylose and arabinose (X+A) g L⁻¹ present in the liquid fraction. Saccharification results showed that the yield of glucose was higher (0.81 g/g cellulose) for the 5% pretreated biomass (X+A) at 20 (FPU/g dry biomass) enzymes

loading. The combine effect of anions of ionic liquids (IL) and anti-solvents on pre-treatment and dissolution mechanism of biomass is not well studied. To reveal the above effect, three different ionic liquids containing fixed cation ([EMIM]⁺) but varied anions were studied for Miscanthus dissolution. Results showed that, [EMIM]⁺[Ac]⁻ was very good in altering the cellulose structure and crystallinity followed by enzymatic digestibility with a sugar yield of 0.98 (g/g of cellulose). The regenerated biomass with water-acetone mixture (1:1 v/v) as anti-solvent resulted in higher glucose yield. The hydrogen bond basicity (β value), correlated well with cellulose crystallinity, lignin removal and glucose yield. *N,N*-diethyl-4-nitroaniline (99% pure) was synthesized and its yield was higher with polar protic solvent (C₂H₅OH) and at higher reaction temperature.

