



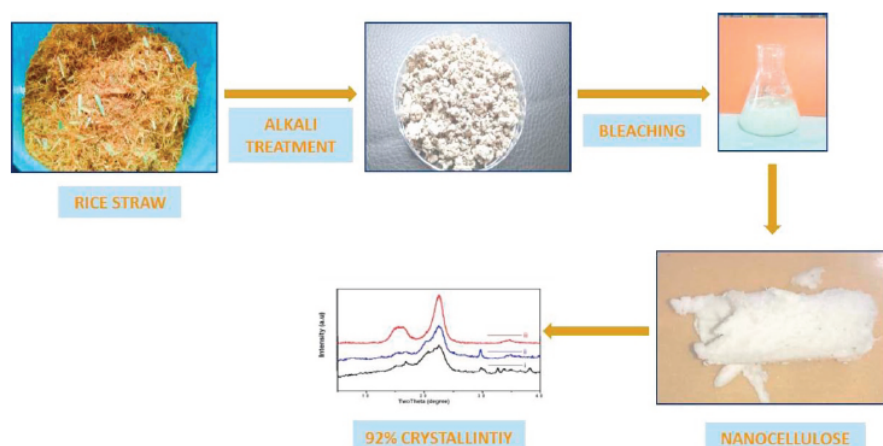
Cellulose nanofibers from rice straw: Process development for improved delignification and better crystallinity index

Amita Sharma^{1,2}, Tamal Mandal² and Saswata Goswami^{1*}

¹Center of Innovative and Applied Bioprocessing, Knowledge City Sector-81, Mohali, Punjab-140306.

²Department of Chemical Engineering, National Institute of Technology, Durgapur-Mahatma Gandhi Avenue, West Bengal, Pin-713209

Graphical Abstract



Abstract

The aim of this work was to study the effect of alkaline pretreatment and delignification methodology on rice straw (RS) for the production of cellulose nanofibers (CNF). RS was treated with 12% (w/v) NaOH at 120 °C for 90 minutes, which resulted in alkaline cellulose fibers (ACF) with 31% yield. Further delignification of ACF with 5% (w/v) sodium chlorite at 70 °C for 60 minutes resulted in α-cellulose. Both the pretreatment and the delignification protocols were optimized by Response Surface Methodology (RSM). Subsequent mechanical treatment with high pressure homogenization (150 MPa pressure) converted α-cellulose into nanocellulose with minimum residual lignin content of 1.32% and crystallinity index around 92% by X-ray diffraction (XRD). The confirmation of removal of lignin was supported by FTIR and TGA studies. The dimensions of the nanocellulose particles derived from rice straw was in the range of 10-50 nm as observed by Transmission Electron Microscopy (TEM).

Keywords: α-cellulose, Cellulose nanofibers, High pressure homogenization, Response surface methodology, Rice straw

1. Introduction

Agricultural residues, such as rice straw, wheat straw, banana rachis, sisal, kapok, are abundant lignocellulosic bio-based feedstock to valorize, both for the purpose of nonedible material preparation as well as for the green impact towards the environment.¹ In India rice is a widely grown crop that leaves substantial

quantity of postharvest straw in the field. Rice straw (dry stalks of rice) can be defined as an underutilized by-product. Current uses of rice straw include fuel for cooking, animal bedding, animal feed, building materials and composting. But majority of rice straw about 70-80 MMT per year is disposed off by burning. However, rice straw burning causes lung and respiratory diseases to the human being, soil erosion

* Corresponding author : Dr. Saswata Goswami
E-mail: saswata@ciab.res.in
Tel: 0172-5221442