Cellulose from lignocellulosic biomass: Extraction and characterization

Subhanki Padhi and Winny Routray

Department of Food Process Engineering,

National Institute of Technology, Rourkela-769008, India

Email: routrayw@nitrkl.ac.in

Abstract

The objective of this work is to isolate and characterize the cellulose from lignocellulosic biomass using alkali hydrolysis and bleaching process. The cellulose was extracted from lignocellulosic biomass by using alkali hydrolysis followed by bleaching process. The alkali hydrolysis was done at different concentrations of NaOH (3 – 5%). The obtained cellulose was characterized by using X-ray diffraction (XRD) for crystallinity, scanning electron microscopy (SEM) for microstructural analysis and Fourier transform infrared spectroscopy (FTIR) for understanding the secondary structural changes that undergoes during the extraction process. The yield of cellulose was higher at 4% NaOH concentration and was 26.7%. The SEM images showed that with the removal of non-cellulosic components the cellulose shows rough surface with fibrillation. The XRD analysis showed that the cellulose had higher crystallinity than the raw powder. The FTIR data confirmed the removal of lignin and hemicellulosic contents from the biomass after alkali treatment and bleaching process. The cellulose obtained from this study can be further used for different food applications such as in packaging films, structural modifiers, stabilizers, texture modifiers and for designing functional foods by changing the colloidal state of cellulose.

Keywords: Cellulose, Extraction, Lignocellulosic biomass, Alkali hydrolysis

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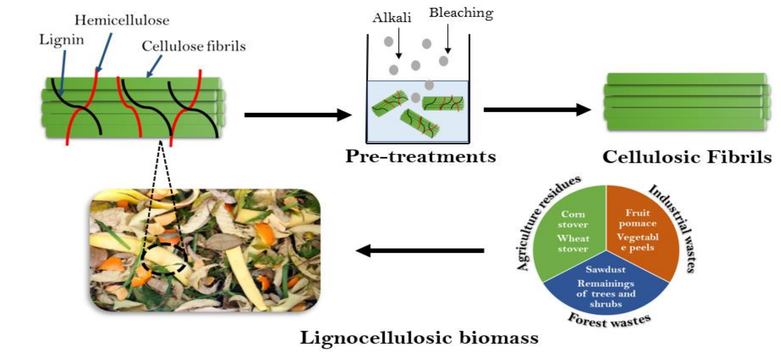
Introduction

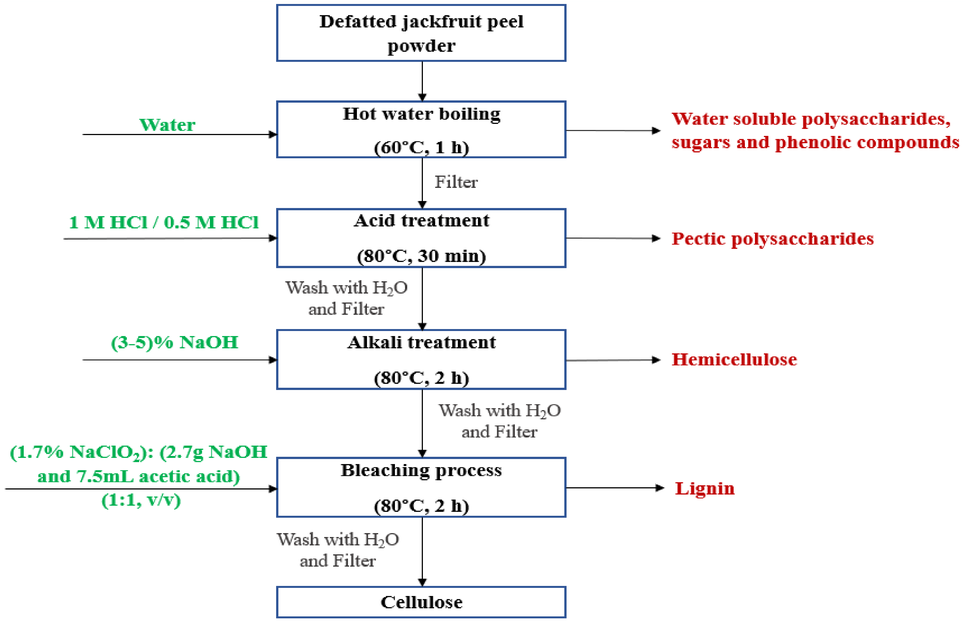
Cellulose is considered a natural or organic polymer, biodegradable in nature. Cellulose is found in the green plants' primary cell wall and accounts for about 35% to 50% of natural fibre composition. Cellulose can also be produced in small quantities by different sea animals, bacteria, and fungi. Cellulose is extensively used owing to its lower cost, biocompatibility, lesser density, renewability, chemical modifications and biodegradability. The cellulose has different food applications such as in packaging films, structural modifiers, stabilizers, texture modifiers and for designing functional foods by changing the colloidal state of cellulose. Lignocellulosic biomass is rich in cellulose, hemicellulose and lignin.



Objective

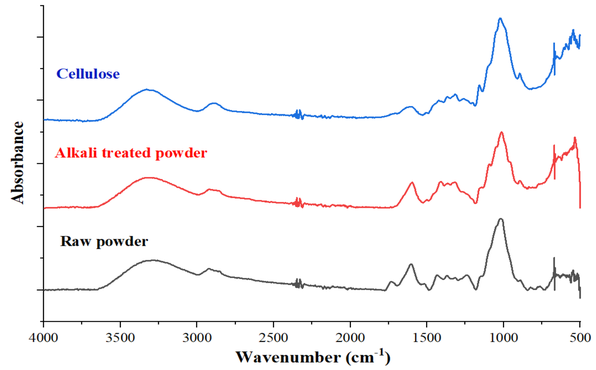
Isolate and characterize the cellulose from lignocellulosic biomass using alkali hydrolysis and bleaching process.

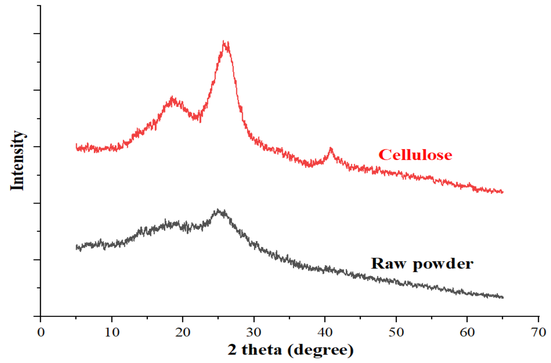
Methodology

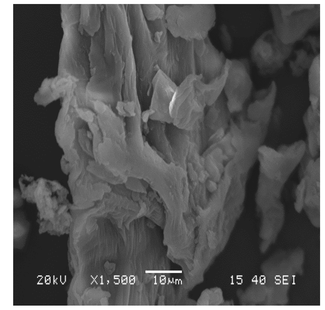


Results and Discussions

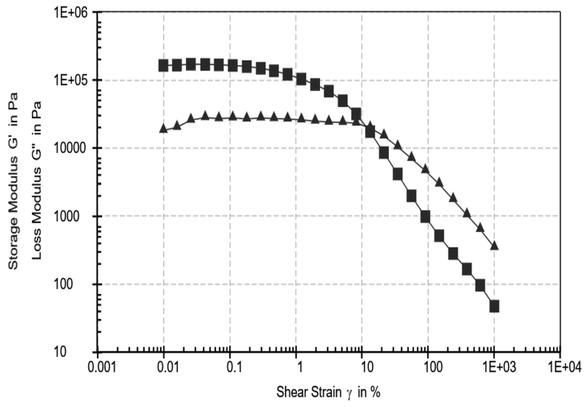
The yield of cellulose was higher at 4% NaOH concentration and was 26.7%.

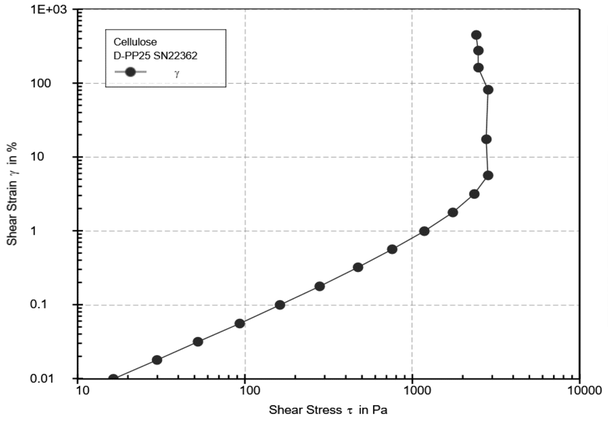


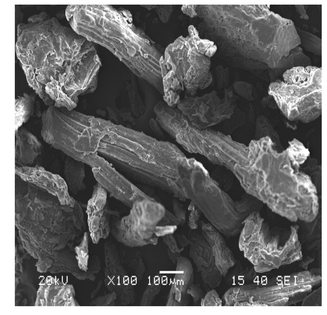




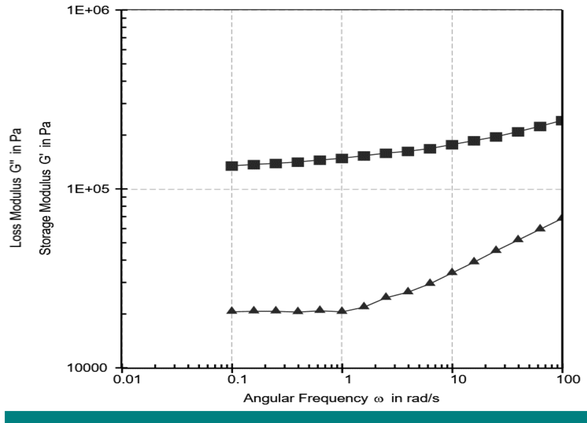
Raw powder

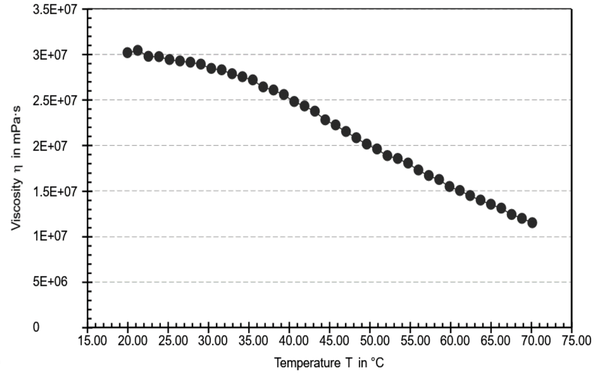


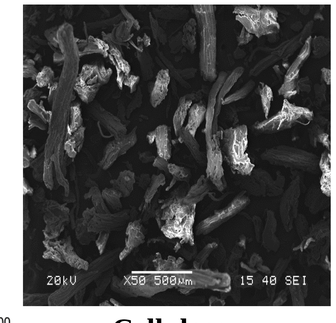




Alkali treated powder







Cellulose

Conclusion

The use of lignocellulosic biomass for isolation of cellulose reduces the waste generation and enhances economy. The removal of lignin and hemicellulose was confirmed from FTIR analysis. The XRD analysis showed that cellulose had higher crystallinity than raw powder. The viscosity and dynamic rheology of the obtained cellulose was studied.

References

Wu, C., McClements, D. J., He, M., Zheng, L., Tian, T., Teng, F., & Li, Y. (2021). Preparation and characterization of okara nanocellulose fabricated using sonication or high-pressure homogenization treatments. *Carbohydrate Polymers*, *255*, 117364.
Yuan, T., Zeng, J., Wang, B., Cheng, Z., & Chen, K. (2021) Cellulosic fiber: mechanical fibrillation-morphology-rheology relationships. *Cellulose*, *28*(12), 7651-7662.

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