

## Synthesis of Cellulose Nanoparticles from *Panicum maximum* and their Application in Gas Filtration

A. H. M. Y. Nilmani<sup>1</sup>, N. Priyantha<sup>2</sup>, M. B. Wijesinghe<sup>3\*</sup>

Department of Chemistry, University of Peradeniya, Peradeniya, Sri Lanka

\* [manjulaw@sci.pdn.ac.lk](mailto:manjulaw@sci.pdn.ac.lk)

Air pollution is a significant global environmental issue. Excessive levels of oxides of carbon, nitrogen, and sulfur oxides cause a wide range of environmental complications, leading to various health problems. Environmentally friendly, economical, and sustainable approaches are essential to treat polluted air. Among various air filtering methods, such as electrostatic precipitation and chemical filtration, mechanical filtration and adsorption are more popular due to their low cost. Air filters made of synthetic polymers are non-biodegradable. The development of affordable membranes and adsorption materials for air filtering contributes to creating efficient devices to meet current and future global demand. This study aims to establish a green synthesis process for producing cellulose nanoparticles from the invasive and abundant weed *Panicum maximum*, which has no commercial value, to develop a gas-filtering device based on the membrane filtration technique. Cellulose nanoparticles possess high surface area, mechanical strength, and biodegradability. The dry grass sample was mechanically ground into fine powder (<63  $\mu\text{m}$ ), followed by delignification and bleaching to extract cellulose. The sample was de-lignified using NaOH, and it was neutralized through multiple washing steps. Subsequently, the sample was bleached with

NaClO, resulting in highly purified cellulose compared to the unbleached sample, as confirmed by Fourier Transformed Infrared Spectroscopy (FTIR) analysis. The purified cellulose was then hydrolyzed with formic acid to produce cellulose nanoparticles. These particles were analyzed using a granulometer, and it was revealed that the nanoparticles ranged in size from 4–170 nm. Scanning electron microscope (SEM) analysis revealed that the synthesized particles appeared in aggregated nature with particle size around 100 nm. To perform gas filtration using synthesized cellulose nanoparticles, cotton fabrics coated with these nanoparticles were tested for CO<sub>2</sub> filtration using a home-built setup. Preliminary experiments revealed a 90 ppm reduction in CO<sub>2</sub> concentration. Filtration optimization is currently being conducted by our group.

### Keywords:

*Panicum maximum*, cellulose nanoparticles, gas filtration

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