Synthesis of Eco-Friendly Biocompatible Membranes and Filters from Sugar Cane and Banana Byproducts

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Masks and synthetic air filters lose their efficiency and become chemical contaminants and hosts for biological pests. With the increased demand for face masks, environmental concerns are exacerbated as filters are typically made of nonbiodegradable material resulting in over 200 tons of nonbiodegradable waste annually. This research aimed at replacing the nonbiodegradable polymers in filters with cellulose extracted from sugar cane bagasse (SUG) and banana midrib (BAN) using sodium hydroxide (NaOH) at various concentrations and sonication times, and further treated with solutions including formic acid, acetic acid, and hydrogen peroxide. The extracted cellulose was characterized mechanically, morphologically, and chemically. Its thermal stability and decomposition were evaluated along with pore size distribution and filtration efficiency. The various treatments affected the extracted membranes' strength, filtration efficiency, and cellular viability. The increase of NaOH in the basic treatment of the cellulose resulted in a decrease in fiber diameter from 13 to 4 μm ($p < 0.0001$) and a decrease in ultimate tensile strength from 80 to 45 MPa ($p < 0.001$). Increasing sonication times also decreased fiber diameter from 4 to 1.7 μm ($p < 0.001$). Treatment of the cellulose membranes with base, acid, and finally bleach resulted in fewer impurities, as determined by TGA graphs, and an improvement in cellular attachment. This work provides an environmentally sustainable alternative to filters and personal protective equipment through the production of biodegradable filter membranes using cellulose from natural byproducts such as SUG and BAN.