Nanofibers from soybean straw: a comparison between enzymatic and acid hydrolysis extraction processes

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Abstract: Soybean straw (SS) is a lignocellulosic agro-industrial residue available in large quantities throughout the world and considered a rich source for obtaining cellulose nanofibers (CN). At present, most of the methods used to extract CN are based on acids hydrolysis. In this work, both acid and enzymatic hydrolysis was used and compared in SS nanofibers extraction. The first process comprises alkali reaction (NaOH 5% a 30ºC por 15h) and bleaching (H_2O_2 4%) in order to purify the residue (TSS). Acid hydrolysis was carried out for 40 min at 40º C, using 30mL of H_2SO_4 (64%)/g TSS. The enzymatic treatment was performed using commercial enzymes (xylanase/cellulases) for 42h (50ºC, pH 4.0). After hydrolysis, the suspension was homogenized using a Ultraturrax disperser (5 min) followed by sonication (3 min). Mass concentration, morphology and size (Transmission Electron Microscopy) and surface charge (Zeta Potencial), were the characterization conducted in CN. CN from chemical or enzymatic treatments presented good colloidal suspension stability (Zeta potential: -23 mV) and similar values of particle diameter (around 15 nm). However, only the chemical hydrolysis showed to be efficient in obtaining nanowhiskers of 180 nm length. The extraction by chemical hydrolysis was less efficient, yielding not more than 5% (g CN/100g cellulose) when compared to enzymatic process (13%). Further studies are under progress to determine CN crystallinity index and thermal degradation. The present work confirmed that enzymatic treatments do have potential to be applied in obtaining CN from lignocellulosic materials. In addition, a rich soluble fraction of reducing sugars can be obtained (around 14g/100g) from the straws. Therefore, enzymatic processes are more environmentally friendly and suitable for application either for nanofiber extraction or for clean energy productions.

Acknowledgments: FAPESP for the postdoctoral (2012/22154-7) and IC (2014/02432-8, 2014/02801-3) fellowships.