CELLULOSE NANO WHISKERS FROM OIL PALM FIBERS

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ABSTRACT

The aim of this work was to obtain and to characterize nanocellulose from pressing mesocarp oil palm fibers. In this way, previous to hydrolysis, oil palm fibers were submitted to alkaline pre-treatment followed by bleaching with hydrogen peroxide. Nano whiskers were obtained by acid hydrolysis at 45 ºC, using H_2SO_4 60% (w/w), and were characterized by x-ray diffraction and transmission electron microscopy (TEM). According to the results, the pre-treatment step was efficient, favouring acid attack until obtained nanocellulose particles.

INTRODUCTION

Oil palm (*Elaeis guineenses*) fibers are considered as one of the agroindustrial residues with potential source of lignin and cellulose. This waste is generated during the process of palm oil extraction, a product with established market. For every ton of palm oil produced, are generated approximately two tons of waste including empty fruit bunches, fibers and shells that would be discarded into the environment (CEPLAC, 2010). The biomass from pressed oil palm mesocarp is an excellent source of fiber rich in lignin and cellulose. It can be has different uses since feed till to the development of biodegradable materials such as biocomposites (Khalil, 2006), and also as a source for extracting lignin and cellulose.

One of the most studied treatments to obtain cellulose crystals, also known as whiskers, is acid hydrolysis. In this treatment occurs removal of cellulose amorphous region, acid soluble, and consequent increasement of its crystallinity. The more used stronger acids are sulphuric and hydrochloric (Silva, 2009). Specific processes must be developed for each cellulose source due to lignocellulosic material has different proportions of lignin and hemicellulose as well as changes in the molecules arrangement.

RESULTS AND CONCLUSIONS

Previous to hydrolysis, oil palm fibers were submitted to alkaline pre-treatment with NaOH 2% (w/v) at 80ºC during 120 min followed by bleaching with a solution of H_2O_2 20% (v/v) and NaOH 4% (w/v) at 55ºC for 90 min. Chemical analysis to compare natural and treated fibers revealed that chemical treatments on oil palm fibers were effective for removing 36% of lignin initially present. In addition, the percentage of alpha-cellulose had an increasing of 20.5% to 64.1%, from natural to treated fiber, respectively.

After bleaching, nanowhiskers were obtained by acid hydrolysis at 45ºC, using H_2SO_4 60% (w/w), during 150 min. The material was characterized using x-ray diffraction and transmission electron microscopy (TEM). Table 1 shows the crystallinity index of studied materials. The parameter to determine the fibers crystallinity was using X-ray diffraction

angle 2θ between 10º and 50º. Chemical treatment of breaching and hydrolysis improve the remotion of amorphous fraction, as lignin and hemicellulose, resulting in an increased crystallinity.

Table 1 Crystallinity index of cellulosic samples from oil palm

Sample	Crystallinity Index (%)
Natural Fiber	38.5
Bleaching Fiber	56.8
Nanocellulose	70.9

Through the nanocellulose micrographs obtained by TEM (Fig. 1), nanoparticles of elongated structures and dispersed were visualized. According to the measurements, the length (L) of the oil palm fibers nanostructures ranged near to 171.76 ± 14.91 nm and the diameter (D) to average 5.48 ± 0.48 nm, corresponding to a ratio aspect (L / D) 35.35 ± 3.37.

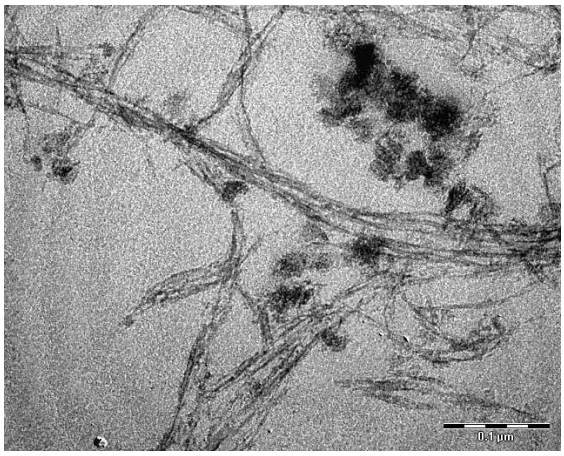

Fig.1 Micrographs, obtained by TEM, of nanocellulose extracted from pressing mesocarp oil palm fiber.

This results showed that the pre-treatments were efficient, favouring acid attack and nanocellulose obtaining.

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