Green synthesis of cellulose Nanoparticles for their use in biomedicine

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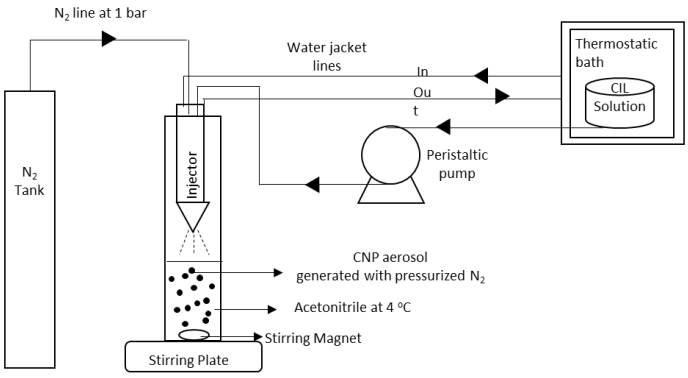
Recently, nanoscience has been developed as a new branch of science to obtain material at the nanometre scale. Cellulose is a polysaccharide whose molecular structure consists of D-glucopyranose units linked by β(1→4) glycosidic bonds that form a linear structure. The use of cellulose, a biodegradable and biocompatible biopolymer [1], for the synthesis of nanoparticles, together with a synthesis procedure with low energy demand and the use of ionic liquids as solvents for the biopolymer [2], meets both the requirements of nanomedicine and the principles of green chemical engineering.

In this work, the synthesis of cellulose nanoparticles (CNPs) using the ionic liquid 1-ethyl-3-methylimidazolium acetate has been investigated and optimised to obtain nanoparticles with good capability for drug carrying. Two types of cellulose purchased from different suppliers were tested. Cell viability studies have been performed with a cancer cell line (HeLa) and with a healthy cell line (EA.hy926).

To obtain the CNPs the experimental setup used was previously described by Fuster et al. [3] to obtain silk fibroin nanoparticles, with modifications as shown in Scheme 1.



Scheme 1. Experimental apparatus used for the CNPs synthesis process.

The synthesized CNPs were characterised by dynamic light scattering (DLS) to determine their hydrodynamic diameter (expressed as Z-Average), Z-potential, polydispersity index (PdI) and the average values of the peaks corresponding to the intensity, number and volume distributions. Figure 1 presents the particle size distribution and Z-potential of CNP-1F (CNPs obtained with cellulose from Thermo Scientific) and CNP 2A (CNPs obtained with cellulose from Redwells).

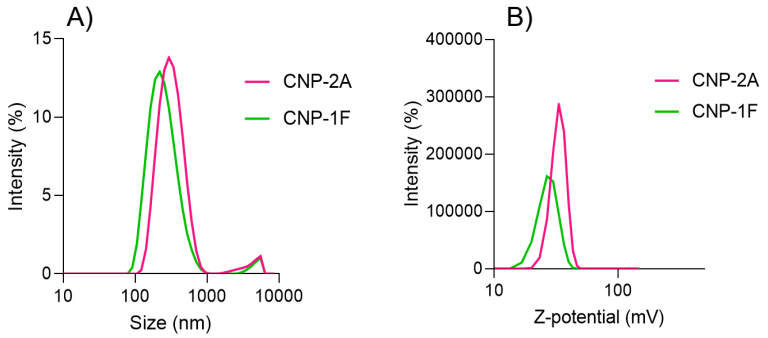


Figure 1. Particle size distribution A) and Z-potential B) of the CNP-2A and CNP-1F.

The cytotoxic effects of the CNPs have been evaluated to determine their suitability for biomedical applications. Cell viability assays were performed with Alamar blue. Assays were carried out on Human cervical cancer cells (HeLa) and Human umbilical immortalized cells (EA.hy926). The results are shown in Figure 2. It can be clearly seen that for both cell lines the cell viability is higher than 85%, demonstrating the non-toxicity of CNPs to both cancer and healthy tissue cells.

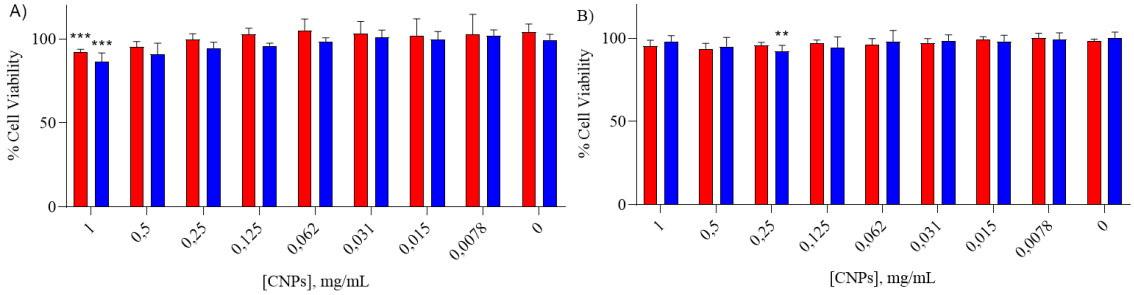


Figure 2. Cell viability assays in **A)** HeLa and **B)** EA.hy926 B) treated with CNP-1F (red) and CNP-2A (blue). The results shown represent 4 replicates per experiment. In both cell lines, untreated cells were used as controls. Values were compared using one-way ANOVA and express percent viability ± SD versus nanoparticle concentration. ** indicates $p < 0.01$ and *** indicates $p < 0.001$, compared to control.

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