Nanocellulose as a support for drug delivery: a hydrophobic interaction

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Objective

Crystalline nanocellulose (CNC) has garnered significant interest within the scientific community due to its distinct properties. It's originated from renewable sources and represent a promising, but not yet fully explored, platform for biomedical applications, such as drug delivery [1]. Despite being formed by polysaccharidic chains, CNC is characterized by an amphiphilic nature. [2] In fact, while the hydroxyl groups of the glucose units, that cover the surface of CNC, impart a hydrophilic nature to nanocellulose, the plane formed by the pyranose rings is responsible for a hydrophobic character. Such characteristic can be exploited in the interactions with hydrophobic bioactive components to decorate CNC in a supramolecular approach. As a matter of fact, it is a well-known that some drugs cannot be easily administered due to their solubility issues: Curcumin is well known example of such problem. Curcumin has potential anticancer and anti-inflammatory activity but is poorly soluble in water and hardly adsorbed by the organism. [3] So, the idea of this work is to take advantage of the biocompatibility of nanocellulose and its amphiphilic character and use it as a support for the delivery of drugs with low solubility in aqueous media.

Methods

Nanocellulose was functionalized with various compounds with a high hydrophobic character using a simple mechanochemical treatment. The CNC nanocomposites were tested for release in aqueous media, using a simple UV-Vis analysis. A characterization to unveil the nature of the interaction of CNC with hydrophobic drugs was also performed.

Results

Release studies have shown that with the increase of the hydrophobicity, moving from 2-Naphtol to Curcumin, the release of the molecules decreases as we expected. The release reaches a plateau generally after 3h, and even in the case of 2-Naphtol, the most hydrophylic compound, the maximum release is 90 %. The nature of the interactions was studied through Raman spectroscopy, that suggests a simple physisorption of the hydrophobic molecules CNC.

Conclusions

This study shows how, with a mechanochemical process, hydrophobic molecules are physiosorbed onto CNC and their release in aqueous media is correlated to their hydrophobicity. The release process revealed irreversible.

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