NANOCELLULOSE AS A CARRIER OF ACTIVE DYES

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ABSTRACT

The potential of nanocellulose consist in its modification possibilities. It can be modified easily by substances which can be chemically bounded with cellulosic -OH groups. Functionalized nanoparticles of cellulose can be used in nanocomposite area e.g. Presented work is focused on the preparation of nanocellulose and study the possibility of functionalization of nanoparticles with active compounds, such as dyes.

Key Words: cellulose, nanoparticles, reactive dyes, antibacterial properties

1. INTRODUCTION

Cellulose nanoparticles have been known for decades. Their potential lies in the easy modifiability of their properties by reactively bounded systems that can carry these properties. The topic of this work is focused on the preparation of cellulose nanoparticles and it will be investigated how the coloring of these particles can be achieved.

2. METHODES

2.1 Acidic hydrolysis

The preparation of cellulose nanoparticles under laboratory conditions was carried out on the basis of acid hydrolysis of cellulose, which is described by several authors before. [1,2] Cellulose, which was hydrolyzed, was in the form of a viscose fabric. This material was treated with 60% sulfuric acid for 48 hours at room temperature. After this time, the samples were repeatedly rinsed with distilled water and neutralized with Na_2CO_3 to pH 7.

2.2 Sonication

After neutralization, the samples were treated by ultrasound with frequency 20kHz for 2 minutes. A gel containing cellulosic nanofibers was obtained.

2.3 Preparation of functionalized nanoparticles

C.I. Reactive Red 198

Further experiments were aimed to functionalize nanoparticles. The dye C.I. Reactive Red 198 was chosen like model of active compound firstly. Application of dye in situ was not successful. Subsequently acid hydrolysis of the dyed material was carried out. The viscose fabric samples were dyed by a standard dyeing procedure. Then it was hydrolyzed by the same way as in the previous case. We obtain colored gel (Fig. 1), and it has been found, that the average amount of dye bounded to cellulose nanoparticles is around 60%, which is suitable for further use of this process.

Figure 1. Collored nanocellulose in gel form

Dye with phthalocyanine chromophore

The next step was to use a reactive dye with phthalocyanine chromophore. Phthalocyanine has a strong antibacterial property. The sampling procedure was the same as in the previous cases - input material was dyed initially, hydrolyzed and sonicated.

3. RESULTS

Antibacterial properties were tested by AATCC Method 100 - An American Standard 1993. Two bacterial strains were used: Escherichia coli - the samples showed 100% (Fig.2) inhibition and Staphylococcus aureus - the samples showed a 98% inhibition of them (Fig.3)

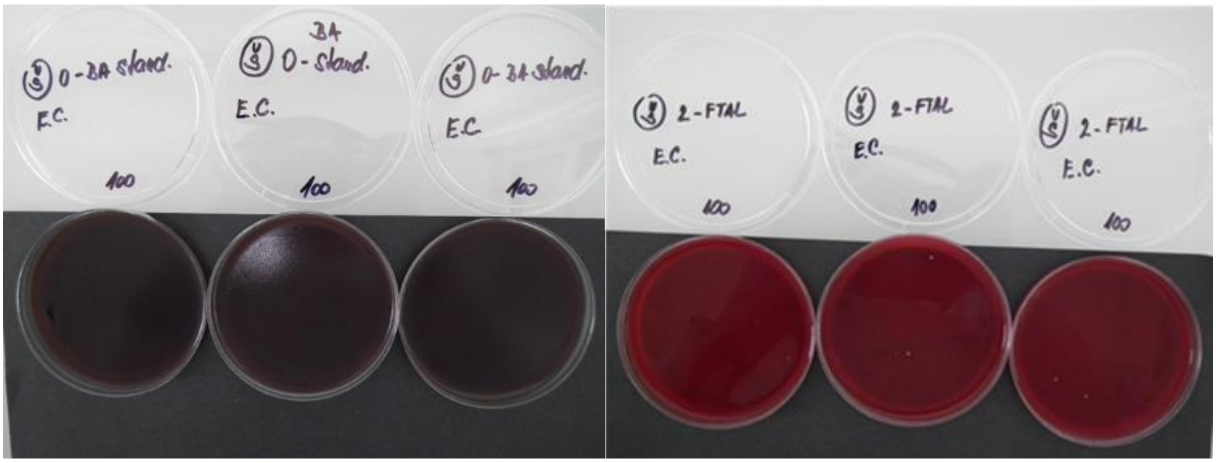

Figure 2. Inhibition of Escherichia coli (blank sample left, nanocellulose functioned by phthalocyanine dye right)

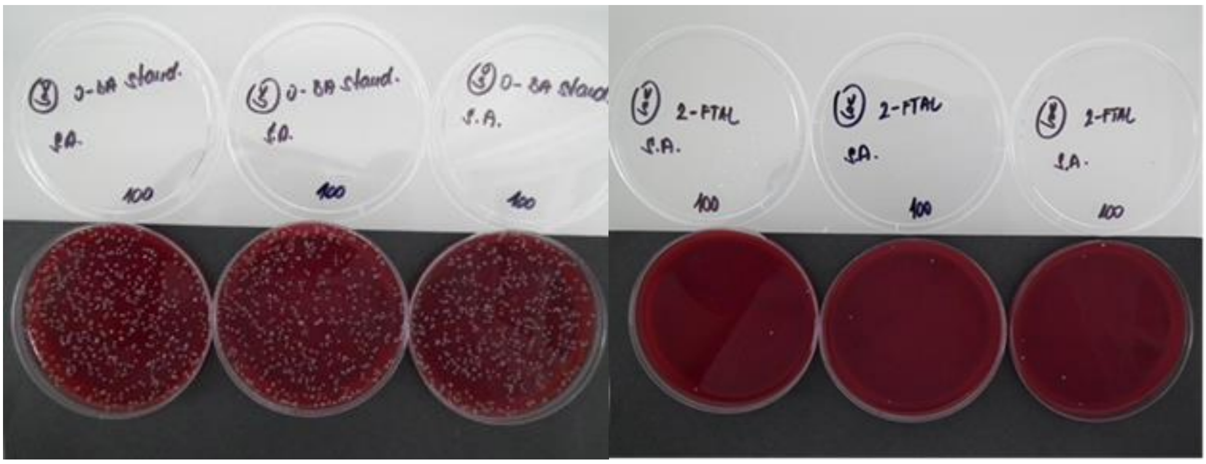

Figure 3. Inhibition of Staphylococcus aureus (blank sample left, nanocellulose functioned by phthalocyanine dye right)

4. CONCLUSION

The possibilities of dyeing and functionalization of cellulose nanoparticles were verified in this work. It was found, that the most suitable method for preparing colored/functioned cellulose nanoparticles is the hydrolysis of the pre-dyed or pre-functionalized material. With this procedure, up to 60% of the originally used compound can remains on the cellulose and properties of compound are maintained.

5. REFERENCES

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