Is wood nanocellulose a good option for biomedical use?

The tiny wood cellulose nanofibrils (Fig. 1) have been suggested for a series of different applications, including biomedical use. However, is the material adequate for such a demanding application that would require direct contact with the human body and its defenses to fight foreign objects? “Biomedical use of nanocellulose requires that the material is ultrapure and thus complies with FDA rules regarding endotoxin levels. Endotoxins are a group of bacterial toxins that can give strong immune responses in humans”, explains PhD candidate Henriette R. Nordli at the Norwegian University of Science and Technology (NTNU). Nordli and co-workers have now published an article which reports for the first time the production of ultrapure wood nanocellulose, with characteristics that show promise for biomedical use, specifically wound healing. The research activities are part of the NanoHeal project, funded by the Norwegian Nano2021 program (Grant no. 219733) and led by lead scientist Dr. Gary Chinga-Carrasco at the Paper and Fibre Research institute (PFI).

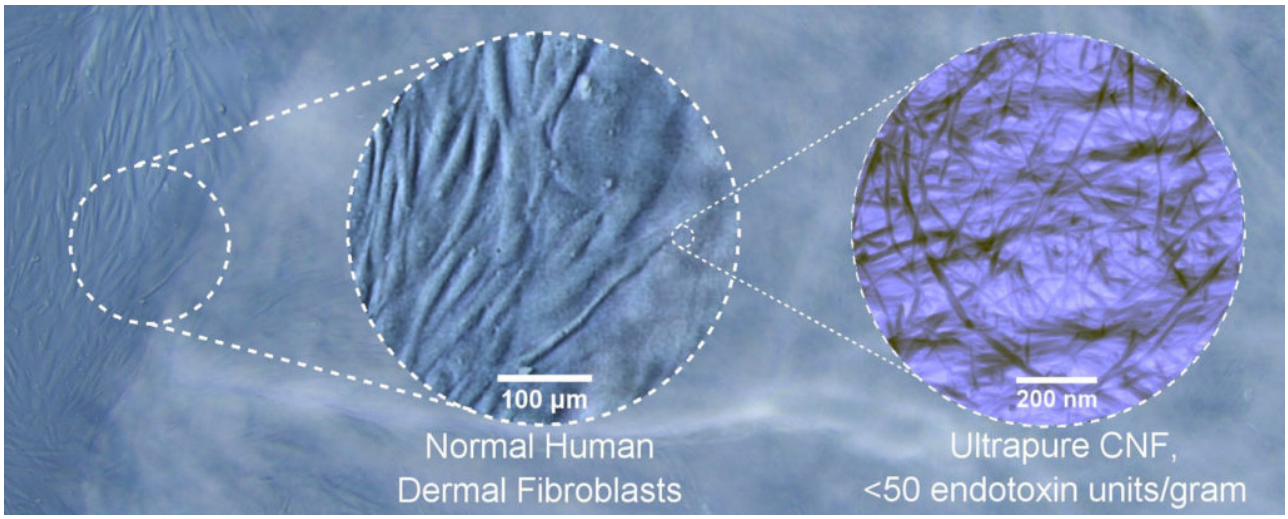

Fig. 1 Ultrapure cellulose nanofibers for wound healing applications.

Using a specific combination of pre-treatments the team produced ultrapure nanocellulose, with an endotoxin level of 45 endotoxin units/g (EU/g) cellulose. “The cytotoxic and metabolic activity”, says Nordli, “was evaluated using two types of human skin cells; fibroblasts and keratinocytes. We demonstrated that the ultrapure biomaterial was as safe as a commercially available wound dressing, used for comparison”. “Another important result was that the nanocellulose material directly exposed to the skin cells did not activate them to produce factors with an inflammatory or immunological potential. These findings indicate that the ultrapure nanocellulose is relatively inert upon direct exposure”, explains Dr. Anne Mari Rokstad at the Centre of Molecular Inflammation Research (NTNU).

A specific product that the NTNU and PFI researchers are developing is wound dressings, based on the ultrapure nanocellulose. “The moisture-holding capacity, an important characteristic of wound dressings, was high (~7500%), indicating that the material is promising as wound dressing for management of wounds with a moderate to high amount of exudate”, adds also Dr. Brita Pukstad at the St. Olavs Hospital in Trondheim, Norway.

The results of this research are most important not only for wound dressings and wound management, but also for the additional biomedical applications where the potential of nanocellulose is being explored, e.g. drug delivery and scaffolds for tissue regeneration. “We are excited about the positive outcome of this work and are in the process of publishing new promising findings within these valuable areas of research and development”, Chinga-Carrasco concludes.

PFI, Norway

Publication

Producing Ultrapure Wood Cellulose Nanofibrils and Evaluating the Cytotoxicity Using Human Skin Cells
Nordli, HR, Chinga-Carrasco, G, Anne Mari Rokstad, Brita Pukstad
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