Antiseptic wound dressings made of bacterial nanocellulose

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Background

Bacterial nanocellulose (BNC) is a novel wound dressing that consists of nearly 95% water.

This hydrophilicity allows this special wound dressing to absorb and release aqueous substances. We investigated how well BNC can absorb different water based antiseptic substances in order to create on demand antimicrobial wound dressings.

Material and Methods

Sheets of BNC-based wound dressings were placed in four different antiseptic substances. The solutions used were two PHMB-based antiseptics (Prontosan® and Lavanid®2), one Octenidine-based solution (Octenisept®), and one Povidone-iodine-based solution (Betaisodona®). Punch biopsies were taken at different time points (10, 20, 30, 60 and 120 minutes) and the concentrations of the antiseptic agent was measured using spectrophotometry. In addition, the release of the substances from the punch biopsies was examined. To test the efficacy of these novel wound dressing, the antimicrobial activity of the BNC sheets loaded with the antiseptic solutions were tested against *Staphylococcus aureus* in an adapted standardized bacterial disk diffusion assay.

Results

All antiseptic solutions showed excellent uptake into the BNC as well as release. Especially the PHMB- and octenidine-containing solutions already showed high values of antiseptic concentrations after only 30 minutes (Figure 1). The overall achieved concentrations were all highly effective against Staphylococcus aureus in comparison to commercially available reference products and were all higher than the minimal bactericidal concentration against MRSA (Figure 2, Table 1).

Conclusion: Antiseptic, water-based solutions were quickly absorbed. All tested antiseptic solutions reached effective antibacterial concentrations making them all suitable for the making of antiseptic BNC-based wound dressings. However, when using a commercially available solution and not a solution containing only the active ingredient, it must be taken into consideration that all ingredients have an effect on the uptake of the active substance and thus influence the maximum uptake and release concentration.

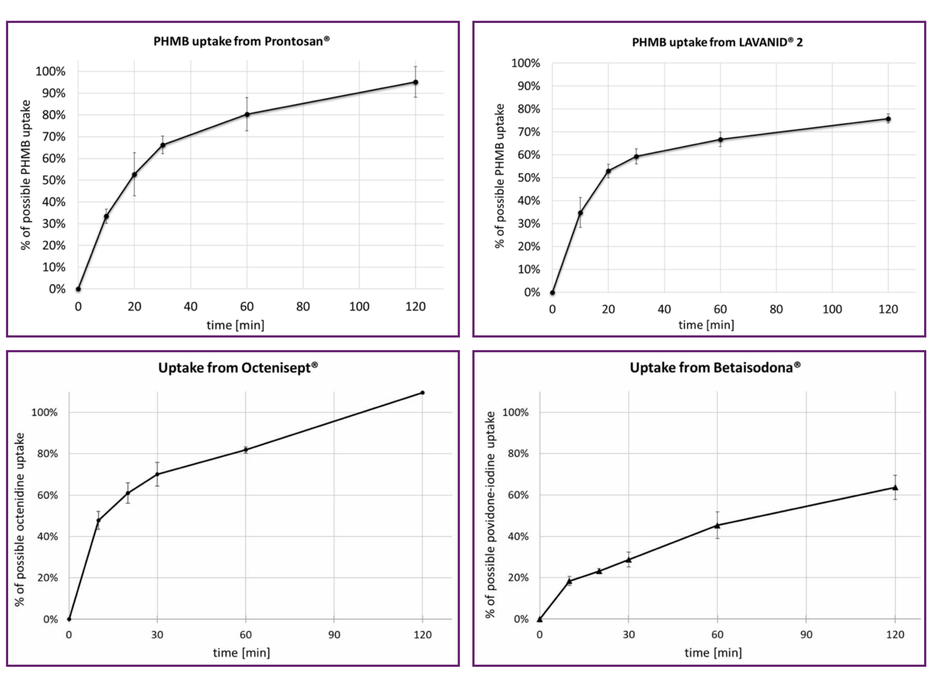
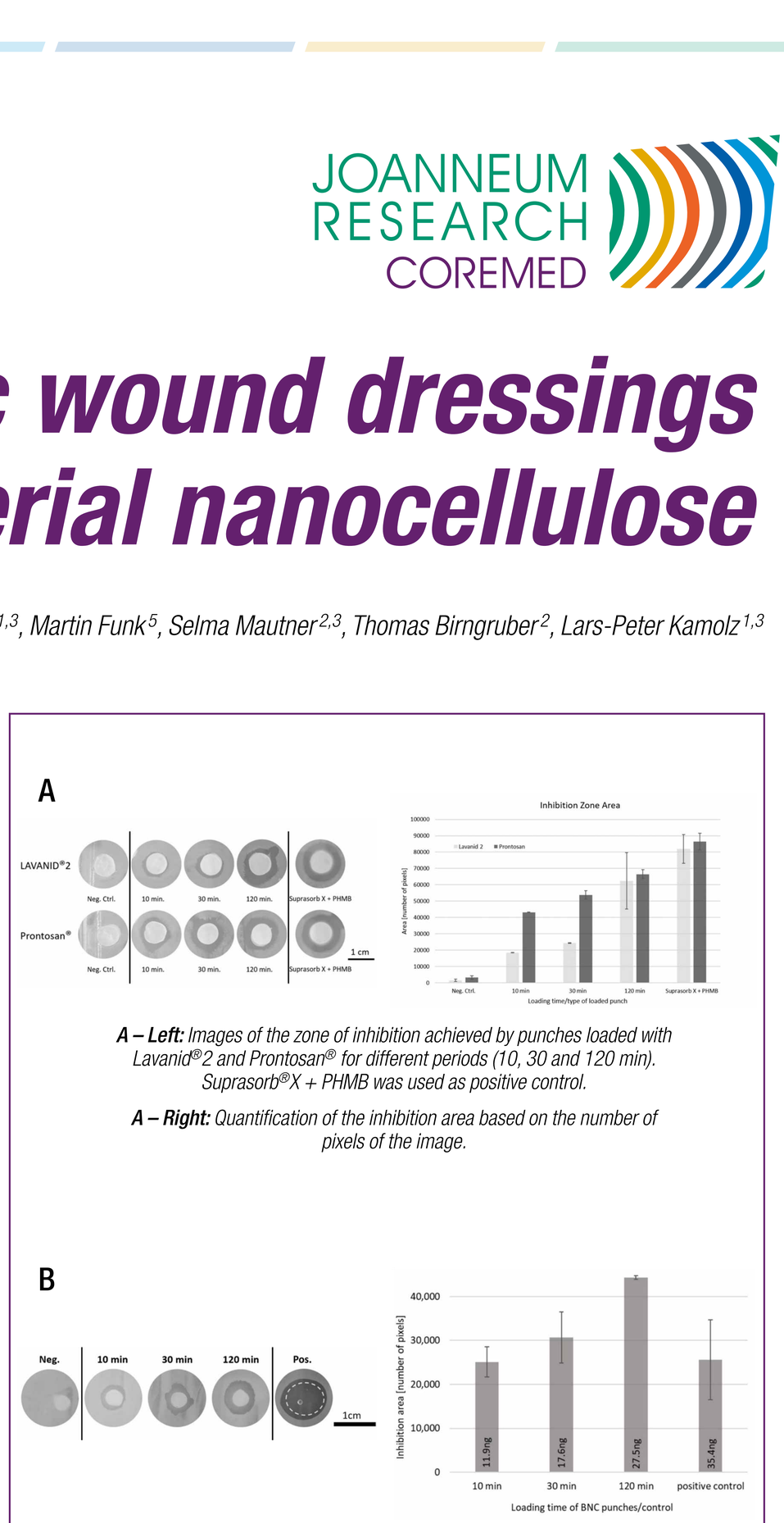


Figure 1: *Uptake from the different antiseptic solutions into the BNC*



A – Left: *Images of the zone of inhibition achieved by punches loaded with Lavanid®2 and Prontosan® for different periods (10, 30 and 120 min). Suprasorb®X + PHMB was used as positive control.*

A – Right: *Quantification of the inhibition area based on the number of pixels of the image.*

B – Left: *Images of the zone of inhibition achieved by punches loaded with Octenisept® for different periods (10, 30 and 120 min). Octenisept® gel was used as positive control. The dotted line delineates the area where Octenisept® gel was applied.*

B – Right: *Quantification of the inhibition area based on the number of pixels of the image. Inside the bars are the concentration of octenidine contained in each treatment.*

C – Left: *Images of the zone of inhibition achieved by punches loaded with Betaisodona® for different periods (10, 30 and 120 min). Betaisodona® Wundgaze was used as positive control.*

C – Right: *Quantification of the inhibition area based on the number of pixels of the image.*

Figure 2: *Antiseptic efficacy of the loaded BNC against Staph. aureus*

Antiseptics	stock solution	30 min	60 min	120 min	$MBC_{24}$for MRSA
LAVANID®2 (PHMB) [25]	400	110	190	230	1.0
Prontosan® (PHMB) [25]	1,000	260	530	760	
Octenisept® (octenidine)	1,000	360	610	800	0.375-3.0
Betaisodona® (povidone-iodine)	100,000	10,000	20,000	50,000	1,024

Table 1: *Concentration (mg/L) of the loaded BNC in comparison to the minimal bactericidal concentration (MBC) MRSA.*

Disclosure

Martin Funk is an employee of QRSkin GmbH whose product epicite^{hydro} was used for the experiments. All other authors state no conflict of interest.