Antimicrobial Properties of, and Proteinase Modulation by, an Activated Carbon Cloth and Other Market-Leading Products

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Introduction

MMPs play an essential and beneficial role in normal wound healing but, when present in excess in a wound bed, they can impair wound healing. Reducing excess protease activity in a non-healing wound may encourage the wound towards a healing trajectory. Bacterial infection can also complicate or delay wound healing. Preventing infection or reducing bacterial bioburden in an infected wound can aid healing.

Methodology

Samples of ACC* were incubated with proteinases MMP-1, MMP-2, MMP-8, MMP-9 and Human Elastase at 37°C for 1, 4 or 24 hours. Following incubation, the remaining proteinase concentration was determined by ELISA. Additionally, the ACC was compared to known proteinase modulating dressings in terms of MMP-2 and MMP-9 sequestration after 24 hours. To determine bactericidal activity of an activated carbon cloth (ACC*), samples were inoculated with Methicillin Resistant *Staphylococcus aureus* (MRSA), incubated at 37°C and viable organisms recovered after 30 minutes and 24 hours.

Results

The concentration of MMPs remaining in ACC treated supernatants was significantly lower than control dressing samples at all time points and was undetectable in ACC treated supernatants after 24 hours. Additionally, the ACC sequestered significantly more MMP-2 and MMP-9 than known protease modulating dressings. Significantly less MRSA was recovered from the ACC compared to the control dressing following 30 minutes and 24 hours incubation; with a 0.88 and 4.48 log difference in recovery, respectively. The quantity of MRSA recovered from the ACC after 30 minutes and 24 hours was comparable suggesting a bacteriostatic effect.

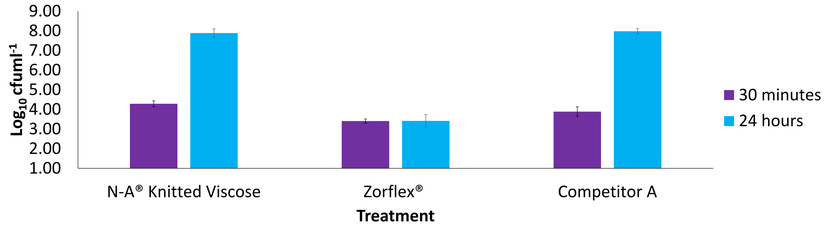

Figure 1. Quantity of Methicillin-resistance *Staphylococcus aureus* recovered from test dressings following 30 minutes and 24 hours incubation.

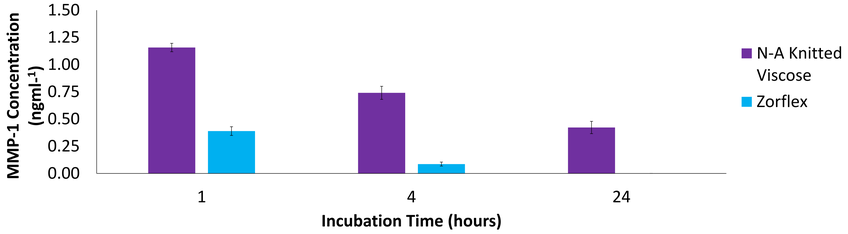

Figure 2. Concentration of MMP-1 remaining in supernatant following 1, 4 and 24 hours incubation with test dressings.

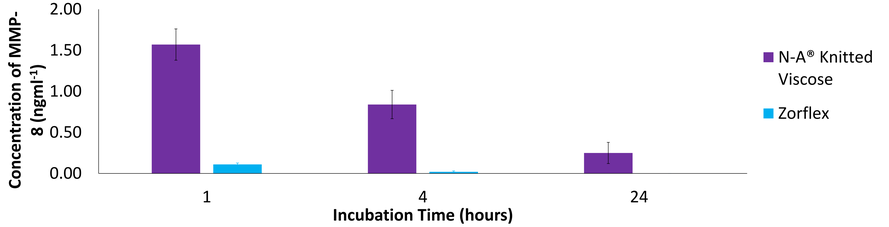

Figure 3. Concentration of MMP-8 remaining in supernatant following 1, 4 and 24 hours incubation with test dressings.

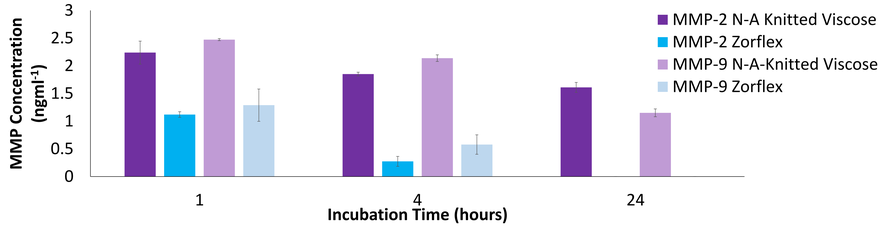

Figure 4. Concentration of MMP-2 and MMP-9 remaining in supernatant following 1, 4 and 24 hours incubation with test dressings.

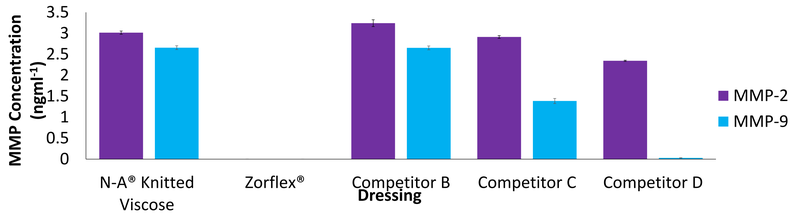

Figure 5. Concentration of MMP-2 and MMP-9 remaining in supernatant following 24 hours incubation with test dressings.

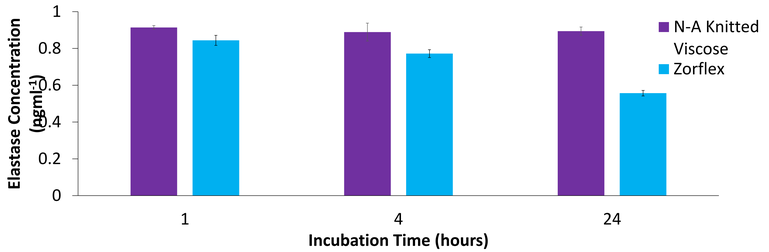

Figure 6. Concentration of Human Elastase remaining in supernatant following 1, 4 and 24 hours incubation with test dressings.

Discussion and Conclusions

The results demonstrate that the ACC sequestered MMP-1, MMP-2, MMP-8 and MMP-9 *in vitro* within 24 hours, with significant sequestration being observed within the first hour. The dressing was also able to inhibit bacterial growth over 24 hours. Wound dressings typically remain *in situ* for 24–72 hours. This data suggested that application of the ACC could potentially reduce elevated protease levels within the wound and inhibit bacterial growth. Consequently, a bacteriostatic and MMP modulating wound dressing could has useful clinical implications.

Elevated levels of protease within a chronic wound can delay wound healing, as can bacterial infection. This data suggests that application of the ACC could reduce elevated protease levels within a wound and may help to suppress bacterial load. Clinical studies are required to confirm these observations.

***ACC – Zorflex® Activated Carbon Cloth Dressing.**

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