Antimicrobial activity of a silver doped fabric for the production of scrubs

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Abstract

Hospital acquired infections (HAIs) caused by bacteria such as Staphylococcus aureus and Klebsiella pneumoniae take an estimated 100,000 lives while costing approximately $33 billion on extended length hospital stays annually in the United States. In addition, the frequency of HAIs have not decreased in the past 20 years (Condé et al. 2015). As a result, new methods for reducing the prevalence of such bacteria often responsible for HAIs are essential in the ultimate reduction of the frequency of HAIs. This research project hypothesized that hospital personnel carry bacteria on their scrubs that contribute to frequency of hospital acquired infections.

Methods

Cultures of S. aureus and K. pneumoniae were grown overnight at 37°C. 1ml of diluted cultures were then deposited onto a sterile control material and a experimental silver material and left in an empty petri dish. After 0,4,12, and 24 hours, materials were removed and vortexed in 5ml of sterile nutrient broth. 100µL of the resulting culture was then spread plated onto three replicates of nutrient agar plates, left to incubate for approximately 24 hours at 37°C, and then analyzed by the counting the number of colony forming units (CFUs) of the resulting agar plate. Percent reductions were then calculated by subtracting the number of CFUs counted by the calculated number of bacterial cells originally plated on the nutrient agar plate.

Results

Analysis of a two-way ANOVA indicated that while time had a significant effect on percent reduction of S. aureus, material has no significant effect on percent reduction of S. aureus (Figure 1). As a result, there is no difference in the antimicrobial ability of either fabric to eliminate S. aureus as both materials eliminated S. aureus by 24 hours. In contrast, however, while time also had a significant effect on percent reduction of K. pneumoniae, material additionally had a significant effect on percent reduction of K. pneumoniae (Figure 2). After conducting pair-wise comparisons, a significant difference in the percent reduction of K. pneumoniae at 12 hours demonstrates that the silver material was more efficient at eliminating K. pneumoniae than the control where elimination did not occur until 24 hours.

Conclusions and Future Directions

Results showed that while S. aureus was completely eliminated at 24 hours by both fabrics, the experimental silver fabric was able to eliminate K. pneumoniae by 12 hours compared to the 24 hours it took the control fabric(Figures 1&2). In conclusion, while the experimental silver fabric was able to reduce K. pneumoniae quicker than the control material, there was no difference in the efficacy at which either material eliminated S. aureus. Interestingly, this is a common finding among the literature and may be indicative of a general higher susceptibility of gram-negative bacteria to damage by silver than gram-positive bacteria (Dakal et al. 2016). Unfortunately, due to this undistributed result, this study is unlikely to go to clinical trials. However, continued research into methods that utilize antimicrobial agents, such as silver, will be essential to the reduction in the frequency of HAIs.

References


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