

Color and material optimization of brushes for improved light-based sanitation

Summary

Produce processing operations use brushes for debris removal or wax applications. Bacterial contamination of these brushes can be hard to reduce using only conventional sanitizers. Antimicrobial lights, such as far-range UVC light (222 nm) and blue light (405 nm), can be used independently or synergistically with conventional sanitizers to improve brush hygiene. The study explores the impact of brush color and surface material on the antimicrobial efficacy of 222 and 405 nm light. Optimal brush color and material determined through laboratory studies will be adopted by collaborating packinghouses in Georgia and Washington. Waxing and wash brushes exposed to antimicrobial light will be evaluated for reduced bacterial counts. Improved brush hygiene could reduce produce contamination by foodborne pathogens and spoilage organisms.

Objectives

1. Evaluate the influence of brush filament color and brush filament material in affecting the antimicrobial efficacy of blue light (405 nm) and far-UVC light (222 nm) against *Salmonella enterica*, Shiga toxin-producing *Escherichia coli* (STEC), and *Listeria monocytogenes*.
2. Evaluate synergistic mitigation between residual peroxyacetic acid on brushes and antimicrobial lights.
3. Validate the effectiveness of 405-nm blue light and 222-nm far UVC in reducing microbial buildup on wash and waxing brushes in peach and apple packinghouses through the packing season.

Methods

Evaluating antimicrobial activity of selected lights against *L. monocytogenes* contaminated filaments: One gram nylon (NL) and horsehair (HH) brush filaments were inoculated by immersing in a phosphate-buffered-saline (PBS) suspension of *L. monocytogenes* culture. The filaments were dried overnight, clamped, and mounted in a petri dish and exposed to 405-nm and 222-nm lights for 8h (Figure 1). Cells were enumerated on RAPID'L.mono agar.

Determining depth of antimicrobial activity in filaments by selected lights: Inoculated NL filaments were exposed to 405-nm and 222-nm lights for 8h as previously described. The top, middle and bottom sections of the brushes were excised into three similarly long portions. Each section was enumerated for surviving *L. monocytogenes* cells.

Results to Date

HH filaments (9.38 ± 0.04 log CFU/g) harbored more *L. monocytogenes* cells than NL filaments (8.54 ± 0.02 log CFU/g). UVC at 222 nm reduced *L. monocytogenes* populations on HH filaments by 2.23 ± 0.19 log CFU/g. Blue light at 405 nm reduced *L. monocytogenes* populations on NL filaments by 4.14 ± 1.00 log CFU/g (Figure 2).

Highest reductions of 2.19 ± 0.58 and 1.99 ± 0.59 log CFU/g were observed in the top section of the NL filaments after 8h exposure to 222-nm and 405-nm lights, respectively. Filaments treated with 222-nm UVC light had reductions of 1.45 ± 0.54 and 1.53 ± 0.71 log CFU/g in the middle and bottom portions, respectively. Filaments treated with 405-nm UV light had reductions of 1.65 ± 0.65 and 1.79 ± 0.75 log CFU/g in the middle and bottom portions, respectively (Figure 3).

Benefits to the Industry

The preliminary results indicate that brush filament material could influence bacterial attachment and that antimicrobial lights can reduce the population of *L. monocytogenes* across the entire brush filament. The results generated from these studies could help packinghouses optimize brush color and brush material for effective sanitation using antimicrobial light. The study would provide the produce industry with a cost-effective, residue-free antimicrobial treatment that would complement current sanitation practices of wash and waxing brushes. Antimicrobial lights at wavelengths of 222 nm and 405 nm could be used individually or synergistically with conventional sanitizers to sanitize brushes. The validation of antimicrobial lights to sanitize brushes and other hard-to-clean spaces could provide the industry with an effective tool to mitigate cross contamination in packinghouses.



Figure 1: Treatment of brush filaments with antimicrobial lights at 222 nm (A) and 405 nm (B)

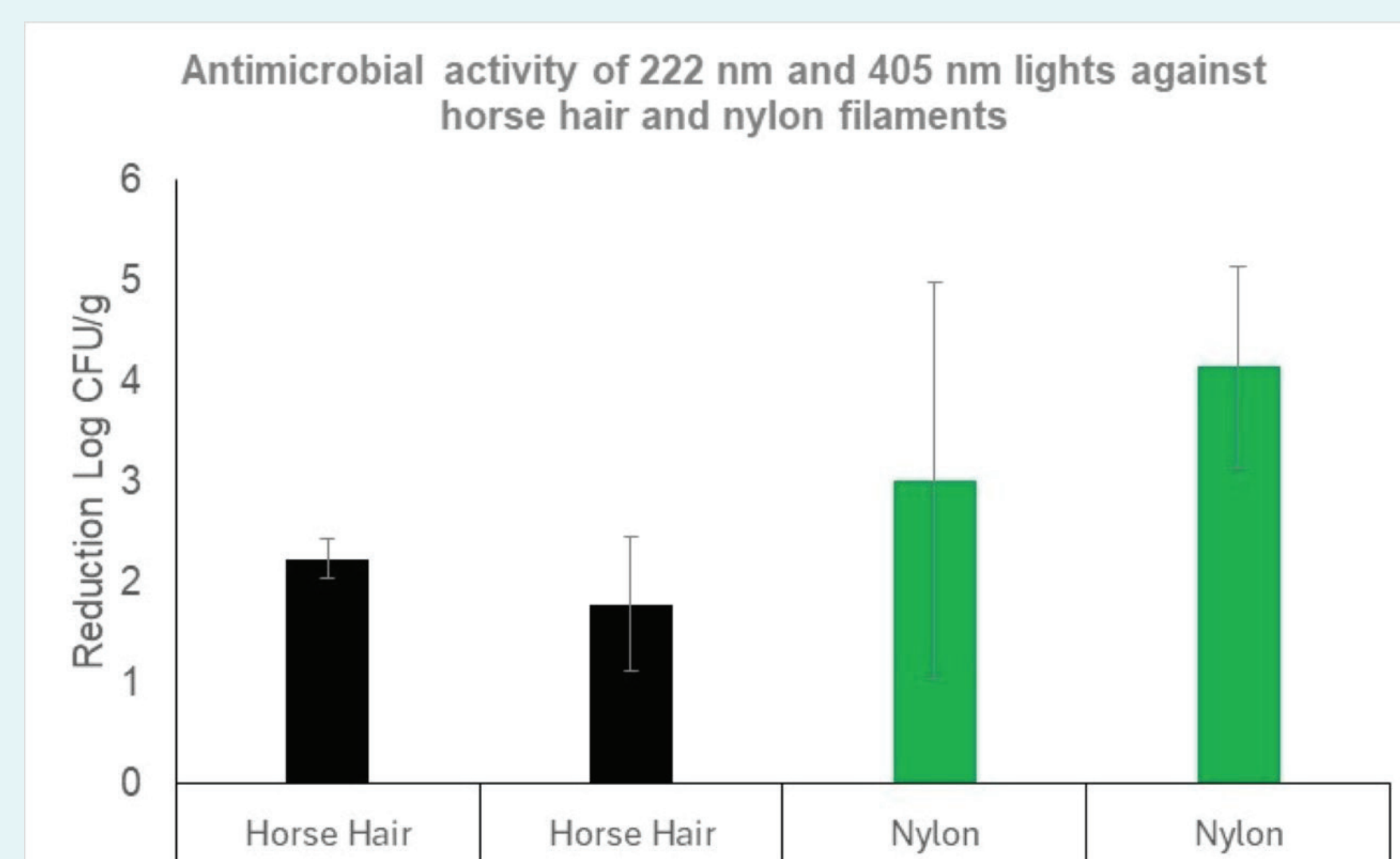


Figure 2

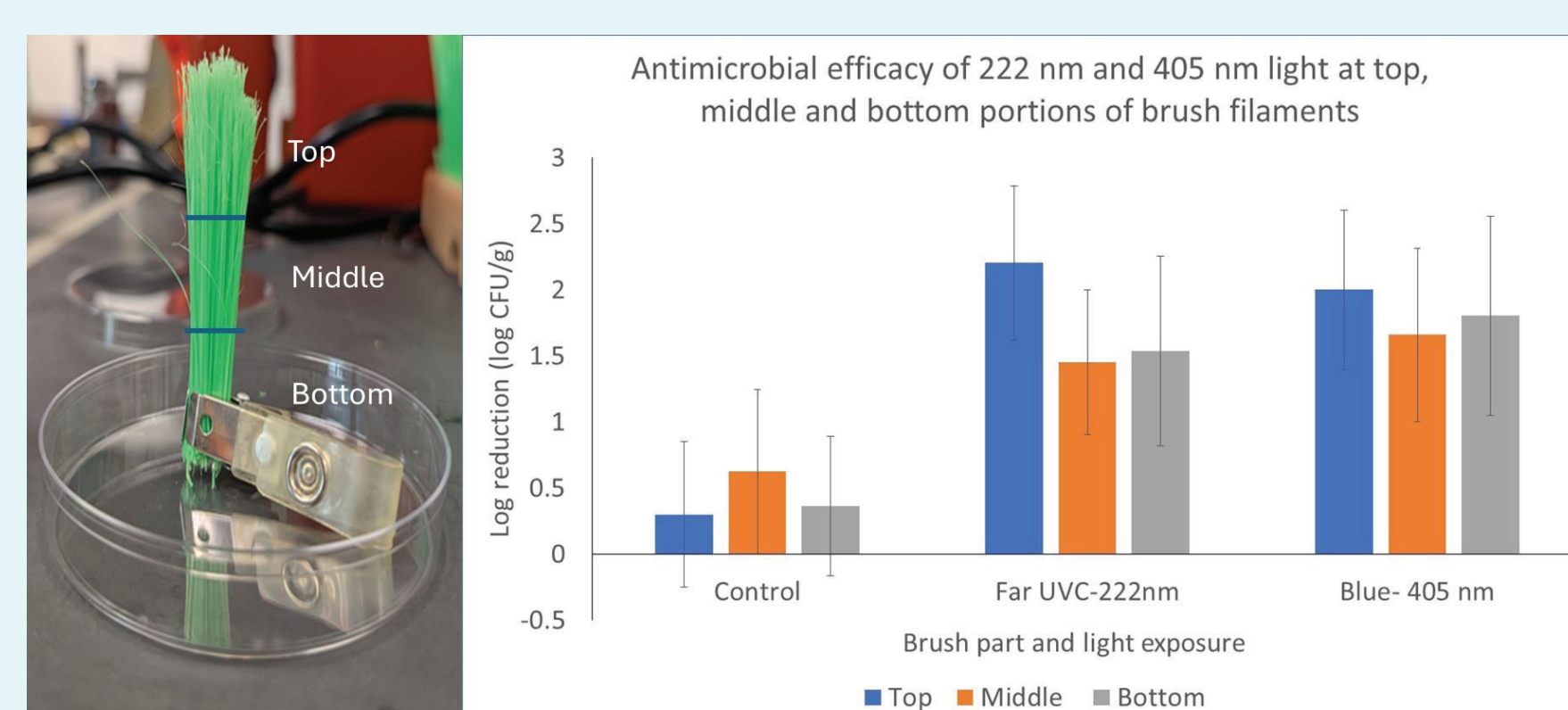
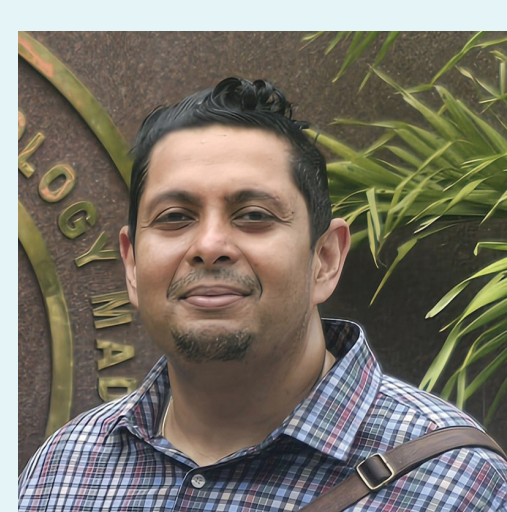


Figure 3



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