PULSED ULTRAVIOLET LIGHT DECONTAMINATION OF MEAT CONVEYOR CONTACT SURFACES

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I. OBJECTIVES

Movement of meat on a continuous belt conveyor during processing results in opportunities for pathogenic and spoilage microorganisms to contaminate the product. Pulsed ultraviolet (PUV) light is an effective antimicrobial treatment with limited application in the food industry. PUV light is the emittance of broad-spectrum electromagnetic radiation, 100–1,100 nm, from a xenon flashlamp pulsed 3 times per second with >50% of the energy deriving from the UV region. The objective of this project was to investigate the germicidal response on the surface of food-grade conveyor materials after treatment by PUV light.

II. MATERIALS AND METHODS

Four conveyor belt types, including stainless-steel chain-link, heat-resistant fabric belt, solid pliable polymer belt, and rigid linked polymer belt, were cut into 100-cm^2 sample units. Materials were inoculated with an antibiotic resistant *Escherichia coli* K12 strain or a lactic acid bacteria (LAB) cocktail, yielding a surface inoculation of 10^5 and 10^4 $\log_{10}$ CFU/cm^2, respectively. Prior to bacterial inoculation, samples were classified as soiled or unsoiled, based on the presence or absence of pork intramuscular fluid on the surface of the sample. Using a conveyor equipped with a xenon flashlamp positioned 10 cm above the surface, each belt sample was exposed to PUV light at 3 fixed conveyor speeds: 3.05, 15.24, and 30.48 cm/s, resulting in a total energy exposure of 3.31, 0.66, and 0.33 J/cm^2, respectively. Three samples of each material were evaluated under all treatment combinations including surface condition, microorganism type, and conveyor speed. After treatment, a 10-cm^2 area was swabbed to retrieve surviving bacteria from each sample. Swab samples were serially diluted and plated on selective agars. Comparison of treated to control samples allowed for quantification of microbial reduction due to PUV light treatment. The main effects, treatment and surface condition and their interaction, were evaluated in a two-way analysis of variance with Tukey multiple comparison test used to detect significant differences ($P < 0.05$) among treatment means.

III. RESULTS

For samples inoculated with *E. coli* K12 NSR, the surface condition by treatment interaction was significant for microbial inactivation on the surface of the rigid polymer linked belt ($P < 0.05$), but not for the heat-resistant fabric, the solid pliable polymer belt, and the stainless-steel chain-link ($P > 0.05$). For samples inoculated with the LAB cocktail, the surface condition by treatment interaction was significant for microbial inactivation on the surface of the heat-resistant fabric and the solid pliable polymer belt ($P < 0.05$), but not for the rigid polymer linked belt and the stainless-steel chain-link ($P > 0.05$). When 3.31 J/cm^2 was delivered to the samples, microbial reduction of *E. coli* K12 ranged from 3.34 to 5.47 and 2.07 to 4.62 $\log_{10}$ CFU/cm^2 for on unsoiled and soiled surfaces, respectively. Those same conditions lead to 2.47 to 5.00 and 2.44 to 5.11 $\log_{10}$ CFU/cm^2 microbial reductions for LAB on unsoiled and soiled surfaces, respectively. Faster conveyor speeds resulted in lower PUV energy fluence and lower microbial destruction.

IV. CONCLUSION

The results of this work demonstrate that PUV light has potential to quickly reduce microbial counts on the surface of various types of conveyor belts, during operation, with reduced effectiveness as meat residue builds up on the surface.

Keywords: contact surfaces, conveyor, *E. coli*, lactic acid bacteria, pulsed ultraviolet light