Effect of High Intensity Pulsed Light on Enterobacteriaceae Applied to Chicken Parts

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MCM Corporation; XENON Corporation; Koch Foods

Introduction

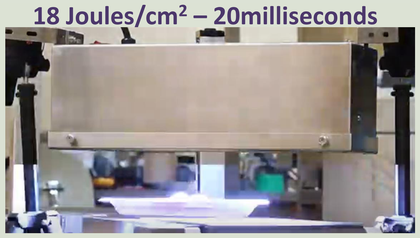
Pulsed light is a non-thermal technology where sterilization and decontamination are achieved by impinging high-intensity light pulses of short durations on surfaces of foods. Pulsed light is different from ultraviolet light in that it includes a wide wavelength range of 200– 1100 nm, which entails ultraviolet (UV): 200–400 nm, visible (VIS): 400–700 nm, and near-infrared region (IR): 700–1100 nm. This broad spectrum application has proven effective against known virus', bacteria, and fungi.[1]The effects of pulsed light on microbial cells works in a 3-fold classification as photo chemical (e.g. thymine-thymine dimer formation in microbial DNA), photo thermal (localized heating of bacteria), and photo physical (constant disturbance caused by the high energy pulses). Because it kills DNA and inactivates microorganisms, there is no antimicrobial resistance. As poultry processors strive for a balance between economic constraints and quality product, pulsed light has the potential to alleviate the need for harsh chemicals and reduce the demand on natural resources.

Materials & Methods

Koch Foods partnered with the XENON Corporation and the MCM Corporation who are experts in the field of pulsed light application. Boneless breast butterfly fillets and chicken whole wings were selected from a Koch Foods facility prior to receiving any antimicrobial treatment and shipped to the pulsed light working laboratory in San Antonio, TX. Each individual breast butterfly fillet was used for both a control (left side) and treated (right side). This allowed for a true control versus treated analysis of the effect of pulsed light with each receiving 505 Joules/cm^2 @ 3 millisecond burst of pulsed light at varying lamp distances and contact times to gauge a wide range of performance matrices for the application. The whole wings received 18 Joules/cm^2 @ 20 millisecond burst of pulsed light at varying distance and contact times. 3M quick swabs were used to evaluate the product's microbial footprint for each group.[2] Samples were sent to a Koch Foods lab and quantified for the presence of *Enterobacteriaceae* which is a common indicator organism for *Salmonella Spp*.[3] In addition to the microbial profile, the surface temperature of the product was recorded before and after treatment to further discern the comprehensive impact of pulsed light as a direct product contact application to poultry.

Pulsed Light 110v 15A

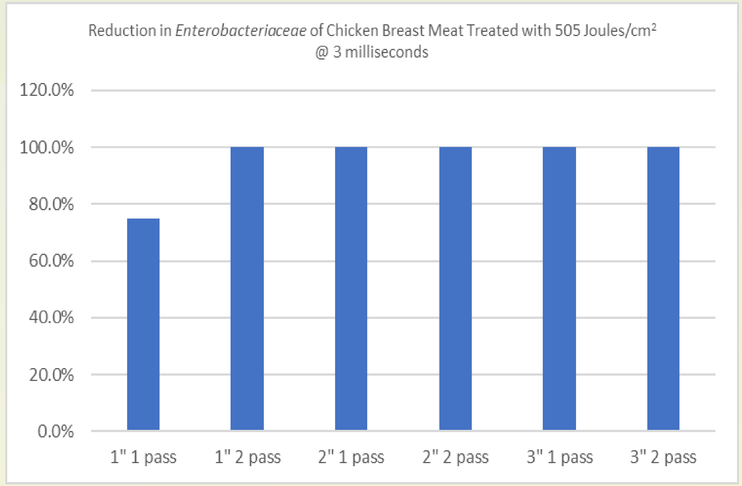
18 Joules/cm² – 20milliseconds

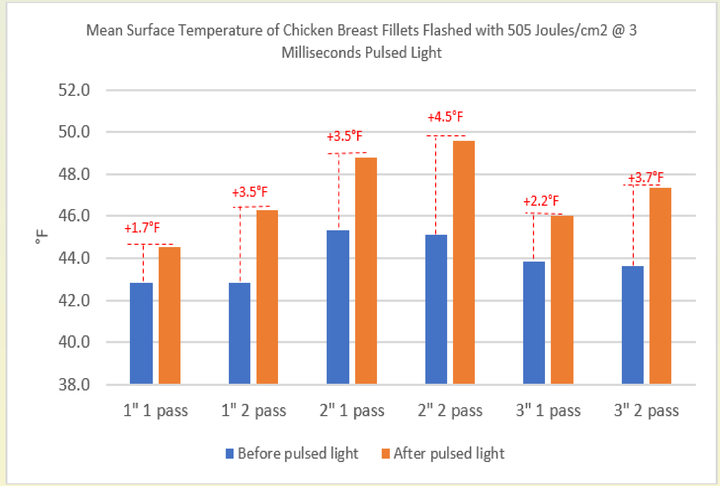


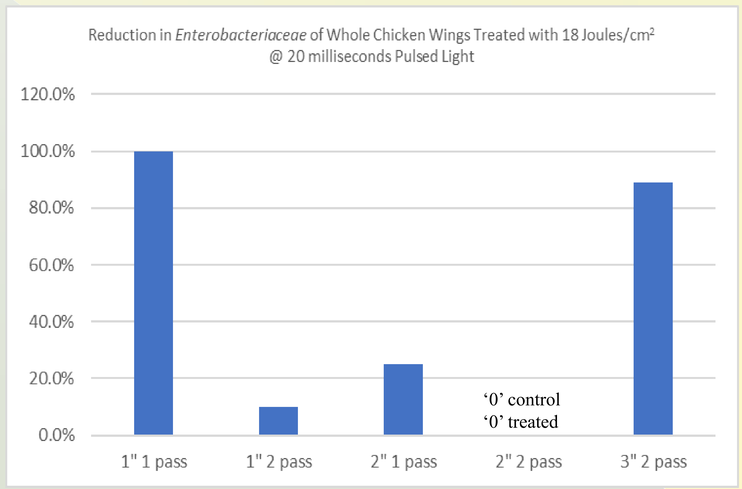
Pulsed Light 220v 30A

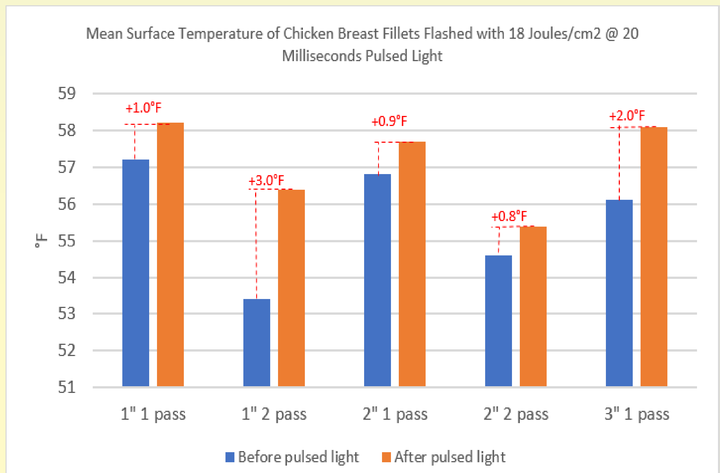
505 Joules/cm² – 3 milliseconds

COMPOSITE DATA









CONCLUSIONS

Multiple variables of pulsed light were used to determine the most efficacious application on chicken breast meat. There was 100% reduction in microorganisms achieved from an application of 505 Joules/cm2 @ 3 milliseconds 'PUL 1' as well as 18 Joules/cm2 @ 20 milliseconds 'PUL 2'. For the PUL 1 unit, all variables completely eliminated the presence of *Enterobacteriaceae* '*EB*' on the surface of the product with the exception of pulsed light at a height of 1 inch and a single pass which did reduce '*EB*' colonies by 75%. The difference in surface temperature on the breast fillets following flashing with 505 Joules/cm^2 @ 3 millisecond bursts ranged from a low of 1.7°F to 4.5°F. Adding a second pass with PUL 1 to the product under the lamps increased the original surface temperature by 1.0°F - 1.8°F. A single application of 18 Joules/cm^2 @ 20 millisecond pulsed light burst flashed on whole chicken wings at a height of 1 inch completely eliminated any *Enterobacteriaceae* on the surface of the product. Subsequent bacterial reductions at 2 & 3 inches in height was 25% and 89% respectively. There was no statistical difference in surface temperature on the whole wings from PUL 2 at a lamp height of 1 inch to 2 inches with differences of 1.0°F to 0.9°F accordingly. When a second treatment of pulsed light was applied, the surface temperature did significantly increase between 2.0-3.0°F. For PUL 1, the best balance between microbial kill effect and surface temperature concerns would be a lamp height of 2 inches. For PUL 2, the best balance between efficacy and temperature would be a lamp height of 1 inch to 2 inches.

REFERENCES

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[3] Enterobacteriaceae. (n.d.). Retrieved from https://www.sciencedirect.com/topics/food-science/enterobacteriaceae