# Comparison of pulsed ultraviolet light systems for microbial reduction of chicken thighs

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Abstract 20-057

## Significance

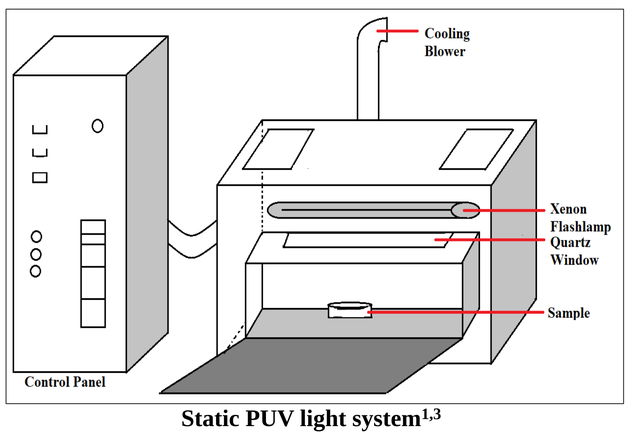
Pulsed Ultraviolet (PUV) light is an effective antimicrobial intervention that reduces the microbial contamination present on the surface of raw chicken[1,2]. Research using PUV light has established that it can be a more effective antimicrobial treatment than conventional UV light. UV wavelengths include a spectrum of 100 – 400 nm. The germicidal, UV-C wavelengths fall between 100 – 280 nm with the optimum germicidal effect at 254 nm. Using a Xenon flashlamp, PUV light emits a much broader spectrum, 100 – 1100 nm, with 50% of the energy deriving from the UV region[2,3]. Though previous research suggests PUV light is effective at reducing microorganisms on the surface of chicken parts, the effectiveness of the technology needs to be continuously evaluated as it is scaled up for commercial application.

## Objective

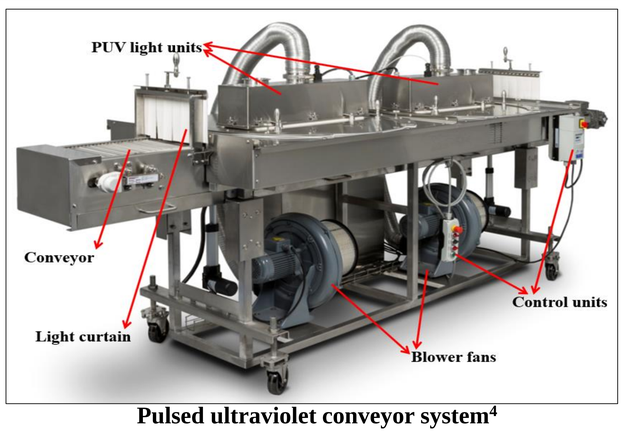
To evaluate the difference in effectiveness of two PUV light systems (static and conveyor) for the reduction of surface microorganisms on raw chicken parts.

## Methodology

Nalidixic acid and streptomycin sulfate resistant *Escherichia coli* K12 were used to inoculate the surface of boneless/skinless (B/S) chicken thigh meat. Treatment variables using the PUV light static system included the distance from the quartz window of the PUV light (8 and 13 cm) and treatment time (5, 15, 30, and 45 seconds) creating total energy fluences that ranged from 3.4 to 62.2 J/cm². Treatment variables for the PUV light conveyor system were 5, 10, 20 and 30 J/cm² that were obtained at 10 cm below the quartz window and by increasing conveyor speeds, respectively. Nine replications were used for each set of treatments[1,2].



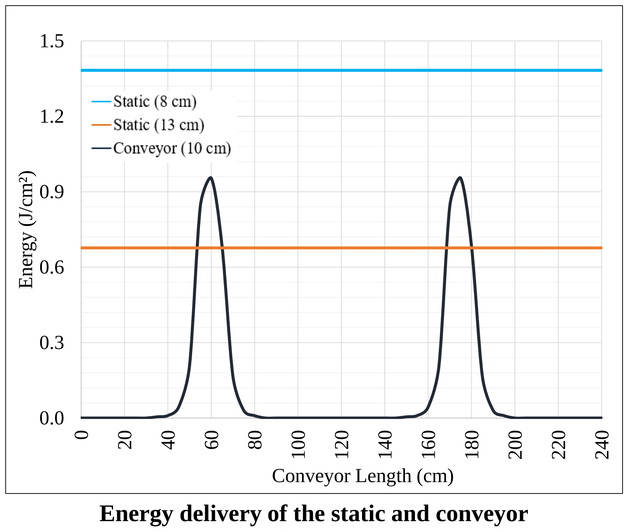

**Static PUV light system[1,3]**



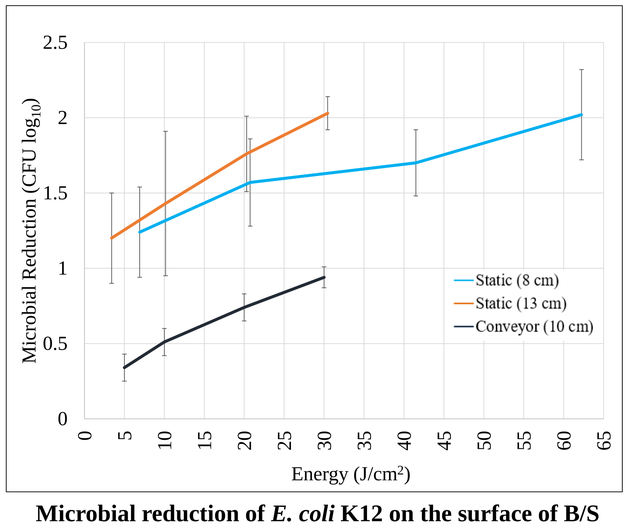

**Pulsed ultraviolet conveyor system[4]**

Chicken thighs treated by the static PUV light system were portioned to 25 cm² and single surface inoculated. Using the PUV light conveyor system, whole thighs were submersion inoculated. In both studies, chicken thighs were held for 30 minutes after inoculation to allow for microbial attachment. After treatment using the conveyor system, 50 cm² portions were removed from whole thighs and microbially evaluated similarly to the static system[1,2].

## Results

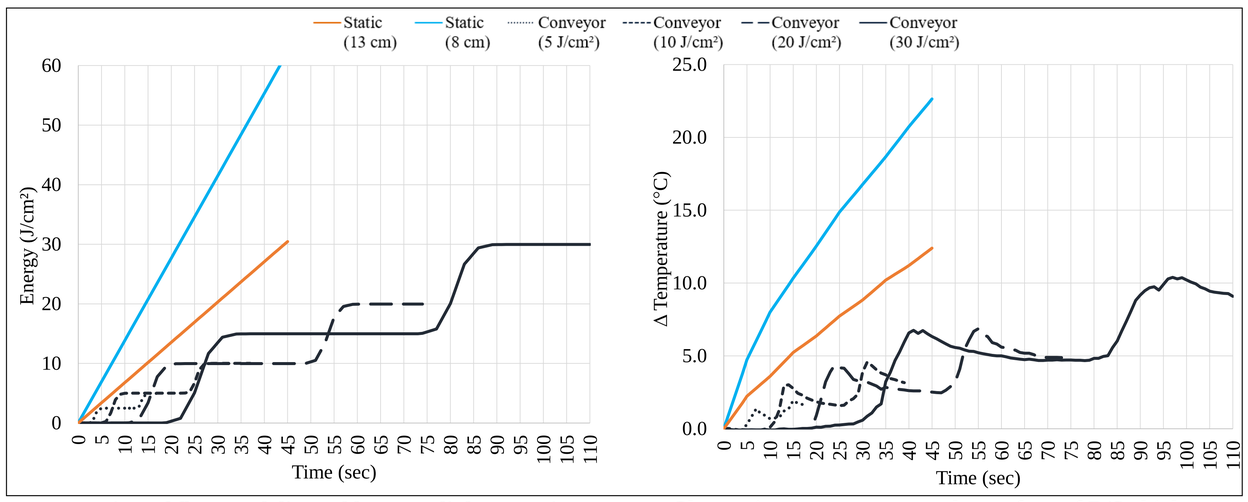



**Energy delivery of the static and conveyor PUV light systems**




**Microbial reduction of *E. coli* K12 on the surface of B/S chicken thighs**

## Results Cont'd



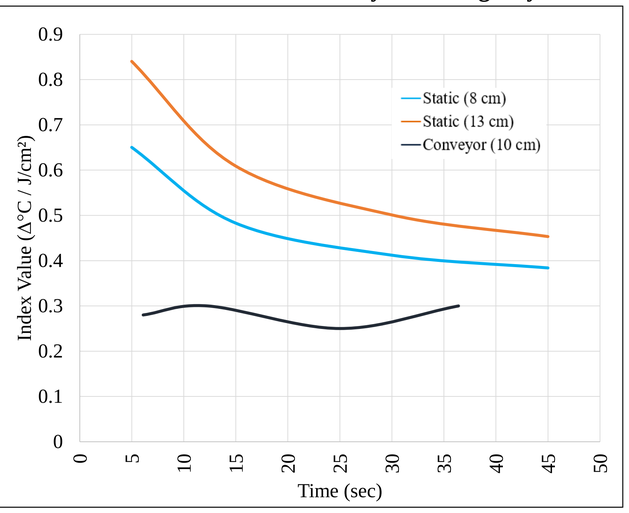

**Expression of fluence delivered by PUV light over time**

**Change in temperature on the surface of B/S chicken thighs during PUV light treatments**

**Thermal index of the change in temperature per energy delivered between the static and conveyor PUV light systems**

| Proximity (cm) | Time (sec) | Δ Temp. (°C) | Energy (J/cm²) | **Index Value (Δ°C / J/cm²)** |
|---|---|---|---|---|
| 8* | 5.0 | 4.5 | 6.9 | **0.65** |
| | 15.0 | 10.0 | 20.8 | **0.48** |
| | 30.0 | 17.1 | 41.5 | **0.41** |
| | 45.0 | 23.9 | 62.2 | **0.38** |
| 13* | 5.0 | 2.8 | 3.4 | **0.84** |
| | 15.0 | 6.2 | 10.2 | **0.61** |
| | 30.0 | 10.2 | 20.3 | **0.50** |
| | 45.0 | 13.8 | 30.5 | **0.45** |
| 10** | 6.1 | 1.4 | 5.0 | **0.28** |
| | 12.3 | 3.0 | 10.0 | **0.30** |
| | 25.0 | 5.0 | 20.0 | **0.25** |
| | 36.4 | 9.0 | 30.0 | **0.30** |

* Using pulsed ultraviolet light static system[1,3]
** Using pulsed ultraviolet light conveyor system[4]




## Conclusions

- Pulsed UV light treatment using the static system results in upwards of 2.0 $\log_{10}$ reductions.
- At 30 J/cm² in the PUV light conveyor system, a microbial reduction of ca. 1.0 $\log_{10}$ can be achieved.
- The static system delivers fluence in a linear function, while the conveyor system delivers energy in a series of progressive exposure.
- The thermal index suggests that the rate of surface temperature rise is greater for the PUV light static system compared to the conveyor system.

## Future Research

- Investigate the contribution of heat for microbial reduction as part of total energy delivered by PUV light.
- Evaluate whether a linear or progressive delivery of PUV light affects the germicidal response on the surface of raw chicken parts.
- Further validate treatment of food samples using a commercial scale PUV light treatment system.
- Perform the cost analysis of PUV light for commercial application.

## Acknowledgements

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## References

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