

Pulsed UV Light for Decontamination of Cold Storage Facilities



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Introduction

Periodic decontamination of post-harvest handling facilities is necessary to prevent the accumulation of pathogenic inoculum on surfaces, equipment and circulated air, that may compromise produce storage life.

Some potential benefits of ultraviolet light (UV) treatment for decontamination are: i) no chemicals; ii) instantaneous and specific biocidal action; iii) equipment is compact and relatively maintenance-free; iv) low capital costs.

Pulsed UV light (PUV) treatment uses radiation from a xenon flash lamp with a broadband emission spectrum, providing high-energy UV output in short pulses. PUV possesses a higher decontamination capacity and results in less microbial photo-reactivation than low-pressure UV lamps (Otaki et al., 2003).

The current research examines the efficacy of the Xtend[®] DeContam[™] PUV device (Fig. 1) in comparison to ultrasonic fogging with H₂O₂ for decontamination of post-harvest cold storage rooms (SR). The Xtend[®] DeContam[™] is FDA approved and environmentally friendly and offers the benefits of being compact, portable, easy to use and chemical free.



Fig. 1. The Xtend[®] DeContam[™] Pulsed UV device

Results

The Effect of PUV on Spore Germination of *Botrytis cinerea* In Vitro

A 30s exposure of *B. cinerea* spores on potato-dextrose agar (PDA) medium to 10MW PUV at a distance of 0.4m prevented germination of 10³ spores. Exposure for 60s was sufficient for complete eradication of 10⁵ and 10⁷ spores (Fig. 2).

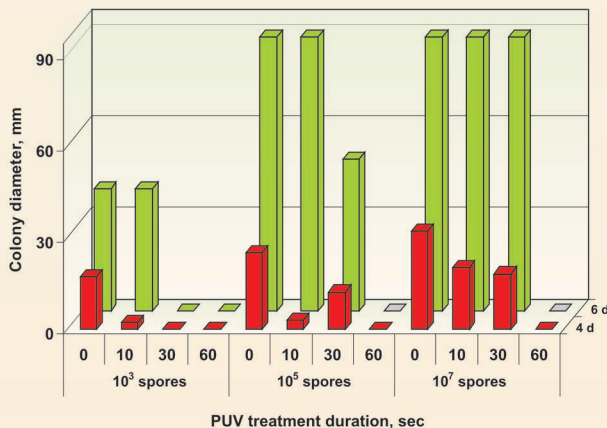


Fig. 2. Influence of PUV treatment on spore germination of *B. cinerea*. Spore loads of 10³, 10⁵ and 10⁷ were spotted in the center of PDA Petri dishes. PUV treatment was applied for 10, 30 and 60s and radial mycelial growth was measured after 4 or 6d at 20-25°C.

Cold Storage Room Decontamination Trials

PUV treatment for 66s resulted in a 5-10 fold decrease in the airborne microbial population of 11m³ SRs as counted on PCA and PDA media, both immediately and 24h after treatment (data not shown). Treatment time was increased to 1000s to determine if the airborne microorganisms could be completely eradicated by prolonged exposure, however similar results were obtained (Fig 3A).

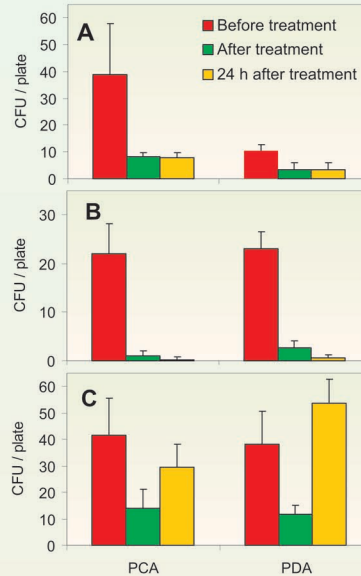


Fig. 3. Influence of PUV or stabilized H₂O₂ on airborne microbial populations of SRs. (A) PUV for 1000 s. with a PVC curtain to minimize external air flow during sampling; (B) PUV for 1000 s. The room was sealed with a polycarbonate sheet and sampled without entering (C) fogging with stabilized H₂O₂ for 1 h with a PVC curtain. Sampling involved exposure of 3 PDA or PCA Petri dishes, positioned in a circle in the center of the SR for 15 min with the door closed: (1) before each treatment, (2) immediately after (PUV), or 4 h after (fogger) treatments, and (3) 24 h after the treatments.

To determine if the residual airborne contamination after PUV treatment (Fig 3A) resulted from entering the SR for sampling, the SRs were sealed with solid polycarbonate sheets and the Petri dishes were opened and closed after treatment without entering. The lids of the Petri dishes were mounted with a ring and removed and re-positioned from outside of the SR using a thin metal rod, inserted through a 4 mm hole in the polycarbonate sheet. This method resulted in a 74 and 32-fold decrease in airborne counts on PCA and PDA, respectively, 24h after treatment (Fig. 3B).

Fogging was conducted for 1h with silver-stabilized H₂O₂ using an ultrasonic fogger releasing 2 l/h of fog. The cooling unit was switched off before fogging to prevent condensation on the unit, but the fans were left on. A 1.5-10 fold reduction of airborne counts was noticed 4h after fogging in different SRs, but microbial populations increased 24h after fogging (Fig. 3C). Removal of the Petri dish lids without entering the SR did not alter this trend, suggesting that the fogging treatment was not sufficiently effective.

Both the PUV method and the fogger treatments effectively reduced SR wall contamination as measured using contact plates for detection of molds (Fig. 4).

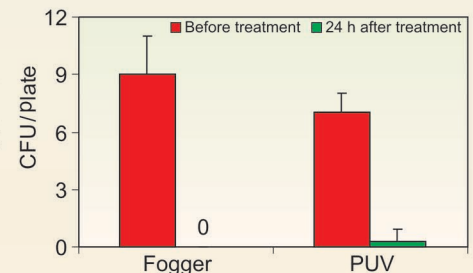


Fig. 4: The effect of PUV or stabilized H₂O₂ on microbial populations on the walls of SRs. PUV was applied for 1000 s and the fogger treatment for 1 h with stabilized H₂O₂. The sampling was carried out by exposure of contact plates containing media for counting of molds to the walls of the cold storage room. Sampling was carried out before and 24 h after the treatment.

Conclusions

The current research demonstrates the potential of PUV as a more rapid and efficient means than fogging for eradicating post-harvest pathogen populations (airborne and surface) in post-harvest cold storage rooms. Residual airborne microorganisms after treatment were primarily from external re-contamination rather than survival of indigenous populations.

Literature Cited

Otaki, M., Okuda, A., Tajima, K., Iwasaki, T., Kinoshita, S. and Ohgaki, S. 2003. Inactivation differences of microorganisms by low pressure UV and pulsed xenon lamps. Water Sci. Technol. 47:185-190.