Thesis Title	Effects of Acidic Electrolyzed Water and Ultraviolet-C on Surface Mould and Quality of ‘Phulae’ Pineapple
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ABSTRACT

Pineapple cv. Phulae (Ananas comosus L. Merr.) is an economically and geographically indication (GI) crop in Chiang Rai Province, Thailand. Market demand in both local and abroad is increasing due to its sweet, crispy and chewable of the core. The crown is cut as postharvest practices to economically safe for logistic process. Nonetheless, a major challenge as unmarketable condition of postharvest loss lies due to the mould growth on the de-crown area of the fruit during cold storage facilities to prolong the shelf life while transportation. Consumer concern for chemical residues also becoming a challenge to sustain the pineapple industries. In this study, acidic electrolyzed water (AEW) treatment (experiment 1), ultraviolet-C radiation (experiment 2) and the selected single treatment or combination of these selected best treatments (experiment 3) from experiment 1 and 2 tested comparing with the control fruit while storage at 13 ºC for 28 days. The purpose of these operations is to explore the effects of these postharvest treatments on surface mould and also to assess the fruit quality changes during cold storage.

In the experiment 1, effect of acidic electrolyzed water (AEW) treatment on ‘Phulae’ pineapple fruit was analysed. Pineapple fruit at green mature stage was treated with AEW (100 ppm, 200 ppm, 300 ppm) and air dry with a fan and stored at

13 ºC, 85-95% relative humidity for 28 days. Mould incidence and mould severity were investigated every 7-day interval. The results showed that until 7-days of storage, all AEW (100, 200 and 300 ppm) treatments were significantly inhibited mould incidence (20.00 %, 26.67% and 16.67% respectively) in ‘Phulae’ pineapples, revealing its antifungal potential from untreated control (60.00%). However, prolonged storage led to 100% mould incidence, indicating limited sustained effectiveness. Mould severity percentage at day 14 of cold storage, AEW 300 ppm (38.33±1.67%) shown significantly different from 200 ppm (60.00±3.82%) and the control (71.67±10.44%) but no difference from 100 ppm (51.25±3.31%). There were no significantly different between the treatments and the control in days 21 and 28 of storage. While AEW treatments consistently decreased mould severity compared to the control, complete prevention was not attained. The study proposes a potential threshold in AEW's antifungal action and highlights a dose-dependent relationship, with higher concentrations correlating with reduced severity. So, AEW 300 ppm was chosen for next experiment. Further exploration across a wider concentration range is advised to optimize efficacy.

In the experiment 2, effect of UV-C irradiation on ‘Phulae’ pineapple fruit was investigated. Pineapple fruit at green mature stage was treated with UV-C (13.2, 26.4 and 39.6 kJ/m^2) then stored at 13 ºC and 85-95% RH for 28 days. Mould incidence and mould severity were investigated every 7-day interval. The results observed that all UV-C treatments (13.2 kJ/m^2, 26.4 kJ/m^2 and 39.6 kJ/m^2) found lower mould incidence percentage (63.33±8.82%, 53.33±8.82% and 53.33±14.53%) than the control (80±0%) but there is no significantly different until 7-day of storage. 100% of mould incidence was observed after 14-days of storage. Mould severity percentage until 7-days found that UV-C 39.6 kJ/m^2 was significantly lowest percentage (13.33±3.63%) than the control (31.37±4.64%) but there were no different from the other treatments 13.2 kJ/m^2(21.67±4.41%) and 26.4 kJ/m^2 (18.33±3%). At 14-days of storage, mould severity treated by all treatments found significantly different than the

control but there were no different between the treatments. On 28-days of storage, UV-C dose at 13.2 kJ/m^2 investigated significantly lowest mould severity percentage (80.83±3%) than UV-C dose at 26.4 kJ/m^2, 39.6 kJ/m^2 and the control (90±2.5%, 90.83±0.83% and 90±1.44 % respectively). UV-C treatment effectively reduced mould incidence and severity in 'Phulae' pineapples during cold storage. However, 100% mould incidence was observed by Day 14, indicating a delay rather than prevention. The absence of notable differences among UV-C doses (13.2, 26.4, 39.6 kJ/m^2) suggests a potential efficacy plateau, prompting further exploration of higher doses or combining treatments for optimal mould control. While UV-C consistently lessened mould severity, a gradual increase over time implied diminishing effectiveness or limitations against established infections. The evident dose-dependent relationship supports the exploration of a broader dose range. UV-C doses of 13.2 kJ/m^2 and 39.6 kJ/m^2 were chosen for study in combination with AEW treatment (for experiment 3), aiming to enhance efficacy while mitigating potential drawbacks.In the experiment 3, the most suitable treatments from each previous experiment (1 and 2) such as in the experiment 1, AEW 300 ppm and in the experiment 2, UV-C dose at 13.2 kJ/m^2 and 39.6 kJ/m^2 were chosen. Effects of selected single treatments (experiment 1 and 2) and combination of these selected AEW and UV-C treatments on 'Phulae' pineapple fruit were investigated. Pineapple fruit at green mature stage was treated with untreated control, AEW (300 ppm), UV-C (13.2 kJ/m^2), UV-C (39.6 kJ/m^2), AEW (300 ppm) + UV-C (13.2 kJ/m^2) and AEW (300 ppm) + UV-C (39.6 kJ/m^2) then stored at 13 ºC and 85-95% RH for 28 days. Mould incidence, mould severity, physico-chemicals and antioxidant activity were investigated every 7-day intervals. The results until 7-days of storage, AEW (300 ppm) (26.67±16.67%) and combination of AEW (300 ppm) with UV-C (39.6 kJ/m^2) (26.67±6.67%) were reduced mould incidence significantly different than UV-C (13.2 kJ/m^2) (60±10.00 %), UV-C (39.6 kJ/m^2) (60±5.77 %) and the control (90±5.77 %) but there is no significantly different from AEW (300 ppm) + UV-C (39.6 kJ/m^2) (33.33±3.33 %).

Mould incidence found 100% from 14-days of storage in all treatments. Combination of AEW (300 ppm) + UV-C (39.6 kJ/m^2) treatments observed that it was significantly reduced mould severity percentage than all others treatments in 21-days of storage but no different from UV-C (13.2 kJ/m^2) and AEW (300 ppm) + UV-C (13.2 kJ/m^2) in 28-days of storage. The results observed that the treatments were significantly reduced ($P<0.05$) in mould incidence than the control until 7-day of storage and AEW (300 ppm) + UV-C (39.6 kJ/m^2) found mould severity effectively until 28-days of storage than the control.

In vitro study, the treatments reduced spore survival, spore germination, germ tube elongation, and mycelium growth than the untreated control. The parameters which the treatments have no significantly reduction ($P<0.05$) were weight loss, moisture content, dry matter, colour, internal browning severity, total soluble solids, titratable acidity, TSS-TA ratio, pH and vitamin C content. But the treatments have significantly induced ($P<0.05$) in total phenolic compound, total flavonoid content, antioxidant activity (measured by DPPH and FRAP). These findings indicate that the combination of AEW (300 ppm) and UV-C (13.2 kJ/m^2) exhibits potential synergistic effects. Further research is required to fine-tune the concentrations and timing of AEW and UV-C treatments. Exploring a broader spectrum of combinations will aid in determining the optimal treatment conditions to enhance both quality retention and germicidal effects.

Keywords: Ionized Water, Irradiation, Non-residue, Disinfectant, Non-thermal Sterilization