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| Thesis Title | Effect of Active Modified Atmosphere Packaging on Maintaining the Qualities of Tomatoes during Cold Storage |
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ABSTRACT

During ripening, the respiration and ethylene production of tomato (*Lycopersicon esculentum* Mill.) increase, expediting postharvest quality deterioration. This study examined the integration of active packaging with modified atmosphere packaging (MAP) to extend the shelf life of tomatoes at both small and large scales during cold storage. In the first experiment, the impact of a CO₂-emitting pad within a low-density polyethylene (LDPE) bag, in comparison to ethylene (C₂H₄) scavengers and nitrogen (N₂) flushing, on the quality deterioration of breaker-turning tomatoes during cold storage was investigated in small-size packaging (400g/bag). Tomatoes were packed in LDPE bags for 21 days with 11 treatments: T1= Control (without an active agent) stored at a room temperature (25°C), T2= LDPE bag (passive MAP), T3= with CO₂-emitter at a concentration of 0.5g (0.278 g NaHCO₃ + 0.222 g C₆H₈O₇), T4= flushing with mixed gas (5% CO₂ + 5% O₂ + 90% N₂) T5= flushing with 99.5% N₂ only and T6= with ethylene scavenger, held at a temperature of 6±1°C. The alternative batch was also stored in small-size packaging (400g/bag) at a storage temperature of 12±2 °C as detailed: T7=LDPE bag (passive MAP), T8= with CO₂-emitter, T9= flushing with mixed gas (5% CO₂+5% O₂+90% N₂), T10= flushing with 99.5% N₂ gas only, and T11= with ethylene scavenger.

The results indicated that in Active MAP, particularly with CO₂-emitter, ethylene scavenger and passive MAP, there was a significant increase in CO₂ levels and a decrease in O₂ levels, along with postponed color changes and a slower decay rate of tomatoes, notably at 6±1 °C storage conditions. At the conclusion of storage, the MAP paired with a CO₂ emitter at a low temperature of 6±1°C effectively delayed tomato ripening, as seen by the postponement of color changes and reduced damage compared to all other treatments, particularly the control group.

Following these findings, a subsequent experiment was performed on modified atmosphere packaging (MAP) combined with CO₂ emitter (CO₂-pad) at different concentrations to identify the best concentration to be applied with MAP in experiment 2. This involved testing various concentrations of a CO₂ emitter in packed turning-pink tomatoes, stored at a temperature of 6±1°C for a duration of 28 days. Treatments included T1 as the control (tomatoes in LDPE bag without active agent) known as passive MAP and other treatments utilizing a CO₂-emitting pad in varying ratios: T2 with a single ratio 0.25g (0.139 g NaHCO₃ + 0.111 g C₆H₈O₇), T3 with a double ratio 5g (0.278 g NaHCO₃ + 0.222 g C₆H₈O₇), and T4 with a quadruple ratio 1g (0.556 g NaHCO₃ + 0.444 g C₆H₈O₇), with samples stored at 6±1 °C. The findings indicated that CO₂-pad (T4) effectively preserved color values and reduced the decay rate of tomatoes more efficiently up to 20 days than alternative treatments when stored at 6±1°C. There were no significant differences in firmness, total soluble solids, titratable acidity and ascorbic acid across all treatments during the storage periods. Adverse effects were observed in tomatoes stored under Active MAP (T4), exhibiting increased softening and water-soaked patches after 16 days of cold storage, attributed to chilling injury. The findings indicated that an Active MAP, specifically the T4 treatment at a low temperature of 6±1°C, effectively extended the shelf life of tomatoes from 8 days to 16 days. However, specific issues require consideration, particularly the potential for chilling injury which might have been caused by low storage temperature. Next study is essential to investigate the optimal temperature and concentration of CO₂ to mitigate these disorders. Furthermore, after identifying the CO₂ emitter concentration which

performed better in the second experiment the third experiment was then conducted by comparing the treatments of Active MAP with CO₂ emitter and flushing of mixed gas (5%CO₂+5% O₂+90% N₂) on mature green tomatoes in a larger scale (bulk-size of 1000g/bag) during a storage temperature of 12±2°C for a duration of 30 days. The quadruple concentration from experiment 2 in T4 which was 1g (0.556 g NaHCO₃ + 0.444 g C₆H₈O₇) was then multiplied 3 times making a total of 3g (1.668 g NaHCO₃ + 1.332 g C₆H₈O₇). The concentration was increased since this time tomatoes were packaged in bulk-sizing. Three treatments were assessed: C = control (tomatoes in LDPE bag without active agent) known as passive MAP, T1 = CO₂ emitter pad at 3g (1.668 g NaHCO₃ + 1.332 g C₆H₈O₇), and T2 = mixed gas (5% CO₂ + 5% O₂ + 90% N₂). The results demonstrated significant differences in treatments with increased CO₂ and reduced O₂, as evidenced by delayed weight loss, hardness, color changes, lycopene accumulation, decay rate, and diminished ethylene production and respiration rate of tomatoes during storage. The findings indicate that utilizing Active MAP with CO₂ emitters at a storage temperature of 12±2°C can maintain the quality and prolong the shelf life of ripe green tomatoes for up to 30 days.

Keywords: Active Modified Atmosphere Packaging, Carbon Dioxide Emitter, Physiological Disorders, Tomato Qualities