Curing Kiwifruit: Physical, Physiological and Storage Impacts

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ABSTRACT

Curing of ‘Hayward’ kiwifruit is a postharvest approach to reduce decay and maintain quality during long-term storage. Curing occurs immediately after harvest, with fruit placed in picking bins in a covered packhouse space for a few days. Curing contributes to fruit quality by allowing the picking scar to heal (resulting in reduced *Botrytis* rot) and allows a proportion of water loss, resulting in fruit cells that are less turgid and hence less prone to mechanical damage during packing. In the contemporary packhouse, curing is also used to buffer logistical challenges, since stockpiling fruit has advantages in ensuring the packing line continues to process fruit. In kiwifruit, the rates of cooling to storage temperature have previously been identified as an influence on long-term storage outcomes, including firmness and storage breakdown development (SBD). Little is known about how curing contributes to long-term storage, yet there is potential to impact post-storage fruit quality given that curing occurs immediately prior to packing and cooling. There is a lack of knowledge regarding the range of conditions which fruit are exposed to when bins are stacked under non-controlled conditions. It is also unknown how these conditions may influence fruit quality (i.e. fruit softening and SBD development) after long-term storage. This thesis incorporates monitoring of within bin environmental conditions to assess possible in-stack heterogeneity during curing.

The spatial-temporal variability of temperature and relative humidity (RH) in the curing stack and its effect on fruit weight loss are described for five different trials. At-harvest fruit temperature had the dominant effect on temperature variability in the stack, regardless of other environmental conditions. The temperature variability throughout the stack was 5-8 °C, with the effect of the initial picking temperature lasting up to approximately 24 h after harvest. The temperature variability in the whole stack reduced with increasing curing period, when bin position had a greater influence on temperature heterogeneity in the stack. The highest temperature was recorded at the top of the stack, resulting in a temperature difference between 2 to 5 °C between layers. One possible explanation for this phenomenon is thermal stratification under the packhouse canopy.

Under real conditions, RH increased to saturation (≥ 97% measured) a few (3-7) hours after the start of curing. Fruit weight loss was between approximately 0.3-0.5% over 2 to 3 days. Under the assumption that weight loss can be attributed to water loss, during saturated RH conditions in the bin, there would be a very low driving force for water loss, resulting in the low weight loss observed in the whole stack. Despite the low range of fruit weight loss, an

influence of at-harvest temperature and also bin position on weight loss could be discerned within each trial.

Controlled simulated curing conditions that mimicked real curing conditions were investigated with respect to long-term storage fruit outcomes. Fruit exposed to > 17.4 °C (with > 64% RH) for 4 days were consistently the firmest and had the lowest incidence of SBD after 100 days of storage. However, the effect of source-orchard on fruit quality outcomes were not suppressed by curing conditions. The range of fruit weight loss (0.6-1%) in fruit exposed > 17.4 °C (with > 64% RH) for 4 days was double that measured in industry.

These results suggest that the interaction of time and temperature during curing significantly influence fruit quality in long-term storage. Curing at > 17.4 °C (with > 64% RH) for 4 days was observed to be the best curing treatment to prepare fruit for long-term storage. However, the quantity of weight loss during curing may be an issue as grower payments are made on a mass basis which is first measured after curing when fruit enter the packing line. Applying curing at > 17.4 °C and ≈ 80% RH (ambient conditions) for 4 days is likely to happen in the industry situation during the months of March and mid-May, without needing the large monetary investments for controlled conditions at the packhouse.

The results of this study have potential implications for the kiwifruit industry. Environmental conditions during curing and the consequent spatial and temporal variability in the stack impact fruit weight loss and possibly post-storage quality outcomes. Applying curing under controlled conditions would allow reduction of variability, necessarily for late harvest fruit. Controlling curing conditions could favour maintenance of fruit quality in kiwifruit batches destined for long-term storage and also reduce curing imparted variability.

Further research is required to understand the mechanism of curing and to determine whether the beneficial effect of curing at > 17.4 °C and > 64% RH for 4 days occurred because of the effect of temperature on biochemical reactions on the cell wall or the effect of the physical process driven by the water loss.

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خراب و مست به ساقی جان همی گوییم   برآر دست که ما دست ها برآوردیم

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