



Determination of Fruit Injury by Quarantine Hot Water Treatment on Tommy Atkins Fruit Grown in Mexico

Most mangos around the world are grown in areas that have a high presence of fruit fly. Consequently, mangos intended for the U.S. market must undergo a quarantine treatment to ensure fruit fly control. The hot water treatment (HWT) protocol is the most common quarantine process utilized for mangos that are imported into the U.S. The protocol requires mangos to be submerged into hot water at 115.0 °F for 65, 75, 90, or 110 minutes according to the size and weight of the fruit. The HWT has been largely attributed to the loss of quality in mangos; however if this treatment is applied properly the quality of the fruit would be potentially greater.

With this in mind, the NMB commissioned a study with Dr. Jorge A. Osuna Garcia, postharvest and food safety researcher at INIFAP-Santiago Ixcuintla Experimental Station to: 1) determine the injury level of the HWT on the physiochemical characteristics and shelf life of the main mango varieties grown in Mexico; 2) quantify the effect of fruit ripeness; the duration and temperature of hydrothermal treatment on quality and shelf life of the main mango varieties grown in Mexico; and 3) evaluate the potential seasonal differences of heat injury.

Methodology

Tommy Atkins mango variety was collected and separated by partially ripe and ripe fruit immediately after washing and evaluated for 75 or 90 minutes. Fruit was in excellent condition, with great external appearance, free of mechanical damage, pests, and diseases. The mangos were then divided into five lots for the application of HWT, the untreated control and four different temperatures (115.5 °F, 116.0 °F, 116.5 °F, and 117.0 °F) using hydrothermal separate bins for each temperature or set point. At the end of the HWT, mangos were immediately hydro-cooled for 20 minutes and then transferred to the postharvest lab at INIFAP for initial analysis and cold preservation. Sampling was done at the beginning and at the end of the refrigerated period and then at consumption stage.

Key Findings

- **The most important factor influencing external fruit damage and fruit quality was the set point temperature.**

- The recommended set point between 115.5 °F and 116.5 °F showed slight damage, while at 117.0 °F showed moderate injury.
- **External damage was mainly affected by the set point temperature.** Fruit without HWT did not show any injury while heat treated fruit showed slight to moderate injury at 117.0 °F. The ripening stage and the hydrothermal time almost did not influence the external damage.
- **Internal injury was almost absent at the end of the refrigerated period for the different ripening stages, set point temperatures and immersion times.** However, at the consumption stage, fruit showed very low and similar internal injury under all the factors in the study.
- Firmness of the fruit was influenced for all factors; partially ripe fruit was firmer than ripe fruit. Fruit that was treated for 75 minutes was firmer than those treated for 90 minutes. **The set point temperature significantly affected fruit firmness; the higher the set point temperature, the lower the fruit firmness at the end of the refrigerated period or at consumption stage.**
- **The pulp color was mainly influenced by the set point temperature.** At the end of the refrigeration period the higher the temperature, the lower the pulp color intensity. At the consumption stage the fruit without HWT showed the highest pulp color intensity.
- Total soluble solids (TSS) content was mainly influenced by the ripening stage where partially ripe fruit showed less sugar content (°Bx) than ripe fruit. **The set point temperature influenced the TSS content in two ways:**
 1. At the end of the refrigeration period – the higher the set point, the higher the TSS content.
 2. At consumption stage, the fruit without HWT showed the highest TSS content.

If the mandatory HWT is applied at the recommended set point temperatures only slight external injury will be observed while maintaining adequate quality and shelf life.

Looking Ahead

More research is needed to understand how the HWT affects the quality of mangos. A new study has been approved and it is currently in progress by the NMB to understand the effects of the

water quality used in the quarantine treatment on the shelf life and quality of the mangos at consumption