



Determination of Chilling Injury in Main Mango Varieties Grown in Mexico

Sea refrigerated shipments can take up to four weeks to reach the U.S. which is a major challenge faced by several mango exporting countries. The delay on arrival can lead to over ripe fruit and problems for distribution at the retail level. The principle behind cold storage is to delay the ripening stage of a product by slowing down its physiological activity. Some fruits like mangos however, are sensitive to chilling injury when stored at low temperatures. Mango fruit experiences chilling injury when stored at temperatures below 50.0 °F showing uneven ripening, poor color and flavor, surface pitting, gray scald-like skin discoloration, increased susceptibility to decay and, in severe cases, flesh browning.

The severity of chilling injury depends on cultivar, ripeness stage, and the duration of exposure temperature. Chilling injury symptoms are not apparent while the fruit is being stored at low temperatures but become visible later when the fruit is exposed to warmer temperatures for ripening or displayed for sale. It is stated that the optimum storage temperature for mango fruit is approximately 54.0-55.0 °F.

With this in mind, the NMB commissioned a study to explore chilling injury in the main mango varieties grown in Mexico. Dr. Jorge A. Osuna Garcia, postharvest and food safety researcher at INIFAP-Santiago Ixcuintla Experimental Station, conducted the study with the following objectives: 1) determine the critical combinations of time and temperature and the associated chilling threshold temperature(s) for the main mango varieties grown in Mexico; and 2) quantify the effect of ripening degree on chilling injury of main mango varieties grown in Mexico.

Methodology

The study was done in the mango cultivars Ataulfo, Tommy Atkins, Kent, and Keitt and the following factors were evaluated: a) ripening degree (partially ripe or ripe), b) storage temperatures (45.5, 50.0, and 54.5 °F), c) storage time (1, 2, or 3 weeks). A factorial design was used with 20 replications for weight loss and 8 replications for all the other variables (chilling injury, firmness, pulp color, and Total Soluble Solids or TSS). The analysis of variance was done independently for each variety.

Key Findings

- **The most important factors were storage temperature and storage time.** The lower the temperature and the longer the time, the higher the damage.

- Significant differences for chilling injury were found among varieties.
 - **Ataulfo and Kent were the most susceptible varieties, showing slight damage at the end of the first week of storage especially at 45.5 °F.** The damage increased to moderate and severe at the end of the second and third week of shipping simulation respectively.
 - **Keitt showed only slight symptoms at the end of one week of shipping simulation at 45.5 °F.** At the end of the second week, Keitt showed slight chilling injury symptoms and at the end of the third week slight to moderate damage.
 - **Tommy Atkins was the most tolerant variety to chilling injury showing only traces of damage at 45.5 °F after week one and week two of shipping simulation.** At the end of the third week, Tommy Atkins showed slight to moderate damage.
- **External chilling injury was practically unobserved,** being statistically equal for ripening degree, storage temperature, or time temperature.
 - **At the end of the three weeks of simulation at 45.5 °F only slight external damage was observed in the Keitt variety.**
- **The internal chilling injury damage was very low and it was reflected mainly in the pulp color.** The lower the temperature and the longer the storage time, the lower the pulp color intensity.
- **A very clear effect of temperature and storage time was also observed for firmness in all varieties.** The lower the temperature, the higher the pulp firmness, whereas, the longer the storage time, the lower the pulp firmness.
- The TSS differences among storage temperatures was observed since the first week of shipping simulation in all varieties except Ataulfo. **The lower the temperature, the lower the TSS.**
 - **After two weeks of shipping simulation, the recommended temperature of 54.5 °F showed the highest TSS content.**

For practical purposes and to obtain the best quality mangos, Ataulfo and Kent should be shipped only at 54.5 °F while Tommy Atkins and Keitt can tolerate up to 50.0 °F.

None of the varieties should be shipped at 45.5 °F.

Looking Ahead

Further research is necessary to determine the best time-temperatures combinations that deliver the best quality mangos that grow in other regions and under different production practices.