Challenges in Postharvest Handling of Tropical Fruit

Beth Mitcham
University of California
Characteristics of Horticultural Crops

- High water content
- Easily damaged
- Alive – a biological system
- Deterioration begins at harvest
Factors Contributing to Postharvest Losses

- Respiration
- Water loss
- Damage
- Diseases
- Ethylene
- Physiological disorders

TIME & TEMPERATURE
Temperature - why is it important?

- Rate of deterioration \( \propto \) rate of respiration
- Respiration:
  \[
  \text{Sugar} + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O} + \text{Energy (Heat)}
  \]
- Respiration increases exponentially with T
Temperature Management

- Reduce respiration rate
- Reduce decay
- Reduce water loss
- Reduce ripening and deterioration
Two Groups of Products
Temperature Compatibility

- Non-chilling sensitive products—store near 0°C
- Chilling sensitive products—store around 10°C (varies)
Chilling Injury of Mango

Damage to mango appearance and eating quality caused by exposing the fruit to temperatures below 12°C

- Lenticel spotting
- Surface pitting
- Poor color development
- Uneven ripening
- Grayish or black skin color
- Internal browning
- Loss of flavor
# Chilling Threshold Temperatures* for Different Varieties/Maturities of Mangos

<table>
<thead>
<tr>
<th>Variety</th>
<th>Maturity/Ripeness Stage**</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td><strong>Ataulfo</strong></td>
<td>&gt;13</td>
</tr>
<tr>
<td><strong>Keitt</strong></td>
<td>13</td>
</tr>
<tr>
<td><strong>Kent</strong></td>
<td>13</td>
</tr>
<tr>
<td><strong>Tommy Atkins</strong></td>
<td>13</td>
</tr>
</tbody>
</table>

*Based on continuous exposure for 3 weeks  
**Ataulfo fruit developed chilling injury at all temperatures (°C) tested; a chilling threshold temperature was not established.
### Differences in Chilling Sensitivity Among Mango Varieties

Browning of Peel and Pulp After Storage

<table>
<thead>
<tr>
<th>Variety</th>
<th>Time in Storage (days)</th>
<th>Peel</th>
<th>Pulp</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>Choke Anan</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Nam Dok Mai</td>
<td>1.0</td>
<td>1.0</td>
<td>2.2</td>
</tr>
<tr>
<td></td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
</tbody>
</table>

Subedi & Walsh 2011
Keep Temperatures Low After Harvest
Mechanisms to Reduce Deterioration in Addition to Temperature Management

- Careful handling to reduce injury
- Harvest maturity
- Modified atmospheres
- Hot water treatment
- Chitosan
- 1-MCP (ethylene action inhibitor)
- Drying or other processing
Careful handling to Reduce Injury and Reduce Decay

- Care in harvest and handling
  - Do not throw, squeeze, etc.
  - Avoid rough & dirty surfaces
  - Minimize product contact

- Packaging and packing
  - Pack gently
  - Use boxes strong enough to support weight above them
  - Do not overfill box

Wounding During Harvest and Handling

Impact Bruising
Harvest Maturity
Effect of Harvesting and Storage Conditions on the Postharvest Quality and Shelf Life of Mango Fruit

M.K. Baloch and F. Bibi
Gomal University
Pakistan
### Color and Firmness at Harvest for Langra and S.B. Chaunsa Mangos Harvested at different days from fruit set

<table>
<thead>
<tr>
<th>Variety</th>
<th>Sample</th>
<th>Days after Full Bloom</th>
<th>Color</th>
<th>Firmness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Langra</td>
<td>I</td>
<td>80</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>II</td>
<td>95</td>
<td>0.5</td>
<td>9.5</td>
</tr>
<tr>
<td></td>
<td>III</td>
<td>110</td>
<td>1.5</td>
<td>9.0</td>
</tr>
<tr>
<td>Chaunsa</td>
<td>I</td>
<td>80</td>
<td>0.6</td>
<td>9.3</td>
</tr>
<tr>
<td></td>
<td>II</td>
<td>95</td>
<td>0.9</td>
<td>9.2</td>
</tr>
<tr>
<td></td>
<td>III</td>
<td>110</td>
<td>1.8</td>
<td>8.7</td>
</tr>
</tbody>
</table>

Baloch & Bibi 2012
Time for Mango Fruit Harvested at Different Maturity Stages to Ripen

Langra

S.B. Chaunsa

Baloch & Bibi 2012
Modified Atmospheres can be a useful supplement in Postharvest Handling

- Reducing oxygen
- Increasing carbon dioxide
- Removing carbon dioxide
- Removing ethylene and other volatiles

Composition of Air

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Component</th>
</tr>
</thead>
<tbody>
<tr>
<td>78.08%</td>
<td>Nitrogen (N₂)</td>
</tr>
<tr>
<td>20.95%</td>
<td>Oxygen (O₂)</td>
</tr>
<tr>
<td>0.93%</td>
<td>Argon (Ar)</td>
</tr>
<tr>
<td>0.03%</td>
<td>Carbon dioxide (CO₂)</td>
</tr>
<tr>
<td>0.0001%</td>
<td>Ethylene (C₂H₄) (1 ppm)</td>
</tr>
</tbody>
</table>
Modified or Controlled Atmospheres can be a useful supplement in Postharvest Handling

Cantaloupe; Bag in Box to provide high CO2

Modified Atmospheres may:
- Be a good supplement to temperature
- Maintain green tissues
- Retard ripening
- Reduce discoloration
- Retard microbial growth
- Reduce water loss

Strawberry: Pallet shrouds with injected CO2 for Botrytis control
Changes in Firmness of Guavas Stored in Modified Atmosphere Packages

S. Mangaraj et al. 2012
Hot Water Treatment for Anthracnose Control
Effect of Hot Water Immersion at 55°C on Development of Anthracnose

Chavez-Sanchez et al. 2013
Change in Firmness of Papaya Fruit Treated with Hot Water at 55°C

Chavez-Sanchez et al. 2013
Use of Chitosan to Reduce Deterioration

Control of Anthracnose by Chitosan through Stimulation of Defence-Related Enzymes in Eksotika II Papaya (*Carica papaya* L.) Fruit

Asgar Ali (corresponding author)
Effect of Chitosan on Development of Anthracnose in Papaya

Chitinase Activity in Papaya Fruit Treated with Chitosan and Inoculated with *Colletotrichum gloeosporioides*
Effects of Chitosan Coating on Postharvest Life and Quality of Guava Fruit During Cold Storage

Hong, et al. Chinese Academy of Tropical Agricultural Sciences, China
Effect of Chitosan Coating on Firmness and Weight Loss of Guava Fruit during Storage at 11°C

Hong et al. 2012
1-Methylcyclopropane

• Binds to ethylene receptor
• Inhibits the effects of ethylene
  – Reduced respiration
  – Reduced yellowing
  – Reduced softening
• Eventually the fruit must ripen
Maximum Shelf Life and respiration rate of Guava Fruit Treated with 1-MCP and Stored at 25°C
Firmness of ‘Pedro Sato’ Guava Fruit after 1-MCP Treatment and Full Ripening at 25°C

Firmness (N)

Exposure Time (h)

0 nl 1^-1
100 nl 1^-1
300 nl 1^-1
900 nl 1^-1
Effect of 1-MCP on Keitt Mango Ripening

![Graph showing the effect of 1-MCP on Keitt Mango ripening. The graph plots firmness (N) against days at 20°C. Different treatments include Untreated, 0.5 μL/L 1-MCP, 1.0 μL/L 1-MCP, 10.0 μL/L 1-MCP, 1.0 μL/L 1-MCP + HWT, HWT + 1.0 μL/L 1-MCP, and HWT. The LSDD_0.05 = 2.35.](image-url)
Effect of 1-MCP on Keitt Mango Ripening
Processing to Preserve Fruit after Harvest

• Drying
• Fruit leathers
• Juicing
• Canning
Horticulture Innovation Lab Chimney Dryer

- Inexpensive
- Efficient
- High air speed
Basic Postharvest Handling Principles

1) Harvest at correct maturity
2) Reduce physical handling
3) Protect product from sun, delays
4) Keep packingline simple and clean; ensure good worker hygiene
5) Select, classify, and pack carefully
6) Align cartons, strap pallet
7) Cool as soon as possible
8) Know market and product requirements
9) Coordinate efficient & rapid handling
10) Train and compensate workers adequately

Problems often result from not adhering to basic principles
Questions?