Mango Ripening

Beth Mitcham
Department of Plant Sciences
University of California, Davis

Assessing Maturity & Eating Quality Potential

- Maturity at harvest determines eating quality potential
- Skin color
  - Dark green to light green in some cultivars
  - Red color is not related to maturity or ripeness
- Fruit shape
  - Fullness of cheeks
  - Shape of shoulders
- Internal flesh color
  - Greenish-white to yellowish-orange
  - Consider that advances in skin and flesh color should have occurred during transit

Skin Color

Skin color is not always related to internal color and ripeness!

Cultivar Differences

- Tommy Atkins Mango
- Kent Mango
- Keitt Mango
- Haden Mango
- Ataulfo Mango

Fruit Shape

- Fullness of cheeks
- Elevation of shoulders above the stem attachment

Flesh Color

Mango Maturity & Ripeness Stages Based on Flesh Color

- Immature
- Partially immature
- Mature
- Partially-ripe
- Ripe
Kent Mango Ripening Stages

Changes Associated with Mango Ripening

- Skin color changes from green to yellow (in some cultivars)
- Flesh color changes from greenish-yellow to yellow to orange (in all cultivars)
- Decrease in flesh firmness and increased juiciness
- Starch conversion into sugars
- Increase in soluble solids content
- Increase in carotenoids and decrease in chlorophyll content
- Increase in characteristic aroma volatiles

Eating Quality

- Soluble solids content
  - Indication of sugar content
  - Approximately 7-9% at harvest; 13-20% in ripe fruit
    - Depending on growing conditions
  - Measure with refractometer
  - Increases with ripening from starch conversion
  - Affected by harvest maturity
- Firmness and texture
  - Degree of softening
    - Measured by hand or with penetrometer
  - Fibrousness
- Aroma
  - Related to ethylene production

Tools to Assess Quality and Ripeness

1. Refractometer – estimate of sugar content
2. Penetrometer – fruit firmness, degree of ripeness
3. Visual color – for skin and flesh color

Soluble Solids Content

- Collect flesh tissue
  - Entire half of fruit
  - Plug taken down to seed
- Juice pieces of flesh, place drop onto refractometer
- Will continue to increase in fruit not yet ripe

Firmness

Penetration Force

Use 5/16-inch (8-mm) tip

Source of Equipment: http://postharvest.ucdavis.edu Yellowpages
### Methods of Measuring Mango Firmness

#### Changes with Ripening

Changes in total soluble solids content and firmness during ripening of Keitt mangos

![Graph showing changes in firmness and TSS over time](image)

### Relationships Among Quality & Maturity Factors

- Upon fruit arrival, check internal color, firmness and soluble solids content:
  - Penetrometer will be much more accurate than hand feel
- Internal flesh should be at least yellow in color; better with 50% orange-yellow color
- Soluble solids content will vary depending on stage of ripeness
  - Remember, soluble solids increase as the fruit soften further
  - Very firm mangos should have approximately 7 to 9% SSC
  - Fully ripe mangos generally have as much as 13 to 20% SSC
- Check for defects, especially chilling injury

### Optimal Conditions for Mango Ripening-1

Best temperatures for ripening mangos 68 to 72°F (20 to 22°C)

- Ripening at 60 to 65°F (15.5 to 18°C) may result in the most attractive skin color, but flavor remains tart
  - additional 2-3 days at 70-75°F (21-24°C) will attain sweet flavor.
- Ripening at 80-86°F(27-30°C) may result in mottled skin and strong, undesirable flavor
- Ripening is retarded above 86°F(30°C).

### Optimal Conditions for Mango Ripening-2

Relative humidity range is 90 to 95% to prevent excessive water loss and shrivel.

- Ethylene (100 ppm) for 24 to 48 hours, depending on maturity
  - Keep CO₂ <1%

- After triggering ripening with ethylene for 24 hours, mangos kept at 65-72°F(18-22°C) will ripen in 5-9 days.

- Once ripened, mangos can be held at 50-55°F(10-13°C) and 90-95% relative humidity for up to one week.

### Flesh Firmness vs Ripeness Stage of Mango Fruit

<table>
<thead>
<tr>
<th>Ripeness Stage</th>
<th>Flesh firmness*</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mature-green</td>
<td>&gt;14</td>
<td>Treat with ethylene for 48 hours</td>
</tr>
<tr>
<td>Partially-ripe</td>
<td>10-14</td>
<td>Treat with ethylene for 24 hours</td>
</tr>
<tr>
<td>Firm-ripe</td>
<td>6-10</td>
<td>Best stage to send to retail stores</td>
</tr>
<tr>
<td>Soft-ripe</td>
<td>2-6</td>
<td>Best stage for eating</td>
</tr>
<tr>
<td>Over-ripe</td>
<td>&lt;2</td>
<td>Good for juice</td>
</tr>
</tbody>
</table>

*pounds-force with 8-mm tip penetrometer
Mango Storage Temperatures

- Mature green mangos
  - Store/ship at 54°F (12.2°C)

- Ripe mangos
  - Store/ship at 46 - 50°F (8 - 10°C)