Postharvest Handling
Melon, Winter Squash
Marita Cantwell, UC Davis
micantwell@ucdavis.edu
http://postharvest.ucdavis.edu

Postharvest Technology
Short Course, June 2012

Ripe Melon
Characteristics

<table>
<thead>
<tr>
<th></th>
<th>HoneyDew</th>
<th>HoneyLoupe</th>
<th>Canary</th>
<th>Casaba</th>
</tr>
</thead>
<tbody>
<tr>
<td>Days from anthesis</td>
<td>55</td>
<td>53</td>
<td>43</td>
<td>60</td>
</tr>
<tr>
<td>Weight, g</td>
<td>2200</td>
<td>1400</td>
<td>2250</td>
<td>3000</td>
</tr>
<tr>
<td>Respiration, µL/h</td>
<td>16</td>
<td>23</td>
<td>17</td>
<td>15</td>
</tr>
<tr>
<td>Internal Ethylene, ppm</td>
<td>4-15</td>
<td>25-45</td>
<td>&lt;1</td>
<td>&lt;0.1</td>
</tr>
<tr>
<td>Firmness, kg/cm²</td>
<td>3</td>
<td>4</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>Soluble solids, %</td>
<td>15</td>
<td>14</td>
<td>13</td>
<td>11</td>
</tr>
</tbody>
</table>

Extreme genetic variation among the melons

Melon Quality Attributes

• Flavor
• Color
• Texture

These quality attributes may vary due to: varieties, growing conditions, season, maturity at harvest, number of harvests, harvest & handling, storage conditions and period……..

Focus on maturity/ripeness at harvest since this continues to be problematic

Cantaloupe

Maturity/Ripeness

• Fruit begins to separate from stem
  – abscission zone; “slip”
• External color between net
• Net well developed with wax
• Subtending leaf dries up
• Internal color, firmness, soluble solids

½ slip
Full slip

The slip is a very useful attribute; applicable to old & new cvs.

Evaluate melon varieties based on minimal changes

Characterization of cantaloupe melons (cv. Laredo) harvested at 2 maturity stages. Data are averages of 12 melons per stage.

<table>
<thead>
<tr>
<th>Attribute</th>
<th>½ slip</th>
<th>Full slip, hard ripe</th>
<th>LSD.05</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight (g)</td>
<td>1367</td>
<td>1398</td>
<td>ns</td>
</tr>
<tr>
<td>External color score¹</td>
<td>2.8</td>
<td>3.3</td>
<td>ns</td>
</tr>
<tr>
<td>Internal CO2 (%)</td>
<td>1.62</td>
<td>1.08</td>
<td>ns</td>
</tr>
<tr>
<td>Internal ethylene (ppm)</td>
<td>2.42</td>
<td>4.24</td>
<td>0.7</td>
</tr>
<tr>
<td>Internal color (chroma)</td>
<td>35.2</td>
<td>35.4</td>
<td>ns</td>
</tr>
<tr>
<td>Pulp firmness (N·cm², 5mm probe)</td>
<td>12.7</td>
<td>13.1</td>
<td>ns</td>
</tr>
<tr>
<td>Soluble solids (%)</td>
<td>12.5</td>
<td>12.2</td>
<td>ns</td>
</tr>
</tbody>
</table>

¹ external color score: 1=green, 2=yellow-green, 3=yellow, 4=granny, 5=orange, 6=orange-yellow-orange

Evaluate melon varieties based on minimal changes

Characterization of cantaloupe melons (cv. Laredo) harvested at 2 maturity stages. Data are averages of 12 melons per stage.

<table>
<thead>
<tr>
<th>Attribute</th>
<th>½ slip</th>
<th>Full slip, hard ripe</th>
<th>LSD.05</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight (g)</td>
<td>1367</td>
<td>1398</td>
<td>ns</td>
</tr>
<tr>
<td>External color score¹</td>
<td>2.8</td>
<td>3.3</td>
<td>ns</td>
</tr>
<tr>
<td>Internal CO2 (%)</td>
<td>1.62</td>
<td>1.08</td>
<td>ns</td>
</tr>
<tr>
<td>Internal ethylene (ppm)</td>
<td>2.42</td>
<td>4.24</td>
<td>0.7</td>
</tr>
<tr>
<td>Internal color (chroma)</td>
<td>35.2</td>
<td>35.4</td>
<td>ns</td>
</tr>
<tr>
<td>Pulp firmness (N·cm², 5mm probe)</td>
<td>12.7</td>
<td>13.1</td>
<td>ns</td>
</tr>
<tr>
<td>Soluble solids (%)</td>
<td>12.5</td>
<td>12.2</td>
<td>ns</td>
</tr>
</tbody>
</table>

¹ external color score: 1=green, 2=yellow-green, 3=yellow, 4=granny, 5=orange, 6=orange-yellow-orange

Cantaloupe & Watermelon

MELON FLAVOR

Sugars (>50% sucrose, 20% glucose, 26% fructose):
At harvest, % soluble solids correlates well with extracted sugars
For good flavor: Cantaloupe 10% & Honeydew 11-12% S.S.
Sugar content determined at harvest
Acids <0.1%, important for good flavor?
Aroma volatiles specific compounds for characteristic flavors

Sugar Measurement

• Destructive: % S.S.
• Nondestructive IR analysis

Temperature compensated refractometer
Digital readout eliminates errors

CONCENTRATION GRADIENTS

Sampling problems
Sugar loss in fresh-cut cantaloupe may be considerable, but Soluble solids do not change much; Sugar loss typically is not as extreme as in this example.

Typical loss over 10 days at 5°C (41°F):
- S.S. 0-10%
- Sugars 10-20%

Sugar loss in fresh-cut cantaloupe may be considerable, but Soluble solids do not change much; Sugar loss typically is not as extreme as in this example.

Melon Maturity & Quality Factors
- External Color
- Firmness (blossom end)
- Surface hairs, smoothness, wax
- Aroma
- Internal cavity condition
- Pulp color and firmness
- Sugar content (soluble solids)
- Aroma and flavor

Honeydew and Orange Flesh Melons

Maturity and Ripeness Classes
- Class 0: Immature
- Class 1: Mature, but Unripe
- Class 2: Mature, Ripening
- Class 3: Ripe
- Class 4: Overripe

Ground color greenish-white; peel fuzzy; no aroma; 10% soluble solids; flesh crisp, melon splits when cut; minimum harvest maturity.

Average 4 cvs Honeydew melons

<table>
<thead>
<tr>
<th>Class</th>
<th>Int. C2H4, ppm</th>
<th>Pulp firm., kg/cm²</th>
<th>Sol. solids, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>~0.2</td>
<td>3.8</td>
<td>&lt;10</td>
</tr>
<tr>
<td>1</td>
<td>0.8</td>
<td>3.1</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td>5.2</td>
<td>2.1</td>
<td>11-12</td>
</tr>
<tr>
<td>3</td>
<td>27.1</td>
<td>1.5</td>
<td>12-14</td>
</tr>
<tr>
<td>4</td>
<td>29.4</td>
<td>1.1</td>
<td>14-15</td>
</tr>
</tbody>
</table>

Honeydew melons: Soluble Solids

Fruits of different ripeness classes stored 18 days plus 3 days at 20°C (68°F)
Honeydew melons: Pulp Firmness
Fruits of different ripeness classes stored 18 days plus 3 days at 20°C (68°F)

![Graph showing pulp firmness of Honeydew melons over different storage temperatures and time periods.](image)

Melon Storage Conditions

- **Cantaloupes**
  - 2.5°C (36°F), 90-95% RH
  - 3-5% Oxygen + 10-15% carbon dioxide
  - 2-4 weeks

- **Honeydew, Specialty Melons**
  - 5 to 15°C (41 to 59°F), 80-90% RH
  - Optimum temperature depends on ripeness
  - 2-6 weeks

- **Watermelon**
  - 10-20°C (50-68°F)
  - Sensitive to ethylene
  - 1-3 weeks

Determination of watermelon maturity is difficult

![Images showing internal appearance of immature, mature, and overmature watermelons.](image)

Decay Control: Cantaloupe

- Minimize physical injury
- Storage temperature: 2-3°C (34-36°F)
- Chlorinated water wash (100 ppm)
- Fungicide in wax
- Hot water dip (135°F for 3 min)
- High CO2 concentrations (10-15%)

![Image of a bag of cantaloupe with text indicating decay control methods.](image)

Galia melons (cv Deneb) stored 4 weeks at 10°C (upper) or 7.5°C (lower) and then after transferred to 20°C for 2 days.

![Image showing Galia melons at different temperatures.](image)

MA-stored cantaloupe; Bag in Box

- Open bag to de-gas
- Allow time (2-3 days, ambient) to change color, improve aroma
**Conditioning or Ripening Melons**  
**Honeydew Melon Example**  
Conclusions from a study on cv Emerald  
- 12 hours 20-50 ppm ethylene  
- Hold 2-3 days at 20°C (68°F)  
- Maturity stage 2 (minimum ~11% SS)  

- Improve external color  
- Improve aroma  
- BUT  
- Loss of texture  
- No improvement in sugars  

**Field packing cantaloupes**  
Forced air cooled  
4-8 hours required  
Gravity flow racking  
Night harvest of cantaloupes  

**1-MCP & Melons**  
- Western shipping cantaloupes—not much benefit on firmness at storage temperature.  
- Eastern shipping cantaloupes—maintain texture loss at warm temperatures.  
- Galia; extend shelf-life, reduce firmness loss  
- Watermelon-clear benefit; reduce firmness loss  

**Common Postharvest Defects: Cantaloupes**  
- Harvested immature  
- Overripe  
- Sunken areas on surface - scuffing, water loss  
- Discolored surface areas - sunburn, scuffing  
- Soft ground spot  
- Decay, especially on stem end  
- “Shaker” melons
Melon Defects and Internal Quality

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Good Quality</th>
<th>Ground Spot</th>
<th>Sunburn</th>
</tr>
</thead>
<tbody>
<tr>
<td>Firmness (N)* (LSD=0.3)</td>
<td>10.7</td>
<td>9.3</td>
<td>6.3</td>
</tr>
<tr>
<td>Soluble Solids (%) (0.4)</td>
<td>11.5</td>
<td>10.5</td>
<td>7.9</td>
</tr>
<tr>
<td>Color (chroma) (0.7)</td>
<td>32.4</td>
<td>32.2</td>
<td>31.7</td>
</tr>
</tbody>
</table>

* 5 mm diameter probe

Melon visual quality after delays to cool at 37°C storage at 10d 5°C + 4d 20°C
Suture Browning associated with increased water loss

Sunburn
Ground Spot
Good Quality

Common Postharvest Defects: Honeydews

- Harvested immature
- Overripe
- Chilling injury
- Brown blotch
- Decay
- Internal breakdown
  - dropping
  - impact injuries

External appearance of stored honeydew melons:
Excellent appearance (A)
Severe surface discoloration (B)
Speckles (C).

Golden Honeydew
Stored 1 month 10°C

Fusarium sp.
Epicoccum sp.
Sclerotinia sp.
Botryodiplodia sp.
Penicillium sp.
**Mature or Winter Squash**

- Green acorn squash
- Spaghetti squash
- Butternut squash
- Ukrainian Winter squash
- Kabocha squash
- Green Hubbard squash
- Blue Hubbard squash
- Delicata squash
- Red Kuri squash
- Chinese winter squash
- Butternut squash
- Red Kuri squash
- Ukrainian Winter squash

**Maturity at harvest is key**

**Careful Handling is key**

**Squash are chilling sensitive**

**Hue**

<table>
<thead>
<tr>
<th></th>
<th>/0.0</th>
<th>/4.89</th>
<th>/8.79</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry Weight (%)</td>
<td>11.2</td>
<td>13.9</td>
<td>14.9</td>
</tr>
</tbody>
</table>

**Total Sugar (sucrose)**

| (mg/g DW) | 465.84 | 565.34 | 631.47 |
| (mg/g FW) | 52.29  | 77.83  | 94.82  |

**October 2004**

**External Appearance fruit previous slide**

**Stem integrity is important to reduce decay**

**Winter Squash and Pumpkin Storage Conditions**

- Well cured
- Temperature: 12.5-15°C (55-59°F)
- RH: 50-70% with 60% usually considered optimum
- 2-6 months
- Avoid ethylene
- Modified atmosphere not beneficial