Postharvest Handling
Melons and Winter Squash

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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/g-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

The slip is a very useful attribute; applicable to old & new cvs.
**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 score(^1)</td>
<td>2.8</td>
<td>3.3</td>
<td>ns</td>
</tr>
<tr>
<td>Internal CO2 (%)</td>
<td>1.02</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-f, 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=slight yellow, mostly green, 3=yellow-green, 4=greenish yellow 5=yellow or yellow-orange

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**Evaluate melon varieties based on minimal changes**

**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

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**Sugar Measurement**

- **Destructive:** % S.S.
- **Nondestructive**
  - IR analysis

**Concentration gradients**

**Sampling problems**

**Temperature compensated refractometer**

Digital readout eliminates errors
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%

(98 yen/dollar; ~$50 U.S.)
### External and internal appearance of Galia melons (cv. Deneb)
harvested at 3 stages of maturity (California, 2003).

<table>
<thead>
<tr>
<th>Maturity/Ripeness Stage</th>
<th>% Soluble solids</th>
<th>Aroma score</th>
<th>Pulp firmness</th>
<th>Internal Ethylene</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Stage 1 = 9.3</td>
<td>Stage 1 = 2.8</td>
<td>Stage 1 = 26.9 N</td>
<td>Stage 1 = 0.2 ppm</td>
</tr>
<tr>
<td></td>
<td>2 = 10.4</td>
<td>2 = 4.2</td>
<td>2 = 27.2 pp</td>
<td>2 = 0.8</td>
</tr>
<tr>
<td></td>
<td>3 = 10.2</td>
<td>3 = 5.0</td>
<td>3 = 10.0</td>
<td>3 = 1.1</td>
</tr>
</tbody>
</table>
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
  Ground color greenish-white; peel fuzzy; no aroma; 10% soluble solids; flesh crisp, melon splits when cut; minimum harvest maturity
- Class 2: Mature, Ripening
  Ground color white; begins to develop surface wax; pulp crisp, melon splits

<table>
<thead>
<tr>
<th>Average 4 cvs Honeydew melons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class</td>
</tr>
<tr>
<td>-------</td>
</tr>
<tr>
<td>0 = Immature</td>
</tr>
<tr>
<td>1 = Mature, Unripe</td>
</tr>
<tr>
<td>2 = Mature, Ripening</td>
</tr>
<tr>
<td>3 = Ripe</td>
</tr>
<tr>
<td>4 = Overripe</td>
</tr>
</tbody>
</table>
3. Development & Ripening of Honeydew Melons Harvested at Different Stages

Data from Pratt, 1977; redrawn from Seymour & McGlasson 1993

4. Honeydew melons: Soluble Solids

Fruits of different ripeness classes stored 18 days plus 3 days at 20°C (68°F)

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Honeydew melons: Pulp Firmness

Fruits of different ripeness classes stored 18 days plus 3 days at 20°C (68°F)

<table>
<thead>
<tr>
<th>Ripeness Class</th>
<th>Initial Temperature</th>
<th>Pulp Firmness (pounds-force)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immature</td>
<td>2.5°C 36°F</td>
<td>8</td>
</tr>
<tr>
<td>Mature</td>
<td>5°C 41°F</td>
<td>7</td>
</tr>
<tr>
<td>Overmature</td>
<td>7.5°C 45°F</td>
<td>6</td>
</tr>
</tbody>
</table>

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Determination of watermelon maturity is difficult

- Immature
- Mature
- Overmature or Ethylene exposed

Density
Subtle differences external color
Subtending dried leaf
Ground spot yellowing

cv. Tri-X 313
Melon Storage Conditions

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

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.
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%)

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

Honeydew melon harvest and packing in field or shed
Field packing watermelon and cantaloupes

Galia melon harvest Pakistan 2012

Cantaloupe harvest, Honduras 2010

Greenhouse Galia harvest
Forced air cooled
4-8 hours required
Gravity flow racking

Field packed melons
waiting to be cooled

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

Watermelon photo
D. Huber
Delays to Cool and 1-MCP treatment of Honeydew Melons

Quality attributes of honeydew melon (cv Summerdew) stored 10 days at 7.5°C (45°F) plus 3 days at 20°C (68°F). Data average of 15 melons per treatment.

T1=fruit cooled to 7.5C (45F) within 6hr after harvest.
T2=fruit cooled and treated with 1-MCP at 7.5C within 6hr after harvest.
T3=fruit held at 22C (72F) for 24hr and then cooled to 7.5°C.
T4=fruit held at 22C for 24 hr and then cooled and treated with 1-MCP at 7.5C.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Visual quality</th>
<th>Surface Discoloration</th>
<th>Decay Stem-end</th>
<th>Decay surface</th>
<th>External color (Hue)</th>
<th>Pulp Firmness, N</th>
<th>Soluble solids, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>8.9</td>
<td>1.1</td>
<td>1.0</td>
<td>1.0</td>
<td>102.6</td>
<td>15.3</td>
<td>13.0</td>
</tr>
<tr>
<td>T2</td>
<td>8.9</td>
<td>1.1</td>
<td>1.0</td>
<td>1.0</td>
<td>102.4</td>
<td>23.3</td>
<td>12.6</td>
</tr>
<tr>
<td>T3</td>
<td>8.8</td>
<td>1.1</td>
<td>1.1</td>
<td>1.1</td>
<td>102.8</td>
<td>10.8</td>
<td>11.7</td>
</tr>
<tr>
<td>T4</td>
<td>8.7</td>
<td>1.1</td>
<td>1.1</td>
<td>1.1</td>
<td>103.1</td>
<td>18.7</td>
<td>11.1</td>
</tr>
<tr>
<td>Average</td>
<td>8.8</td>
<td>1.1</td>
<td>1.0</td>
<td>1.0</td>
<td>102.7</td>
<td>17.0</td>
<td>12.1</td>
</tr>
<tr>
<td>LSD.05</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
<td>5.1</td>
<td>1.2</td>
</tr>
</tbody>
</table>

Cantwell, 2011

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 (severe) 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 (%) (0.6)</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 due to delays to cool

Total Weight loss

0 h: 2.4%
8 h: 3.2%
16 h: 4.0%
24 h: 4.8%
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.
Penicillium sp.

Botryodiplodia sp.
Maturity at harvest is key
Careful Handling is essential
Curing important for storage life
Squash are chilling sensitive
Hue | 78.03 | 74.80 | 68.39
---|---|---|---
Dry Weight (%) | 11.2 | 13.9 | 14.9
Total Sugar (sucrose) | (mg/g DW) | 465.84 | 565.34 | 631.47 | (mg/g FW) | 52.29 | 77.83 | 94.82

External Appearance fruit previous slide

Stem integrity is Important to reduce decay
Respiration rates of Butternut Squash

Changes in physiology precede postharvest decay problems

Cantwell and Zacchari, 2004
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