Postharvest Handling of Berries

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Berries

• Consumption of fresh and processed berries has increased over the past decade.
• All berries have been experiencing growth in both dollar sales and volume.
• Comparison of the antioxidant capacities of different fruits, berries invariably rank high due to their high antioxidant content.
• Delicious!
Top 10 Produce Categories - Dollars

Total U.S.

Dollars (Billions) and Dollar Share of Total Produce
Ranking of Top 10 Categories
52 Weeks Ending 1/22/17

- With $6.3 billion in annual sales, the berry category ranks #1 in total produce.
- At $3.0 billion, strawberries rank #7 in produce, and 4th among individual fruits.
- Berries and strawberries contribute 10.1% (+0.5%) and 4.8% (+0.2%) to total produce sales, respectively.
- The top 10 categories account for 52.2% of total produce dollars.
Berries

• Short Shelf Life
• Essential Handling Needs
• Quickly Lose of Value
FRESH PRODUCE

- IS ALIVE
- BREATHES
- LOSES MOISTURE
- RELEASING HEAT
- CAN EVEN DIE
- CAN GET SICK
Postharvest challenges

• Most of berries won’t continue to ripen after detached
• Have to be picked near fully ripeness
• Delicate, easily damaged
• Picked directly into final containers
• Grading and sorting is part of harvesting
• Relatively high respiration and transpiration rates
• Highly susceptible to molding
• Require rapid cooling
• Short life
• Consumer practices
Postharvest Basics

- Respiration
- Transpiration (water loss)
- Compositional changes (Color changes)
- Physiological disorders
- Changes in temperature
- Physical damage
- Decay and insect infestation
- Humidity
- Contamination
Quality attributes for berries

• Gloss/Bloom
• Full color, usually darker
• No defects (injury, bruise)
• No decay
• Firm. Crisp
• Large size
• Sweet
• Green sepals (strawberry)
• No stems (blueberry)
Fresh Commodities Are Still ALIVE!

• They carry out respiration:

\[
\text{Sugar } + \text{ O}_2 \rightarrow \text{CO}_2 + \text{ Water } + \text{ Energy } + \text{ Heat (ATP)}
\]
Respiration Rates and Ethylene Production

<table>
<thead>
<tr>
<th>Fruit</th>
<th>Respiration 0°C</th>
<th>Respiration 20°C</th>
<th>Ethylene 5°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blackberry</td>
<td>22</td>
<td>155</td>
<td>&lt;0.1</td>
</tr>
<tr>
<td>Blueberry</td>
<td>6</td>
<td>68</td>
<td>0.1 to 1.0</td>
</tr>
<tr>
<td>Cranberry</td>
<td>3</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>Raspberry</td>
<td>24</td>
<td>200</td>
<td></td>
</tr>
<tr>
<td>Strawberry</td>
<td>15</td>
<td>127</td>
<td>&lt;0.1</td>
</tr>
<tr>
<td>Currant</td>
<td>16</td>
<td>130</td>
<td></td>
</tr>
<tr>
<td>Gooseberry</td>
<td>10</td>
<td>58</td>
<td></td>
</tr>
</tbody>
</table>
Shelf Life

• Blackberry: 2-3 d
• Blueberry: 2 wk
• Boysenberry: 2-3 d
• Cranberry: 2-4 mo
• Dewberry: 2-3 d
• Elderberry: 1-2 wk
• Gooseberry: 3-4 wk
• Loganberry: 2-3 d
• Raspberry: 2-3 d
• Strawberry: 1-2 wk
HARVESTED PRODUCE ARE LIVING SYSTEMS THAT “AGE”

GOAL: slow down the aging process!
Temperature

- **Temperature is the most important factor** influencing the postharvest life of a given commodity
  - Dictates the speed of chemical reactions (including respiration)

- Typically, for every 18 °F (10 °C) increase, respiration increases between 2 and 4 fold
Slowing Respiration

- Room Cooling
Slowing Respiration

• Forced-air cooling
Slowing Respiration

Cool and Ship: A low-cost portable forced-air cooling unit

Maintain the cold chain

The “KoolKat” mobile refrigerated unit, of K-state Olathe Horticulture Research and Extension Center
Water Loss

• Besides resulting in direct loss of salable weight, it is also an important source of quality loss
  – Appearance quality - wilting, shriveling, accelerated development of injury symptoms
  – Textural quality – loss of crispness, juiciness, etc.
  – Nutritional quality – e.g., vitamins A & C
How we prevent water loss

- Control relative humidity
- Lower temperature
- Reduce air movement
- Protective packaging
Nesting of *Botrytis* Rot
One Bad Berry can Destroy the Whole Tray

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Harvest, Sort, and Pack in the Field

- Harvest only fully red (ripe) berries, and pick every three days.
- Cut by the stem; do not pull the berry.
- Mechanical harvesters exist but main problems are:
  - inability of the machines to differentiate between ripe and unripe fruit
  - rough handling of the fruit

E. J. Mitcham
Rules for Berry Pickers

- Keep hands clean
- Wash your hands after each visit to the rest station
- Pick all the ripe berries on the bush before moving on
- Harvest only well-ripened fruit
- Leave immature fruit for the next harvest
- Place your hand under the clusters to avoid dropping the berries
- Avoid overfilling your hands; do not squeeze or roll the fruit
- Do not put trash or cull berries into the container
- Never allow harvested fruit to remain in the sun
When do we harvest?
Strawberry

- Hand harvested
- Not subject to washing at the time of harvest
- Placed directly in clamshells, then flats and loaded on trucks, within 1-2 hrs of picking,
- Transported to a cooling facility
- Cooled, usually within 1-4 hrs after harvest
- Forced-air cooled at temperatures of 1°C (34°F)
- Cooling reduces decay and prolongs the fruits shelf-life
- Strawberries are shipped to the market in refrigerated trucks at 1-2°C (34-36°F)
- Controlled/Modified Atmospheres
  - Shipments with 10 to 15% CO₂ reduces the growth of *Botrytis cinerea*
  - Reduces the respiration rate of the strawberries thereby extending postharvest life
  - Use of whole pallet covers for modified atmospheres is the most common method
Importance of Temperature to Maintain Quality

7 days

A 0°C 32°F
B 5°C 41°F
C 10°C 50°F

Cantwell, UC Davis
Modified Atmospheres
Raspberry harvest

- Gentle harvest by hand
- Harvest into small containers to avoid bruising

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Packaging at the edge of the field

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Packaging area must be in the shade!

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Blackberries

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Blueberries

• Machine harvesting possible
  – Height of fall determines bruising
  – Bruising affects storage life
  – Use for berries to be processed
  – Varietal differences – stem scars
  – Needs clean up, debris removal

• Less perishable than raspberries and strawberries
  – long-distance international trade, including between hemisphere

• Can be stored at 5°C from two up to seven weeks, depending on the cultivar

• Recommended optimal temperature is 0°C
Hand harvest of blueberries
Reduce handling to maintain waxy bloom
Field totes dumped onto the packing line
Sorting by hand

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Mechanical sorting

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General Recommendation

Harvest tips

Avoid picking in heat
- Don’t pick when is wet
- Don’t pick overripe or decay fruit
- Don’t pick immature fruit
- Avoid fruit with defects
- Overfilling causes compression damage
- Clean hands and containers
General Recommendation

Postharvest
Shaded in field and transport
Rapid cooling
Forced air or room cooling
Optimum temperatures: 32°F-35°F
Optimum relative humidity: 90-95%
Do not allow rewarming
Use appropriate containers
Resources

Postharvest Technology Center
http://postharvest.ucdavis.edu/

Small-Scale Postharvest Handling Practices: A manual for Horticultural Crops

Production Guide for Storage of Organic Fruits and Vegetables
https://ecommons.cornell.edu/bitstream/handle/1813/42885/organic-stored-fruit-veg-NYSIPM.pdf?sequence=1

Post Harvest Handling Decision Tool

Wholesale Success: A farmers guide to food safety, selling, postharvest Handling and packaging produce
Thank you all for your attention

QUESTIONS ?