Enhancing Postharvest quality and shelf life of locally-grown vegetables

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Fresh fruits and vegetables

In the last 2 decades:

- Fresh fruits per capita consumption increased 19%
- Fresh vegetables (including potatoes) 29%
Demand of local food

Local and regional food sales in the U.S. totaled US $6.1 billion in 2012. 7.8% of U.S farms sold food thought local food market channels.
Increasing consumption of local food

Sources: USDA, Agricultural Marketing Service, Food Nutrition Service; National Farm to School Network.
Challenges for scaling up

- product volume
- quality
- consistency
- variety, or extended availability
- lack of distribution
- storage
- processing
- marketing infrastructure
Solution?

- No “one-size-fits-all” approach
Production systems
• High tunnels:
  – Extend the harvest season
  – Increase marketability (fewer cracks, splotches and other aesthetic defects)
  – Prevent losses?
  – Nutritional quality?
  – Shelf life?
# 2014 – 2016 Yield and Marketable Yield

<table>
<thead>
<tr>
<th></th>
<th>Fruit Yield (# per plant)</th>
<th>Fruit Yield (lbs per plant)</th>
<th>% Marketability</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Marketable</td>
<td>Total</td>
<td>Marketable</td>
</tr>
<tr>
<td><strong>Main Effects</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Tunnel</td>
<td>35.1</td>
<td>A</td>
<td>49.8</td>
</tr>
<tr>
<td>Open Field</td>
<td>13.2</td>
<td>B</td>
<td>20.6</td>
</tr>
<tr>
<td><strong>Simple Effects</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Tunnel</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cherokee Purple</td>
<td>28.3</td>
<td>C</td>
<td>42.7</td>
</tr>
<tr>
<td>Open Field</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cherokee Purple</td>
<td>9.1</td>
<td>A</td>
<td>16.7</td>
</tr>
<tr>
<td>High Tunnel</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BHN589</td>
<td>41.9</td>
<td>D</td>
<td>56.8</td>
</tr>
<tr>
<td>Open Field</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BHN589</td>
<td>17.2</td>
<td>B</td>
<td>24.6</td>
</tr>
</tbody>
</table>

[Image of two people in a greenhouse]
2015-2016 Total % Marketable Spinach Yield

Total % Marketable Yield

- High Tunnel
- Open Field

Production System

Marketable Yield / Total Yield (%)
2015-2016 Total % Marketable Spinach Yield During The Growing Season

% Marketable Yield During Growing Season

Marketable Yield/Total Yield (%) vs Date

- 21-Oct
- 16-Nov
- 4-Dec
- 29-Feb
- 2-Mar
- 21-Mar
- 13-Apr
- 25-Apr
- 5-Apr

High Tunnel vs Open Field

United States Department of Agriculture
National Institute of Food and Agriculture

University of Florida
Kansas State University
### BHN589 at 25°C at day of harvest

<table>
<thead>
<tr>
<th></th>
<th>High Tunnel</th>
<th>Open Field</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sugar/acid ratio</td>
<td>12.13 (2.51)</td>
<td>9.84 (1.71)</td>
</tr>
<tr>
<td>Antioxidant capacity (ORAC)</td>
<td>776.29 (131.82)</td>
<td>762.49 (55.53)</td>
</tr>
<tr>
<td>Antioxidant capacity (FRAP)</td>
<td>293.50 (42.53)</td>
<td>284.21 (22.99)</td>
</tr>
</tbody>
</table>

### Cherokee purple t 25°C at day of harvest

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<th>High Tunnel</th>
<th>Open Field</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sugar/acid ratio</td>
<td>14.56 (3.63)</td>
<td>14.89 (0.73)</td>
</tr>
<tr>
<td>Antioxidant capacity (ORAC)</td>
<td>572.36 (75.34)</td>
<td>772.52 (113.38)</td>
</tr>
<tr>
<td>Antioxidant capacity (FRAP)</td>
<td>150.36 (12.70)</td>
<td>342.78 (63.36)</td>
</tr>
</tbody>
</table>
Spinach

Overall Quality of Spinach stored at 3°C

Overall Quality of Spinach stored at 13°C

Average of 3 days shelf life extension

United States Department of Agriculture
National Institute of Food and Agriculture
Storage in non-optimum temperatures

- The most common method for prolonging the storage life of fresh fruits and vegetables is temperature control.
  - Low storage temperature decreases the respiration rate, which slows ripening and senescence.

Modified atmosphere packaging (MAP) is a technique that is used as a supplement to, or even a substitute for, refrigeration as a means to prolong the storage life of fresh produce during transportation and retail handling (Kader et al., 1989)
Table 2. Shelf life of crops stored at 13°C under different washing treatments combined or not with commercial MAP bags\(^1\).

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Days</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Asparagus</td>
<td>Broccoli</td>
<td>Spinach</td>
</tr>
<tr>
<td>CC</td>
<td>9.67 (1.53)(^{*a,b})</td>
<td>5.67 (0.58)(^{a})</td>
<td>10.25 (2.06)(^{a})</td>
</tr>
<tr>
<td>WC</td>
<td>9.67 (1.53)(^{a,b})</td>
<td>5.67 (0.58)(^{a})</td>
<td>13.00 (2.45)(^{a,c})</td>
</tr>
<tr>
<td>OC</td>
<td>10.33 (0.58)(^{a})</td>
<td>5.33 (0.58)(^{a})</td>
<td>12.00 (0.00)(^{a})</td>
</tr>
<tr>
<td>CM</td>
<td>12.33 (1.53)(^{a,b})</td>
<td>12.33 (2.89)(^{b})</td>
<td>15.50 (1.73)(^{b,c})</td>
</tr>
<tr>
<td>WM</td>
<td>13.00 (1.73)(^{a,b})</td>
<td>11.67 (3.21)(^{b})</td>
<td>17.50 (1.00)(^{b})</td>
</tr>
<tr>
<td>OM</td>
<td>12.67 (1.15)(^{b})</td>
<td>12.00 (0.00)(^{b})</td>
<td>17.00 (2.00)(^{b})</td>
</tr>
</tbody>
</table>

\(^1\)Average (SD) of days of storage of three separate trials, values in column followed by unlike letters are significantly different at \(p \leq 0.05\)

Shelf life

34%  117%  70%
At harvest

After 5 days, stored in a produce bag (13°C)

After 12 days, in MAP bag (13°C)
Washing

- Potable water
- Chlorination
- Ozonated water
- Hot water
- Others
Results of Dr. Jerry Bartz, UF

Decay Incidence

Infected area (%)

Decay severity

Erwinia (Pectobacterium) carotovora (Bacterial Soft Rot)
The “Kool Kat”
Conclusions

• Production systems
  – Pre-harvest
  – Postharvest
• MAP
• Washing
• Kool Kat
Questions ?