Postharvest Handling of Some Specialty Fruits (Pitahaya, Fig, Pomegranate, Date, Olive)

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PITAHAYAS

Hylocereus undatus (white flesh)
Hylocereus purpusii and H. polyrhizus (red flesh)
H. costaricensis (purple-red flesh)

Pitahaya Fruit Composition
(near full ripe at harvest)

- Water (85-88%)
- Carbohydrates (10-15%)
  - Sugars (mostly glucose, fructose)
  - Soluble solids (10-15%)
  - Dietary fiber (0.6-0.8%)
  - Mucilage, not well studied
- Minerals: calcium, potassium
- Vitamins: small amounts of Vitamin C
- Pigments in red flesh: Betalains
- Polyphenols

* Sugars to not increase after harvest
* Harvest maturity is key for good eating quality

Physical Graffiti indicates best flavor scores
Israel Nerd et al., 1999
PH Biol. Tech. 17:39-45

Maturity is extremely important for good eating Pitahayas
Skin coloration completed before reach maximum sugar levels

For California grown pitahaya:
40-45 days to harvest? Do we pick too soon? Need similar information for fruit changes

Maturity at Harvest is Key to Good Flavor!

Sugars are reasonably well correlated with soluble solids (Brix)
Acid content is well correlated with pH measurement.

Pitahaya Sugar and Soluble Solids Correlation
White and Red, 2007-2008

Pitahaya Sugar and Soluble Solids Correlation
White and Red, 2007-2008

Titratable acidity, %
0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8
pH value
3.4
3.6
3.8
4.0
4.2
4.4
4.6
4.8
5.0
5.2
5.4
5.6
5.8

y = -2.42x + 5.44
R² = 0.90

PITAHAYA (white and red) 2007

Sugars, mg/g
40 60 80 100 120 140
Soluble solids, %
8 10 12 14 16

y = 0.073x + 7.01
R² = 0.69

Physical Graffiti
Cantwell and Lobo
Pitahaya Postharvest Operations

- Twist, but better cut from the stem and place in crates or baskets for transport to pack area
- Transfer to a cool area (10-15°C)
  - to remove field heat and delay deterioration
- Sort for defects
  - remove dried floral tissues
  - Insects (mealybug, scale)
  - Wounds, cracks, etc.
  - Dehydration
- Select for color and size
  - small, medium, large; 300-380, 380-500, >500 g
- Rinse in potable or chlorinated water, dry:
  - possibly wax
  - wrap in paper
- Pack into labeled carton box
  - 6, 8, 10, 12 fruits per 4-5 kg box
  - 10 kg boxes

Pitahaya Storage (near full ripe at harvest)

- Non-climacteric fruit; moderate respiration rate
  - very low ethylene production
  - color is not stimulated by ethylene
- 10 to 12°C, 85-90% RH for shelf-life of 2-3 weeks; 14°C 2 weeks
- 20-25°C (ambient) shelf-life of ~ 1 week
- Chilling sensitive
  - Maturity, temperature, time all affect chilling damage
  - Chilling occurs at 8°C or lower (but 2 studies indicate best temp is 5-6°C)
  - transfer from storage to warm conditions accentuates chill symptoms
  - Symptoms: bracts darken, lose flavor and firmness, pulp translucency
- Postharvest decays
  - Bacterial and fungal, associated with damage
- Modified atmospheres
  - 1-3% O2 at 12°C; marketable to 30D, but decrease in sugars, Vit C, acids
  - 2 reports of MAP up to 30 days, main benefit from reducing water loss
- Quarantine treatments required for imported fruit
  - Pitahaya and related cactus fruits are host for various fruit flies
  - Heat treatments (hot water and hot air), irradiation

Postharvest Losses

- Dehydration, Shriveling
- Mechanical Damage
- Decay
- Chilling Injury

Storage

- Fruit Surface
  - Loss of Gloss
  - Water loss
- Bracts
  - Discoloration
- Decay
- Dehydration

Changes in Composition

- After 10 days 10°C:
  - 9% decrease soluble solids
  - 12% decrease sugars
  - 36% decrease acidity
  - No change Vitamin C

Cantwell and Lobo, UC Davis
Composition of fig cultivars separated by stage of maturity (ripeness). All the fruit were in boxes of “Commercial Maturity” (Cantwell & Crisosto, 2010)

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Maturity stage</th>
<th>Weight, g</th>
<th>Firmness, N</th>
<th>Soluble solids, %</th>
<th>Titratable acidity, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black Mission</td>
<td>Under-ripe</td>
<td>29.9</td>
<td>12.1</td>
<td>14.3</td>
<td>0.38</td>
</tr>
<tr>
<td></td>
<td>Commercial maturity</td>
<td>32.2</td>
<td>7.2</td>
<td>17.5</td>
<td>0.19</td>
</tr>
<tr>
<td></td>
<td>Tree-ripe</td>
<td>34.5</td>
<td>4.0</td>
<td>21.0</td>
<td>0.22</td>
</tr>
<tr>
<td>Kadota</td>
<td>Under-ripe</td>
<td>46.1</td>
<td>11.2</td>
<td>15.2</td>
<td>0.36</td>
</tr>
<tr>
<td></td>
<td>Commercial maturity</td>
<td>56.3</td>
<td>4.4</td>
<td>15.9</td>
<td>0.24</td>
</tr>
<tr>
<td></td>
<td>Tree-ripe</td>
<td>57.6</td>
<td>2.4</td>
<td>17.9</td>
<td>0.25</td>
</tr>
</tbody>
</table>

LSD 0.05 3.7 1.3 1.9 0.05

Evaluating Quality Attributes of Four Fresh Fig (Ficus carica L.) Cultivars Harvested at Two Maturity Stages (Crisosto et al, 2010)

• Fig quality attributes such as weight, soluble solids concentration (SSC), titratable acidity (TA), SSC:TA, firmness, antioxidant capacity, and consumer acceptance varied by cultivar.
• Fig cultivars harvested at the advanced maturity stage (“tree-ripe”) had lower TA and firmness but higher weight, SSC, and SSC:TA than figs harvested at “commercial maturity.” Fig maturity did not affect antioxidant capacity, but tree-ripe figs had higher consumer acceptance than commercial maturity figs.
• SSC was more highly correlated with consumer acceptance than TA or SSC:TA, but other factors may also be important in controlling this relationship.
Effect of temperature on decay incidence on fresh figs

Evaluation of the use of sulfur dioxide to reduce postharvest losses on dark and green figs (Cantin et al, 2011)

- \(\text{SO}_2\) fumigation seems to be a promising technology to reduce decay and increase the shelf life of fresh figs. However, continuous application has significant impact and requires further research, at the same time that application conditions must be optimized to minimize secondary negative effects such as fruit bleaching and browning.
- \(\text{SO}_2\) fumigation with 25 (\(\text{uL}/\text{L}\).h) was a less harmful method to reduce decay than \(\text{SO}_2\) generating pads or the combination of an initial fumigation with the use of \(\text{SO}_2\) pads.
- In addition, repeated fumigations during fig cold storage did not significantly improve control of decay compared to a single 25 (\(\text{uL}/\text{L}\).h) fumigation before cold storage.
- \(\text{SO}_2\) fumigation was, to some extent, able to kill the pathogens present on the surface of fresh figs that cause decay under favorable conditions.

Pomegranate Maturity Indices

- Red color of juice equal to or darker than Munsell color chart 5R-5/12
- Acidity of juice below 1.85%
Preharvest Defects include Cracking and Sunburn

Pomegranate Harvesting Operations

Pomegranate Harvesting Operations

Harvesting and Postharvest Handling Defects

Alternaria and Aspergillus Rot as a Preharvest Defect
Infection begins in the orchard especially following rain during flowering and early fruit development. The fungus can grow within the fruit without external symptoms

Pomegranate Packinghouse Operations-1
These pomegranates were kept in containers ventilated with humidified air.

The higher the temperature and the lower the relative humidity, the greater the water loss.

External Symptoms of Chilling Injury

Effect of temperature on Chilling Injury of Pomegranates
Optimal Storage Conditions for Pomegranates

- 7°C (45°F) for longer than 2 months; 5°C (41°F) is acceptable for up to 2 months.
- 90-95% relative humidity.
- CA of 5% Oxygen + 15% Carbon dioxide, especially if storage for longer than 3 months is desired.

Postharvest Pathology Considerations

*Botrytis cinerea* is the major fungus that causes decay on pomegranates. Infection begins in the orchard and fungal spores may be present in the fruit calyx at harvesting time.

Use of Fludioxonil (Scholar) as a postharvest fungicidal dip or drench is effective in controlling *Botrytis cinerea*.

Carbon dioxide-enriched Atmospheres inhibit Botrytis growth.

Pomegranate is a nonclimacteric fruit that produces less than 0.1 microliter ethylene per kilogram-hour.

Genotypic variation in color of khalal stage dates.

Some cultivars with lower phenolics content (such as Barhee, Samani, and Zaghlol) are consumed at this stage.
Ripening of Barhee Dates from Khalal to Rutab

Genotypic differences in color and size of tamar (tamr) stage dates

Date Harvesting in California-1

Date Harvesting in California-2

Date Harvesting in California-3

Date Harvesting in California-4

Photos by David Karp
Sun Drying of Dates in Coachella Valley, California

From David Karp

Sun drying of Medjool dates in a pallet wrapped with shrink wrap with ventilation at the top and bottom

Date fumigation for insect control

Bin of Tamar (Tamr) Stage ‘Deglet Noor’ Dates (leading cultivar grown in Southern California)

Preparation of Dates for Market-1

- Initial sorting to remove defective dates and foreign materials.
- Cleaning to remove dust, dirt, and other foreign materials using air pressure and water followed by air drying to remove surface moisture. Damp towels may be used in cleaning the dates.
- Sorting by quality and size into grades.

Sorting dates by quality
Preparation of Dates for Market-2

- Surface coating with wax or other materials to reduce stickiness and improve appearance (gloss).
- In some cases, the dates are pitted and may be stuffed with nuts. Other products include date pieces that are used in cereals and other foods and macerated dates that are used in backed products.
- Packaging to protect the dates from physical damage and moisture absorption if moisture-proof packaging material is used. Use of insect-proof packaging is highly recommended to prevent reinfestation of the dates with insects during their subsequent storage and handling step.

Packages of Dates

Storage Potential of Dates

<table>
<thead>
<tr>
<th>Semi-Dry Dates (Baghali Norooz, Halawy and Zahidi and Caizid)</th>
<th>Soft Dates (Masir, Barou, Khaledry, Mousna, Sayer, and Bayat)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Temperature</strong></td>
<td><strong>Temperature</strong></td>
</tr>
<tr>
<td>32°F (0°C)</td>
<td>68°F (20°C)</td>
</tr>
<tr>
<td>60°F (15°C)</td>
<td>95°F (35°C)</td>
</tr>
<tr>
<td><strong>Storage Period</strong></td>
<td><strong>Storage Period</strong></td>
</tr>
<tr>
<td>1 month</td>
<td>6 months</td>
</tr>
<tr>
<td>3 months</td>
<td>More than 6 months</td>
</tr>
<tr>
<td>4 months</td>
<td></td>
</tr>
<tr>
<td>1 year</td>
<td></td>
</tr>
<tr>
<td>5 years</td>
<td></td>
</tr>
<tr>
<td>10 years</td>
<td></td>
</tr>
<tr>
<td><strong>Relative Humidity</strong></td>
<td><strong>Relative Humidity</strong></td>
</tr>
<tr>
<td>65% or less</td>
<td>75% or less</td>
</tr>
</tbody>
</table>

Figs

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Postharvest Handling System for Fresh Figs
Effect of temperature and CO₂-enriched air on decay incidence on figs

Effect of temperature on decay incidence on fresh figs

Effect of carbon dioxide on decay incidence on fresh figs

Evaluation of the use of sulfur dioxide to reduce postharvest losses on dark and green figs (Cantin et al, 2011)

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Olives

Mature-green olive harvesting operation in California-1
Olives are non-climacteric fruits

Mechanical Harvesting of Olives for oil extraction in High-density Plantings

Maturity and Ripeness Stages of Manzanillo Olives

Effect of storage temperature on color development and softening of mature-green olives

Source: Jim Thompson, UC Davis
**Intercultivar Differences in Olive Sensitivity to Chilling Injury after one month at 0°C (32°F)**

**Optimum Storage Conditions For Fresh Olives**

- **Temperature:** 5 to 7°C (41 to 45°F)
- **Relative humidity:** 90 to 95%
- **Avoid exposure to ammonia and sulfur dioxide**